

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner

v.

S.M.R INNOVATIONS LTD and Y.M.R TECH LTD
Patent Owners

Inter Partes Review Case No. IPR2024-01048
U.S. Patent No. 10,547,648

**DECLARATION OF DR. SAYFE KIAEI
IN SUPPORT OF PETITION *INTER PARTES* REVIEW OF
U.S. PATENT NO. 10,547,648**

TABLE OF CONTENTS

<i>I.</i>	<i>INTRODUCTION AND QUALIFICATIONS</i>	<i>14</i>
<i>A.</i>	<i>Educational Background and Professional Experience</i>	<i>14</i>
<i>II.</i>	<i>METHODOLOGY; MATERIALS CONSIDERED</i>	<i>19</i>
<i>III.</i>	<i>OVERVIEW AND LEGAL STANDARDS</i>	<i>21</i>
<i>A.</i>	<i>Person of Ordinary Skill in the Art</i>	<i>21</i>
<i>B.</i>	<i>Obviousness</i>	<i>22</i>
<i>C.</i>	<i>Analogous Art</i>	<i>27</i>
<i>D.</i>	<i>Claim Construction</i>	<i>28</i>
<i>IV.</i>	<i>Level of a person of ordinary skill</i>	<i>28</i>
<i>V.</i>	<i>OVERVIEW OF THE TECHNOLOGY</i>	<i>29</i>
<i>A.</i>	<i>Wireless Networking</i>	<i>30</i>
<i>B.</i>	<i>Device Discovery and Service Discovery</i>	<i>34</i>
<i>C.</i>	<i>Media Streaming</i>	<i>38</i>
<i>D.</i>	<i>Streaming Protocols</i>	<i>40</i>
<i>E.</i>	<i>Graphical User Interfaces (GUIs) and Touch Screens</i>	<i>43</i>
<i>F.</i>	<i>Mobile Device Hardware</i>	<i>46</i>
<i>G.</i>	<i>Auxiliary Rendering Devices (aka Helper Servers/Helper Devices)</i>	<i>47</i>
<i>H.</i>	<i>Codecs</i>	<i>51</i>
<i>VI.</i>	<i>OVERVIEW OF THE '648 PATENT</i>	<i>52</i>
<i>A.</i>	<i>The '648 Patent's Alleged Invention</i>	<i>52</i>
<i>B.</i>	<i>The '648 Patent's Prosecution</i>	<i>53</i>
<i>VII.</i>	<i>PROPOSED GROUNDS OF UNPATENTABILITY</i>	<i>54</i>
<i>VIII.</i>	<i>overview of the THE PRIOR ART</i>	<i>55</i>
<i>A.</i>	<i>Overview of Zhang</i>	<i>55</i>
<i>B.</i>	<i>Overview of Fillebrown</i>	<i>56</i>
<i>C.</i>	<i>Overview of Pasanen</i>	<i>57</i>
<i>D.</i>	<i>Overview of Skinner</i>	<i>58</i>

E.	Overview of Rofheart	59
F.	Overview of Angelo	60
IX.	<i>GROUND 1: CLAIMS 1, 5-6, 15, 18 ARE OBVIOUS OVER ZHANG, FILLEBROWN, AND PASANEN</i>	61
A.	Claim 1(Pre) - A method of informing a device about an availability of media content at a mobile device connected to a local area network (LAN), comprising:	61
	1. Zhang's Mobile Device Discovers Helper Servers and Informs Said Helper Servers About Availability of Media Content	62
	2. Zhang's Network Environment – Wireless Local Area Network (WLAN)	66
B.	Claim 1(a) - using the mobile device for:	67
C.	Claim 1(b) - identifying one or more available devices compatible to handle the media content and connected to the LAN;	67
D.	Claim 1(c) - wirelessly communicating information to an intermediate routing device connected to the LAN for indirectly routing messages or media content to at least one of the one or more available devices via said intermediate routing device; and	70
	1. Zhang Teaches Wirelessly Routing Messages or Media Content to Available Helper Servers	70
	2. Fillebrown's Teachings – Wireless Router for Indirectly Routing Media	74
	3. Motivation to Combine Zhang and Fillebrown	75
E.	Claim 1(d) - wirelessly signaling the one or more available devices indicating an availability of a media content at the mobile device;	77
F.	Claim 1(e) - wherein the media content is originated from an external source disconnected from the LAN;	83
	1. '648 Patent's Media Content	83
	2. Zhang Teaches a Cellular Phone	83
	3. Pasanen Teaches a Mobile Phone That Receives Phone Calls from Mobile Network (External Source) and Routes the Call Audio to a Wireless Audio Interface (Speaker/Microphone)	84

4.	Motivation to Combine Zhang-Fillebrown-Pasanen	85
G.	Claim 1(f) - wherein the media content selected from a group consisting of: audio content and video content.	87
H.	Claim 5 - The method of claim 1, wherein the media content is a phone call; further comprising routing the phone call to the one or more available devices in response to a receipt of a response to the signaling received from the one or more device.	88
I.	Claim 6 - The method of claim 1, wherein the media content is a phone call; further comprising routing the phone call to the one or more available devices while the phone call is ongoing using the mobile device.	89
J.	Claim 15(Pre) - A mobile apparatus for informing a device about an availability of media content, comprising:	90
K.	Claim 15(a) - a receiver adapted to receive wirelessly, from an external source, media content selected from a group consisting of: audio content and video content; and	90
1.	Zhang's Teachings – Mobile Device	90
2.	Pasanen's Teachings – Mobile Phone Includes Receiver For Receiving Phone Call from Cellular Network	91
3.	Motivation to Combine Zhang and Pasanen	92
L.	Claim 15(b) - a controller adapted to identify one or more available devices connected to a local area network (LAN) and compatible to handle the media content;	94
1.	Zhang's Teachings – Mobile Device	94
2.	Pasanen's Teachings – Controller for Identifying Available Peripheral Devices	94
3.	Motivation to Combine Zhang and Pasanen	96
M.	Claim 15(c) - wherein the controller is adapted to instruct communicating wirelessly information to an intermediate routing device connected to the LAN for indirectly routing messages or media content to at least one of the one or more available devices via said intermediate routing device;	98
1.	Zhang-Pasanen's Teachings – Controller for Communicating Wireless Information	98
2.	Fillebrown's Teachings – Wireless Router for Indirectly Routing Media	99

3.	Motivation to Combine Zhang-Pasanen and Fillebrown	100
N.	Claim 15(d) - wherein the controller is adapted to wirelessly signaling the one or more available devices indicating an availability of the media content at the mobile device;	101
O.	Claim 15(e) - wherein the media content is originated from an external source disconnected from the LAN.	102
P.	Claim 18 - The mobile apparatus of claim 15, wherein the media content is audio content selected from a group consisting of: a phone call data, bidirectional voice data, bidirectional audio data and a radio broadcast.	102
X.	<i>GROUND 2: CLAIMS 7, 11, 16, AND 19 ARE OBVIOUS OVER ZHANG, FILLEBROWN, PASANEN, AND SKINNER</i>	<i>103</i>
A.	Claim 7 - The method of claim 1, wherein the one or more available devices is triggered by the signaling to perform one or more of the following: flash light, ring, and play a loudspeaker sound.	103
1.	Skinner's Teachings – Informing User of Incoming Phone Call	103
2.	Motivation to Combine Zhang-Fillebrown-Pasanen and Skinner	104
B.	Claim 11 - The method of claim 1, wherein the one or more available devices are triggered by the signaling to inform a user about an availability of media content at the mobile device.	107
C.	Claim 16 - The mobile apparatus of claim 15, wherein the one or more available devices is triggered by the mobile device to perform one or more of the following: flash light, ring, and play a loudspeaker sound.	107
D.	Claim 19(Pre) - A computer program product for a device for informing a user about an availability of media content at a mobile device, the computer program product comprising:	108
E.	Claim 19(a) – a non-transitory computer readable storage medium having stored thereon:	111
F.	Claim 19(b) - first program instructions executable by a processor to wirelessly communicating information to an	

intermediate routing device connected to a local area network (LAN) for indirectly receive messages or media content routed from one or more available devices connected to the LAN via the intermediate routing device; and	112
G. Claim 19(c) - second program instructions executable by the processor to wirelessly receive signal from the mobile device indicating an availability of a media content at the mobile device;	116
H. Claim 19(d) - third program instructions executable by the processor to inform the user of said device about an availability of a media content at the mobile device with one or more of the following: flash light, ring, and play a loudspeaker sound;	117
XI. Claim 19(e) - wherein the media content is originated from an external source disconnected from the LAN;	117
A. Claim 19(f) - wherein the media content selected from a group consisting of: audio content, text content and video content.	117
XII. GROUND 3: CLAIMS 8, 10 ARE OBVIOUS OVER ZHANG, FILLEBROWN, PASANEN, AND ROFHEART	117
A. Claim 8 – The method of claim 1, further comprising setting up a wireless communication link between the at least one of the one or more available devices based on a user interaction made with the mobile device or the one or more available devices and causing a routing of the media content to the at least one device via the wireless communication link.	117
1. Setting Up a Wireless Communication Link	118
2. User Interaction – Rofheart’s Teachings	122
3. Routing of the Media Content	125
4. Motivation to Combine Zhang-Fillebrown-Pasanen-Rofheart	125
B. Claim 10 - The method of claim 1, wherein the identifying comprises triggering a display of a menu by the one or more available devices or the mobile device to allow a user to perform a user interaction.	127

<i>XIII. GROUND 4: CLAIM 13 IS OBVIOUS OVER ZHANG, FILLEBROWN, PASANEN, AND ANGELO</i>	<i>127</i>
<i>A. Claim 13 - The method of claim 1, further comprising encrypting and routing the media content to the one or more available devices.</i>	<i>127</i>
<i>XIV. CONCLUSION</i>	<i>130</i>

CLAIM LISTING

Claim 1:

Claim 1[Pre]: A method of informing a device about an availability of media content at a mobile device connected to a local area network (LAN), comprising:

Claim 1(a): using the mobile device for:

Claim 1(b): identifying one or more available devices compatible to handle the media content and connected to the LAN;

Claim 1(c): wirelessly communicating information to an intermediate routing device connected to the LAN for indirectly routing messages or media content to at least one of the one or more available devices via said intermediate routing device; and

Claim 1(d): wirelessly signaling the one or more available devices indicating an availability of a media content at the mobile device;

Claim 1(e): wherein the media content is originated from an external source disconnected from the LAN;

Claim 1(f): wherein the media content selected from a group consisting of: audio content and video content.

Claim 5:

The method of claim 1, wherein the media content is a phone call; further comprising routing the phone call to the one or more available devices in response to a receipt of a response to the signaling received from the one or more device.

Claim 6:

The method of claim 1, wherein the media content is a phone call; further comprising routing the phone call to the one or more available devices while the phone call is ongoing using the mobile device.

Claim 7:

The method of claim 1, wherein the one or more available devices is triggered by the signaling to perform one or more of the following: flash light, ring, and play a loudspeaker sound.

Claim 8:

The method of claim 1, further comprising setting up a wireless communication link between the at least one of the one or more available devices based on a user interaction made with the mobile device or the one or more available devices and causing a routing of the media content to the at least one device via the wireless communication link.

Claim 10:

The method of claim 1, wherein the identifying comprises triggering a display of a menu by the one or more available devices or the mobile device to allow a user to perform a user interaction.

Claim 11:

The method of claim 1, wherein the one or more available devices are triggered by the signaling to inform a user about an availability of media content at the mobile device.

Claim 13:

The method of claim 1, further comprising encrypting and routing the media content to the one or more available devices.

Claim 15:

Claim 15[Pre]: A mobile apparatus for informing a device about an availability of media content, comprising:

Claim 15(a): a receiver adapted to receive wirelessly, from an external source, media content selected from a group consisting of: audio content and video content; and

Claim 15(b): a controller adapted to identify one or more available devices connected to a local area network (LAN) and compatible to handle the media content;

Claim 15(c): wherein the controller is adapted to instruct communicating wirelessly information to an intermediate routing device connected to the LAN for indirectly routing messages or media content to at least one of the one or more available devices via said intermediate routing device;

Claim 15(d): wherein the controller is adapted to wirelessly signaling the one or more available devices indicating an availability of the media content at the mobile device;

Claim 15(e): wherein the media content is originated from an external source disconnected from the LAN.

Claim 16:

The mobile apparatus of claim 15, wherein the one or more available devices is triggered by the mobile device to perform one or more of the following: flash light, ring, and play a loudspeaker sound.

Claim 18:

The mobile apparatus of claim 15, wherein the media content is audio content selected from a group consisting of: a phone call data, bidirectional voice data, bidirectional audio data and a radio broadcast.

Claim 19:

Claim 19[Pre]: A computer program product for a device for informing a user about an availability of media content at a mobile device, the computer program product comprising:

Claim 19(a): a non-transitory computer readable storage medium having stored thereon:

Claim 19(b): first program instructions executable by a processor to wirelessly communicating information to an intermediate routing device connected to a local area network (LAN) for indirectly receive messages or media content routed from one or more available devices connected to the LAN via the intermediate routing device; and

Claim 19(c): second program instructions executable by the processor to wirelessly receive signal from the mobile device indicating an availability of a media content at the mobile device;

Claim 19(d): third program instructions executable by the processor to inform the user of said device about an availability of a media content at the mobile device with one or more of the following: flash light, ring, and play a loudspeaker sound;

Claim 19(e): wherein the media content is originated from an external source disconnected from the LAN;

Claim 19(f): wherein the media content selected from a group consisting of:
audio content, text content and video content.

I, Sayfe Kiaei, declare as follows:

I. INTRODUCTION AND QUALIFICATIONS

1. I am over the age of 21 and am competent to make this declaration. I make this declaration based on facts and matters within my own knowledge and on information provided to me by others, and, if called as a witness, I could and would competently testify to the matters set forth herein.

A. Educational Background and Professional Experience

2. My qualifications are stated more fully in my curriculum vitae, which is attached as Exhibit A. Below is a summary of my education, work experience, and other qualifications.

3. I earned a Ph.D. in 1987 from Washington State University in Electrical, Computer, and Energy Engineering. From 1985 through 1987, while working toward my Ph.D., I worked with Boeing on the development of signal processing and control systems.

4. From 1987 through 1993, I was a tenured Professor at Oregon State University in the Electrical and Computer Engineering Department.

5. From 1993 to 2002, I was a Senior Member of Technical Staff with the Wireless Technology Center and Broadband Operations at Motorola Inc. With the Wireless Integrated Technology Center (WITC) group of Motorola, I was responsible for the development of wireless system for cellular system, 2-way

Radios, RF integrated circuits, GPS, and Bluetooth. I represented Motorola at the Bluetooth (BT) SIG group forming the first BT standard. I was also responsible for the development of BT and GPS IC solutions for Motorola's Cellular phones. With the Broadband Operation, I worked with the team on the development of Single-Chip COPPERGOLD™ Motorola Digital Subscriber Lines (DSL) transceivers. I worked on the development of broadband transceivers for MODEMS including DSL, SDSL, VDSL, and Optical communication systems. I also represented Motorola in the T1E1 and ETSI, and cable MODEM DOCIS standards.

6. Since 2001 I have held the position of Motorola Endowed Chair Professor in Analog and Radio Frequency Integrated Circuitry at the School of Electrical, Computer, and Energy Engineering at Arizona State University in Tempe, Arizona. I am also the Director of the National Science Foundation Center, Connection One. Connection One is an industry/university cooperative research center with focus on communication systems. The center has over thirty industrial members and five university members focused on developing communication systems, sensors, electronics, bio-electronics, and networking technologies.

7. At Arizona State University, I have developed and taught courses on Communications, Broadband Wirelines and Wireless Transceivers, Electronics, VLSI, Analog IC design, RFIC, communications, and related areas. In my over thirty years of academic experience, I have taught university courses and done research in

electronics, RF and wireless system, bio-electronics, networking, communication systems, and sensors. I have graduated over 100 M.S. and Ph.D. students working under my supervision on their thesis, and many of them are professors in academia, or have senior positions in the industry. Currently, I have 8 M.S., Ph.D., and postdoc students working with me in my lab on research related to communication and networking systems, wireless systems, RF, and integrated circuits. My research is funded by various sources, including industry, federal agencies including NSF, DARPA, ONR, DOE, and other, with an average total research funding of \$1M per year.

8. I have been conducting research, publishing papers, and supervising graduate students working on communication system, signal process, audio processing, GPS, BT, DSL, RFIC, and communication transceivers for the past 40 years. I have published over two hundred journal and conference papers covering topics such as wireless systems, power management, low-power electronics, sensors, radio frequency, integrated circuits (IC), filter design, and related areas. A list of my publications can be found in my CV, attached as Exhibit A. I also have over 10 patents and patent applications in electronics, RF, and low-power bio-electronics.

9. I am an IEEE Fellow, a distinction and the highest level of IEEE membership awarded by the IEEE directors to recognize a high level of demonstrated extraordinary accomplishments. The IEEE is the Institute of Electrical

and Electronics Engineers, the world's largest association of technical professionals whose objectives include the educational and technical advancement of electrical and electronic engineering, telecommunications, computer engineering, and related disciplines. I am a member of the IEEE Circuits and Systems Society, IEEE Solid State Circuits Society, and IEEE Communication Society, IEEE RF and Microwave committees, IEEE International Symposium on Low Power Electronics and Design (ISLPED), IEEE Signal Processing Society, IEEE Fellow Selection Committee, and many other International Electrical Engineering societies. I was one of the key organizers to establish the IEEE Radio Frequency Integrated Circuits (RFIC) symposium in 1995, and IEEE International Symposium on Low Power Electronics and Design (ISLPED) in 1997. I have been on the executive committee, and technical committee of RFIC and ISLPED for the last 16 years. The RFIC and ISLPED Symposia have grown and is now the premier international symposium in the world where the latest RF, low-power electronics, wireless, and bio-electronic circuits and components are presented.

10. I have received several awards including the Carter Best Teacher Award, the IEEE Darlington Award (which is given for the best technical paper on circuits and systems in the IEEE Circuits and Systems Society), and the Motorola 10X Rapid Design Cycle Reduction Award.

11. I have been one of the key organizers of the IEEE International Symposium on Low Power Electronics and Design (ISLPED) since 1997. I have published papers and organized sessions on techniques for low-power cellular phones at ISLPED. I have published a number of papers on the design and development of low-power RF, wireless transceivers, sensors, and low-power bioelectronics.

12. I have also been a consultant on various projects with Motorola, Intel (designing 2G, 3G mobile telephone transceivers, Internet-of-Things (IOT), and sensors), Texas Instrument (developing 3G cellular and Bluetooth technologies), Sony Wireless (developing GPS technologies), Tektronics (designing wireless systems), and various other consultancies. During my work in industry, I have designed and contributed to the design of many wireless systems for commercial products. Many of my designs are still in use today in products manufactured by the companies I have worked for, including Motorola, Intel, Sony, and more.

13. I am being compensated for my time at my ordinary hourly rate of \$475. My compensation is not dependent on the outcome of these proceedings or the content of my opinions. To the best of my knowledge, I have no financial interest in either party or in the outcome of this proceeding.

II. METHODOLOGY; MATERIALS CONSIDERED

14. I have relied upon my education, knowledge, and experience with the technology of communication networks, as well as the other materials as discussed in this declaration in forming my opinions.

15. For this work, I have been asked to review U.S. Patent No. 10,547,648 (“the ’648 Patent”) (Ex. 1001) including the specification and claims, and the ’648 Patent’s prosecution history (“’648 File History”) (Ex. 1002). In developing my opinions relating to the ’648 Patent, I have considered the materials cited or discussed herein, including those listed below.

- U.S. Patent No. 10,547,648 (“’648 Patent”) (Ex. 1001)
- Prosecution History for the ’648 Patent (“’648 FH”) (Ex. 1002)
- U.S. Patent No. 7,536,182 to Zhang (“Zhang”) (Ex. 1004)
- U.S. Patent App. Pub. No. 2001/0053134 to Fillebrown et al. (“Fillebrown”) (Ex. 1005)
- U.S. Patent No. 6,587,450 to Pasanen (“Pasanen”) (Ex. 1006)
- U.S. Patent No. 6,703,930 to Skinner (“Skinner”) (Ex. 1007)
- U.S. Patent No. 7,058,414 to Rofheart et al. (“Rofheart”) (Ex. 1008)
- U.S. Patent App. Pub. No. 2003/0061493 to Angelo et al. (“Angelo”) (Ex. 1009)
- U.S. Patent App. Pub. No. 2002/01782789 to Janik et al. (“Janik”) (Ex. 1010)
- International Publication No. WO 01/74024 to Hartmaier et al. (“Hartmaier”) (Ex. 1011)
- European Patent Application No. EP1132847 to Han et al. (“Han”) (Ex. 1012)
- U.S. Patent App. Pub. 2002/0102998 to Lin (“Lin”) (Ex. 1013)
- U.S. Patent No. 7,580,005 to Palin (“Palin”) (Ex. 1014)
- U.S. Patent App. Pub. No. 2003/0110234 to Egli et al. (“Egli”) (Ex. 1015)
- U.S. Patent No. 6,910,068 to Zintel et al. (“Zintel”) (Ex. 1016)

- Bluetooth Core Specification version 1.1 (“*Bluetooth V1.1 Core Spec.*”) (Ex. 1017)
- U.S. Patent No. 6,901,273 to Lutnaes (“*Lutnaes*”) (Ex. 1018)
- U.S. Patent App. Pub. No. 2002/0141548 to Boda (“*Boda*”) (Ex. 1019)
- International Publication No. WO 02/19152 to Bergman et al. (“*Bergman*”) (Ex. 1020)
- Matthew S. Gast. *802.11 Wireless Networks The Definitive Guide*. O’Reilly & Associates. April 2002. (“*Gast*”) (Ex. 1021)
- U.S. Patent No. 6,925,108 to Miller et al. (“*Miller*”) (Ex. 1022)
- Jim Geier. *Wireless LANs*. 2nd Edition. Sams Publishing. July 2001. (“*Geier*”) (Ex. 1023)
- U.S. Patent No. 6,212,282 to Mershon (“*Mershon*”) (Ex. 1024)
- U.S. Patent No. 6,526,287 to Lee (“*Lee*”) (Ex. 1025)
- U.S. Patent App. Pub. No. 2002/0101367 to Geiger et al. (“*Geiger*”) (Ex. 1026)
- U.S. Patent App. Pub. No. 2002/0186770 to Jawerth et al. (“*Jawerth*”) (Ex. 1027)
- U.S. Patent App. Pub. No. 2003/0013438 to Darby (“*Darby*”) (Ex. 1028)
- U.S. Patent App. Pub. No. 2003/0139966 to Sirota et al. (“*Sirota*”) (Ex. 1029)
- U.S. Patent No. 7,346,135 to Narasimhan (“*Narasimhan*”) (Ex. 1031)
- U.S. Patent No. 5,956,681 to Yamakita (“*Yamakita*”) (Ex. 1033)
- U.S. Patent App. Pub. No. 2002/0174208 to Morlitz (“*Morlitz*”) (Ex. 1034)

16. I have considered these materials from the viewpoint of a POSITA as of the priority date of the ’648 Patent. For the purposes of this declaration, I have been asked to assume that the priority date of the ’648 Patent is July 25, 2002. I note that my opinions provided in this declaration are made from the perspective of a POSITA as of this priority date of the ’648 Patent, unless expressly stated otherwise. To the extent that I use any verb tense in this declaration that is present tense (e.g., “a POSITA would understand” instead of “a POSITA would have understood”),

such verb tense should be understood to be my opinion as of the '648 Patent's priority date (again, unless expressly stated otherwise). I merely use the present verb tense for ease of reading.

III. OVERVIEW AND LEGAL STANDARDS

17. In formulating my opinions, I have been instructed to apply certain legal standards. I am not a lawyer. I do not expect to offer any testimony regarding what the law is. Instead, the following sections summarize the law as I have been instructed to apply it in formulating and rendering my opinions found later in this declaration. I understand that, in an *inter partes* review ("IPR") proceeding, patent claims may be deemed unpatentable if it is shown that they were anticipated or rendered obvious in view of the prior art. I understand that prior art in an IPR review is limited to patents or printed publications that predate the priority date of the patent at issue. I understand that questions of claim clarity (definiteness) and enablement cannot be considered as a ground for considering the patentability of a claim in these proceedings.

A. Person of Ordinary Skill in the Art

18. I understand that the '648 Patent, the record of proceedings at the Patent Office (which I understand is called the "File History" or "Prosecution History"), and the teachings of the prior art are evaluated from the perspective of a person of ordinary skill in the art ("POSITA"). I understand that the factors considered in

determining the ordinary level of skill in the art include: (i) the levels of education and experience of persons working in the field; (ii) the types of problems encountered in the field; and (iii) the sophistication of the technology. I may also consider, if available, the education level of the inventor, prior art solutions to the problems encountered in the art, and the rapidity with which innovations are made in the relevant art.

19. I understand that a person of ordinary skill in the art is not a specific real individual, but rather a hypothetical individual having the qualities reflected by the factors above. This hypothetical person has knowledge of all prior art in the relevant field as if it were arranged on a workshop wall and takes from each reference what it would teach to a person having the skills of a POSITA.

B. Obviousness

20. I understand that a claim may be invalid under 35 U.S.C. § 103(a) if the subject matter described by the claim as a whole would have been “obvious” to a hypothetical POSITA in view of a single prior art reference or in view of a combination of references at the time the claimed invention was made. Therefore, I understand that obviousness is determined from the perspective of a hypothetical POSITA. I further understand that a hypothetical POSITA is assumed to know and to have all relevant prior art in the field of endeavor covered by the patent in suit and all analogous prior art. I understand that obviousness in an IPR review proceeding

is evaluated using a preponderance of the evidence standard, which means that the claims must be more likely obvious than nonobvious.

21. I also understand that an analysis of whether a claimed invention would have been obvious should be considered in light of the scope and content of the prior art, the differences (if any) between the prior art and the claimed invention, and the level of ordinary skill in the pertinent art involved. I understand as well that a prior art reference should be viewed as a whole. I understand that in considering whether an invention for a claimed combination would have been obvious, I may assess whether there are apparent reasons to combine known elements in the prior art in the manner claimed in view of interrelated teachings of multiple prior art references, the effects of demands known to the design community or present in the marketplace, and/or the background knowledge possessed by a POSITA. I also understand that other principles may be relied on in evaluating whether a claimed invention would have been obvious, and that these principles include the following:

- A combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results;
- When a device or technology is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or in a different one, so that if a POSITA can implement a predictable variation, the variation is likely obvious;

- If a technique has been used to improve one device, and a POSITA would have recognized that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill;
- An explicit or implicit teaching, suggestion, or motivation to combine two prior art references to form the claimed combination may demonstrate obviousness, but proof of obviousness does not depend on or require showing a teaching, suggestion, or motivation to combine;
- Market demand, rather than scientific literature, can drive design trends and may show obviousness;
- In determining whether the subject matter of a patent claim would have been obvious, neither the particular motivation nor the avowed purpose of the named inventor controls;
- One of the ways in which a patent's subject can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims;
- Any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed;

- “Common sense” teaches that familiar items may have obvious uses beyond their primary purposes, and in many cases a POSITA will be able to fit the teachings of multiple patents together like pieces of a puzzle;
- A POSITA is also a person of ordinary creativity, and is not an automaton;
- A patent claim can be proved obvious by showing that the claimed combination of elements was “obvious to try,” particularly when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions such that a POSITA would have had good reason to pursue the known options within his or her technical grasp; and
- One should not use hindsight in evaluating whether a claimed invention would have been obvious.

22. I also understand that an obviousness determination includes the consideration of various factors such as: (1) the scope and content of the prior art, (2) the differences between the prior art and the asserted claims, (3) the level of ordinary skill in the pertinent art, and (4) the existence of secondary considerations such as commercial success, long-felt but unresolved needs, failure of others, and so forth.

23. I am informed that it is improper to combine references where the references teach away from their combination. I am informed that a reference may be said to teach away when a person of ordinary skill in the relevant art, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the patent applicant. In general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the patentee. I am informed that a reference teaches away, for example, if (1) the combination would produce a seemingly inoperative device, or (2) the references leave the impression that the product would not have the property sought by the patentee. I also am informed, however, that a reference does not teach away if it merely expresses a general preference for an alternative invention but does not criticize, discredit, or otherwise discourage investigation into the invention claimed.

24. I am informed that even if a *prima facie* case of obviousness is established, the final determination of obviousness must also consider "secondary considerations" if presented. In most instances, the patentee raises these secondary considerations of non-obviousness. In that context, the patentee argues an invention would not have been obvious in view of these considerations, which include: (a) commercial success of a product due to the merits of the claimed invention; (b) a

long-felt, but unsatisfied need for the invention; (c) failure of others to find the solution provided by the claimed invention; (d) deliberate copying of the invention by others; (e) unexpected results achieved by the invention; (f) praise of the invention by others skilled in the art; (g) lack of independent simultaneous invention within a comparatively short space of time; and (h) teaching away from the invention in the prior art.

25. I am further informed that secondary considerations evidence is only relevant if the offering party establishes a connection, or nexus, between the evidence and the claimed invention. The nexus cannot be based on prior art features. The establishment of a nexus is a question of fact. While I understand that Patent Owner here has not offered any secondary considerations at this time, I will supplement my opinions in the event that Patent Owner raises secondary considerations during the course of this proceeding.

C. Analogous Art

26. I have been informed that for a prior art reference to be proper for use in an obviousness analysis, the reference must be “analogous art” to the claimed invention. I have been informed that a reference is analogous art to the claimed invention if: (1) the reference is from the same field of endeavor as the claimed invention (even if it addresses a different problem); or (2) the reference is reasonably pertinent to the problem faced by the inventor (even if it is not in the same field of

endeavor as the claimed invention). In order for a reference to be “reasonably pertinent” to the problem, it must logically have commended itself to an inventor’s attention in considering his problem. In determining whether a reference is reasonably pertinent, one should consider the problem faced by the inventor, as reflected either explicitly or implicitly, in the specification. I believe that all of the references that my opinions in this IPR are based upon are well within the range of references a person having ordinary skill in the art would consult to address the type of problems described in the Challenged Claims.

D. Claim Construction

27. I understand that the claim terms in this IPR will be construed according to their plain and ordinary meaning as understood in light of the claim language, the patent’s description, and the prosecution history viewed from the perspective of a POSITA. I further understand that where a patent defines claim language, the definition in the patent controls, even if there are other definitions that might be understood by those working in the art.

IV. LEVEL OF A PERSON OF ORDINARY SKILL

28. Based on my review and analysis of the ’648 Patent, the prior art cited herein, and the ordinary skill factors described in this section, a POSITA in the field of the ’648 Patent at the time of the earliest possible priority date (July 25, 2002) would have been knowledgeable regarding the field of communication networks. In

my experience working in this field, most workers of ordinary skill in the art as of the earliest possible priority date of July 25, 2002, would have had a master's degree in computer engineering, electrical engineering, or a related field, with at least 2 years of experience with wireless communications. *See, e.g., '648 Patent* (Ex. 1001), 1:22-29, 4:26-46, 11:13-12:30 (describing embodiments of '648 Patent). A person with less relevant practical experience but with additional education can also qualify as a POSITA in the field of the '648 Patent. When I refer to the understanding of a POSITA, I am referring to the understanding of such a person as of July 25, 2002.

29. As of July 25, 2002, as set forth in detail above and in my cv, I had more than ordinary skill in the art. I am, however, familiar with the skills and knowledge possessed by those I would have considered to be of ordinary skill in the art as of that date.

30. My opinions provided in this declaration would not change in view of minor modifications to this level of ordinary skill.

V. OVERVIEW OF THE TECHNOLOGY

31. The features described and claimed in the '648 Patent were routine as of July 25, 2002. In the following paragraphs, I briefly summarize the technology background for a few key features relevant to the opinions set forth herein.

A. Wireless Networking

32. Wireless networking was well known before the priority date of the '648 Patent. In general, wireless networking is similar to wired networking in that both involve connecting a number of devices so that the devices may communicate, transfer information, stream data or media, or otherwise communicate electronically, but wireless networking performs such functionality without the need for wires connecting the devices together. *Gast* (Ex. 1021), 3 (“Like all networks, wireless networks transmit data over a network medium. The medium is a form of electromagnetic radiation.”). *Geier* (Ex. 1023), 34 (“Wireless networks perform functions similar to their wired ethernet and token-ring counterparts.”), 34-35 (“1. The medium provides a bit pipe (a path for data to flow) for the transmission of data. ... 4. Routing mechanisms move the data from the originating source to the intended destination.”)

33. Numerous standards and commercially available technology existed for wireless networking before the priority date of the '648 Patent. For example, IEEE 802.11 included well-known standards for connecting devices in a wireless local area network (WLAN). *Gast*, 1 (“Wireless telephony has been successful because it enables people to connect with each other regardless of location. New technologies targeted at computer networks promise to do the same for Internet connectivity. The most successful wireless networking technology th[u]s far has been 802.11.”). By

April 2002, wireless networking such as WLAN was already widely used and IEEE 802.11 in particular had gained success. *Gast*, 6 (“802.11 is a success *now*. Apple initiated the pricing moves that caused the market for 802.11 equipment to explode in 1999. Price erosion made the equipment affordable and started the growth that continues today.”).

34. IEEE 802.11 includes various versions that were developed over time. For example, the first version of the 802.11 standard was from 1997 and featured “both frequency-hopping and direct-sequence modulation techniques.” *Gast*, 6. The second version of the IEEE 802.11 standard, 802.11a, was from 1999, with 802.11a products released in 2000. *Id.* 802.11b was the third version of the standard, and was the “most common 802.11 equipment as this book was written.” *Id.* I note that *Gast* published in April 2002, making 802.11b the most common 802.11 standard used in the 2002 timeframe, according to *Gast*.

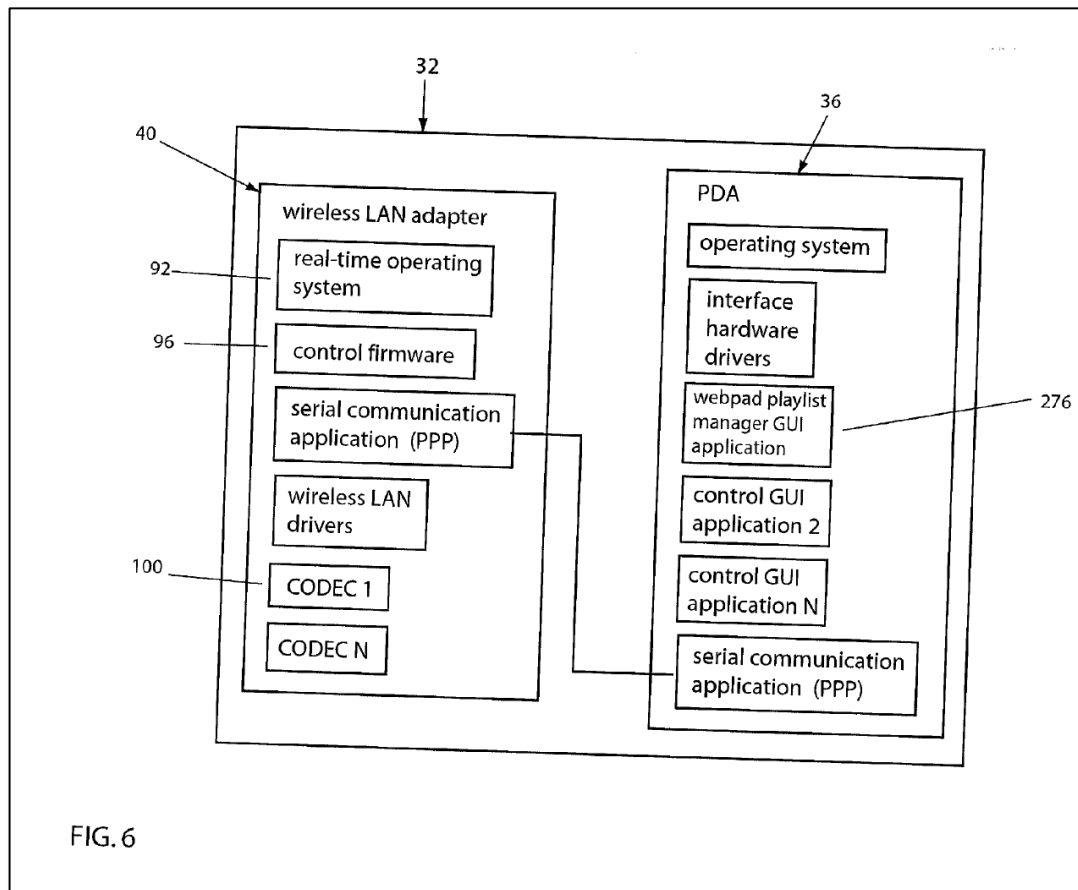
35. In a network, a server device generally provides a function, content, or data to a requesting device called a client device. *Geier*, 47 (“The server-based network operating system provides a centralized platform for applications and data storage for mobile users.”), *id.* (“A network operating system (NOS) such as Microsoft NT Server, hosted on a high-end PC, provides file, print, and applications services. Many NOSs are server oriented ... where the core application software and databases reside. In most cases, the appliances [clients] will interface via TCP/IP

with application software or a database running on the NOS.”). Similarly, the client device directs a user’s commands to a server. *Geier*, 48 (“Client software, located on the end-user’s appliance, directs the user’s commands to the local appliance software or steers them out through the wireless network. The software residing on a wireless appliance is very similar to software that runs on a wired appliance.”). It was well known that a server connected to the Internet (often referred to as a Web server) provides content to requesting client devices. For example, a web server may provide music, video, data, or files based on content stored at the server. *Janik*, [0043] (“PC has access via content services to downloadable digital audio files such as MP3 formatted audio files, MPEG-2 and MPEG-4 video files, as well as digital audio and video streams from Internet 8 servers.”), [0044] (“PC can also route Internet 8 streams of content to webpad 32”).

36. In a wireless network, devices connect to each other using hardware and software or other programming instructions. Wireless networks operated in layers such as Network, Data Link, and Physical (or PHY layer) or network. For example, mobile devices often include a wireless interface, such as a wireless transceiver, to send and receive signals wirelessly to/from other devices connected to the wireless network. *Gast* teaches one example. *Gast*, 3 (“The two media that have seen the widest use in local-area applications are infrared light and radio waves. ... Radio waves can penetrate most office obstructions and offer a wider coverage

range. It is no surprise that most, if not all, 802.11 products on the market use the radio wave physical layer.”).

37. Another example of mobile devices with a wireless transceiver is *Janik*, which teaches a wireless LAN adapter 40 in a “webpad 32” (e.g., a PDA [personal digital assistant]). *Janik* (Ex. 1010), [0041]-[0043].



Janik, Fig. 6.

38. *Janik* further teaches components of wireless LAN adapter 40 include a wireless LAN transceiver 44. *Janik*, [0049]. *Janik* teaches wireless LAN transceiver 44 of wireless LAN adapter 40 is “capable of sending and receiving data

using radio frequencies via a wireless data transfer protocol. Technology for such a LAN is currently available and includes the Symphony wireless networking access point provided by Proxim, Inc.” *Janik*, [0051].

B. Device Discovery and Service Discovery

39. Before the priority date of the '648 Patent, it was known that mobile devices performed device discovery to locate other nearby devices with which to connect.

40. One well known industry standard for discovering nearby devices, pairing with devices, and performing communications between said devices was the Bluetooth specification. To establish a new Bluetooth connection, Bluetooth enabled devices use what is called the “Inquiry” and “Page” (or “Paging”) procedures, which are generally described in the Bluetooth V1.1 Core Spec. as follows:

In order to establish new connections the procedures inquiry and paging are used. The inquiry procedure enables a unit to discover which units are in range, and what their device addresses and clocks are. With the paging procedure, an actual connection can be established. Only the Bluetooth device address is required to set up a connection. Knowledge about the clock will accelerate the setup procedure. A unit that establishes a connection will carry out a page procedure and will automatically be the master of the connection.

Bluetooth V1.1 Core Spec. (Ex. 1017), 96.

41. The Bluetooth Inquiry procedure begins with an inquiry message that is broadcast by a source or master unit that wants to discover other Bluetooth units that are within range. The inquiry message defines whether all Bluetooth enabled devices should respond (using the general inquiry access code or GIAC) or only a particular type of device should respond to the inquiry (using a number of dedicated inquiry access codes or DIAC). A Bluetooth enabled unit or slave unit that is in a discoverable mode allows itself to be discovered by regularly entering the “inquiry scan substate” to receive inquiry messages and respond thereto.

The inquiry message broadcasted by the source does not contain any information about the source. However, it may indicate which class of devices should respond. There is one general inquiry access code (GIAC) to inquire for any Bluetooth device, and a number of dedicated inquiry access codes (DIAC) that only inquire for a certain type of devices. The inquiry access codes are derived from reserved Bluetooth device addresses and are further described in Section 4.2.1.

A unit that wants to discover other Bluetooth units enters an inquiry substate. In this substate, it continuously transmits the inquiry message (which is the ID packet, see Section 4.4.1.1 on page 55) at different hop frequencies. The inquiry hop sequence is always derived from the LAP of the GIAC. Thus, even when DIACs are used, the applied hopping sequence is generated from the GIAC LAP. A unit that allows itself to be discovered, regularly enters the inquiry scan substate to respond to inquiry messages.

Bluetooth V1.1 Core Spec., 105.

42. A discoverable Bluetooth unit that receives an inquiry message responds to the inquiring Bluetooth unit with an inquiry response message, which is a Frequency Hop Synchronization (FHS) packet containing the recipient's Bluetooth device address (BD_ADDR) and also the recipient's Class of Device.

For the inquiry operation, there is only a slave response, no master response. The master listens between inquiry messages for responses, but after reading a response, it continues to transmit inquiry messages. The slave response routine for inquiries differs completely from the slave response routine applied for pages. When the inquiry message is received in the inquiry scan substate, a response message containing the recipient's address must be returned.

Bluetooth V1.1 Core Spec., 108.

43. In order to establish a Bluetooth connection with a responding Bluetooth (slave) unit, the source or master unit carries out the Page Procedure, thereby forming a piconet. *Bluetooth V1.1 Core Spec.* at 96-104. During the Page Procedure, the master unit will assign the slave unit an active member address (AM_ADDR) that is carried in the packet header for subsequent communications between the master and slave units. *Bluetooth V1.1 Core Spec.*, 51.

44. The Bluetooth specification also provides a Service Discovery Protocol (SDP) whereby, after establishing a communication link, a Bluetooth unit can obtain more detailed information about available services from another Bluetooth unit. *Bluetooth V1.1 Core Spec.*, 331-392. In particular, the Bluetooth specification

teaches the “service discovery mechanism provides the means for client applications to discover the existence of services provided by server applications as well as the attributes of those services.” *Bluetooth V1.1 Core Spec*, 338. Further, the Bluetooth specification teaches the “attributes of a service include the type or class of service offered and the mechanism or protocol information needed to utilize the service.” *Id.*

45. Various commercially available technologies existed before the priority date of the '648 Patent to perform such device discovery and capability determination. For example, *Han* teaches “SLP (Service Location Protocol), Jini* from Sun Microsystems, Bluetooth’s* SDP (Service Discovery Protocol), Microsoft*’s UPnP* (Universal Plug and Play), etc.” *Han* (Ex. 1012), [0030].

46. Universal Plug and Play from Microsoft was used so a “universal plug and play (UPnP) device makes itself known and available for communication with other entities on a network through a set of processes-discovery, description, control, eventing, and presentation[.]” *Zintel* (Ex. 1016), 2:62-66. “Following discovery of a UPnP device, an entity can learn more about the device and its capabilities, or interact with the device, by retrieving the device’s description from a URL provided by the device in an initial discovery message.” *Zintel*, 2:67-3:4.

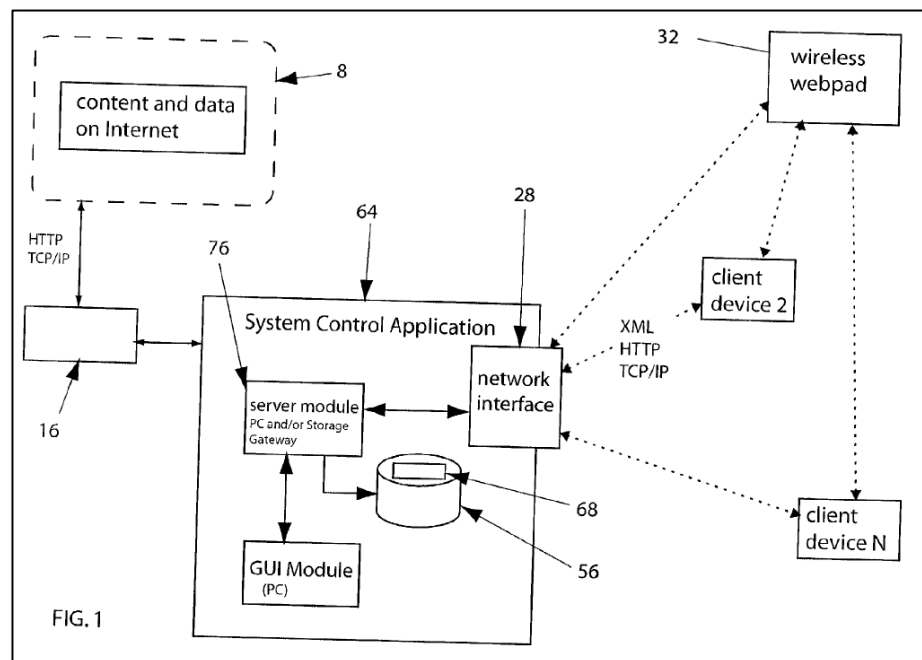
C. Media Streaming

47. Streaming audio and/or video was known well before the priority date of the '648 Patent. *Hartmaier* teaches “[s]treaming audio and/or video techniques provide a method of sending the audio or video data over the Internet as a continuous, compressed stream that is played for the user on the fly as it is received. Streaming allows the user to listen to or view received information almost as soon as it is received, as compared to playing downloaded audio or video files which may have a delay of several minutes while the entire file is transferred.” *Hartmaier* (Ex. 1011), 2:17-21.

48. Further, *Hartmaier* teaches that “[s]treaming technology not only allows users to play prerecorded audio and video files, such as books, music or videos that have been digitized and stored, but also allows users to receive live audio and video in realtime.” *Hartmaier*, 2:24-26. *Hartmaier* teaches that “radio stations and television stations can stream their broadcasts over the Internet or any other computer network. Any other source of live or recorded audio or video can also be streamed to send users information or entertainment via the Internet.” *Hartmaier*, 2:26-29. *Hartmaier* also teaches that devices such as a wireless telephone can receive such streaming content. *Hartmaier*, 18:1-2 (“any analog, digital, or PCS phone without restrictions as to standard or format”), 15:23-16:19 (teaching audio

streaming of sports scores to wireless telephone 101), 17:12-18 (audio streaming to wireless telephone 101).

49. *Janik* teaches an example of a mobile device receiving streaming media content over a WLAN. For example, *Janik* teaches Internet servers with media content and a PC functioning as a proxy server on a network (e.g., wireless LAN). *Janik*, [0041]-[0043]. *Janik* teaches the proxy server streams content such as audio and video from Internet servers to mobile devices such as a PDA on the WLAN. *Id.* As depicted in Fig. 1 below, *Janik* teaches content and data on Internet servers 8, which is streamed to a PC (represented by element 64), and which is further streamed to client devices including a wireless webpad (PDA) 32:



Janik, Fig. 1. I also note that *Janik* teaches using HTTP and TCP/IP for streaming connections between the Internet server 8, PC “64,” and client devices and wireless

webpad 32, as depicted in Fig. 1 above. *Janik*, [0007], [0030], [0036]-[0037], [0043]-[0044], [0054]-[0057], [0062]-[0063], [0081], [0084]-[0085], [0090].

50. *Han* teaches an example of streaming media from a mobile device to an end device. For example, *Han* teaches a portable device such as a PDA that streams content to a nearby output device with better capabilities, such as a TV screen or speaker. *Han* (Ex. 1012), [0032]. *Han* teaches the “user can also control which output data/stream is played/displayed on which output device, such that still images could be sent for display on the monitor of PC 36 or for outputting as hard copy at printer 38, while video images would be sent to TV 34.” *Id.*

51. In another example, *Sirota* teaches a mobile device receiving streaming radio broadcasts over a wireless network. For example, *Sirota* teaches “Client system 102 represents a broad range of digital systems known in the art, including but are not limited to devices such as wireless mobile phones, palm sized personal digital assistants, notebook computers, desktop computers, set-top boxes, and game consoles.” *Sirota*, [0026]. *Sirota* also teaches the mobile device client system 102 includes a streaming player 104 to play streaming content such as streaming radio. *Sirota*, [0025]-[0027], *see also generally Sirota*, [0014]-[0029].

D. Streaming Protocols

52. Application programs send streams of data to one of the Internet Transport Layer Protocols, either the **User Datagram Protocol (UDP)** or the

Transmission Control Protocol (TCP). Before the priority date of the '648 Patent, one well-known protocol used for streaming was TCP/IP.¹ *Egli* teaches “TCP stands for Transmission Control Protocol. TCP is one of the main protocols in TCP/IP networks. Whereas the IP protocol deals only with packets, TCP enables two hosts to establish a connection and exchange streams of data. TCP guarantees delivery of data and also guarantees that packets will be delivered in the same order in which they were sent.” *Egli* (Ex. 1015), [0022]. TCP and/or UDP receive the data stream from the sender and package them into *packets* with the destination address. The packets are sent to the next layer called Internet Network layer. The Internet Network layer packages the packet in an **Internet Protocol (IP)** datagram and sends it to a destination or gateway. Further, *Egli* teaches “TCP/IP: Stands for Transmission Control Protocol/Internet Protocol, the suite of communications protocols used to connect hosts on the Internet. TCP/IP uses several protocols, the two main ones being TCP and IP.” *Egli*, [0023]. Moreover, *Yamakita* (Ex. 1033) shows the format of an IP header including the “destination IP address” used in the TCP/IP protocol. *Yamakita* (Ex. 1033), 3:4-5, 29:6-11.

¹ I note that while TCP and IP are separate protocols, I refer to TCP/IP as a “protocol” for simplicity. Likewise, I refer to UDP/IP as a “protocol” rather than two separate protocols (UDP and IP) for simplicity.

FIRST WORD	VERSION	HEADER LENGTH	SERVICE TYPE	TOTAL IP DATAGRAM LENGTH	
SECOND WORD	IDENTIFICATION NUMBER			FLAG STRING	FRAGMENT OFFSET
THIRD WORD	TIME OF LIVE		PROTOCOL	HEADER CHECKSUM	
FOURTH WORD	TRANSMISSION SOURCE IP ADDRESS				
FIFTH WORD	DESTINATION IP ADDRESS				
SIXTH WORD	IP OPTION				PADDING

Yamakita, Fig. 7A. Further, as noted by *Morlitz*:

The TCP/IP packets are directed to their final destination by packet transmission devices Such as routers, bridges, gateways, or the like. These packet transmission devices use the data available within the headers at different levels of the TCP/IP stack to determine the appropriate route to send the packets. For example, a router directs a TCP/IP packet using the IP address, which is available in the IP header. The router receives the TCP/IP packet, strips the network and IP headers from the packet, and inspects the IP address in the IP header to determine the packet's final destination. The router then attaches the IP and network headers and sends the TCP/IP packet to the final destination or to another packet transmission device en route to the final destination.

Morlitz (Ex. 1034), [0002].

53. Another well-known streaming protocol was UDP/IP. For example,

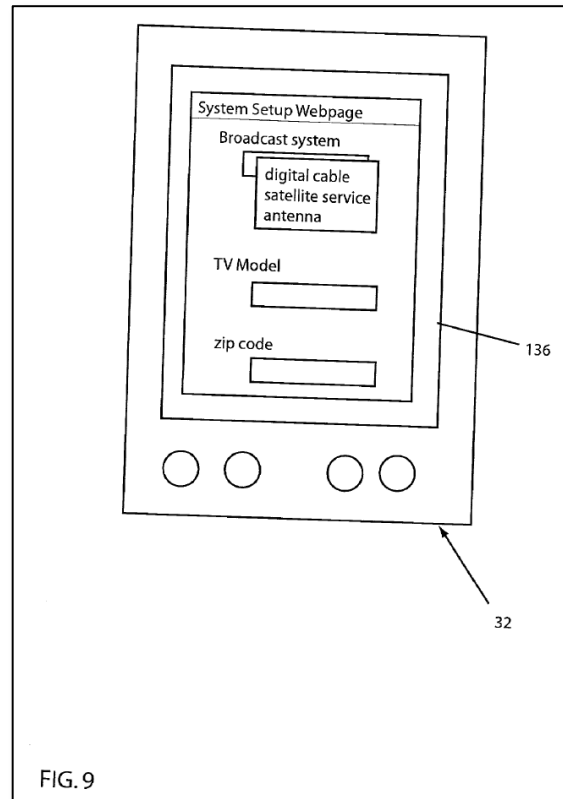
Bergman teaches that one use for UDP/IP was streaming sound files:

On the Internet, streaming media is typically transferred or streamed to the receiving computer by a communications protocol known as UDP (User Datagram Protocol). Since IP (Internet Protocol) is packet-based, the packets are transferred in units known as datagrams. As known by those skilled in the art, UDP is a 'connectionless' protocol which uses IP to transmit datagrams while not making sure that all the packets reach their destination. This makes UDP ideal for use in applications where it is not essential for all of the packets to arrive, such as streaming sound files where the occasional lost packets do not make a noticeable difference to the listener.

Bergman (Ex. 1020), 4:28-5:5.

E. Graphical User Interfaces (GUIs) and Touch Screens

54. Mobile devices with graphical user interfaces, menus, and touch screens were well known before the priority date of the '648 Patent. For example, *Janik* teaches a webpad 32 (e.g., PDA) that includes a GUI to control functions of webpad 32. *Janik*, [0057]-[0059], [0062], [0079]-[0085], [0088], [0090]. *Janik* further teaches a PDA, for example, allowed a user to write on it with a stylus. *Janik*, [0026].



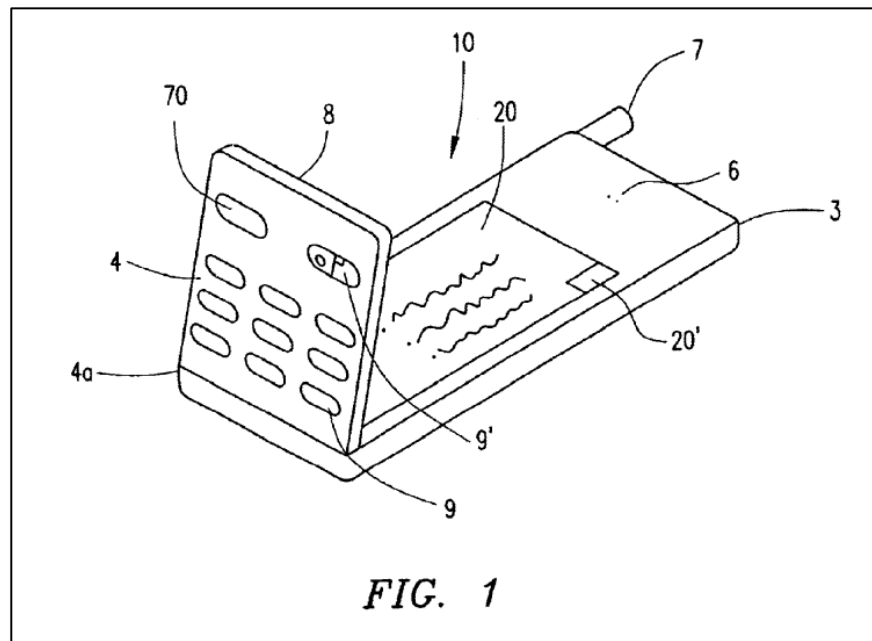
Janik, Fig. 9.

55. In another example, *Lutnaes* teaches a portable phone 10 with a touch screen display 20 for receiving commands from a user:

FIG. 1 shows a perspective view of an embodiment of a portable phone 10 according to the invention. The portable phone 10 is provided with a touch screen display 20 for displaying information such as telephone number(s), signal strength, battery level, roaming information etc, and intended for receiving commands from a user in a conventional way, as well as the inventive power-on function. The portable phone 10 has a main body 3, comprising a loudspeaker 6, an antenna 7, a microphone 8, and a flip 4, attached to the main body 3 by means of a flip hinge 4 a, and movable in relation to the main body 3, which flip 4 can be folded

up against the main body 3. The flip 4 has input means 70, for example a keypad having a plurality of keys 9, where each key 9 corresponds to a desired function. The function of each key 9 can be determined by the software of the portable phone 10. The touch screen display 20 detects which key 9 has been pushed and carries out the desired function.

Lutnaes (Ex. 1018), 3:53-4:6.



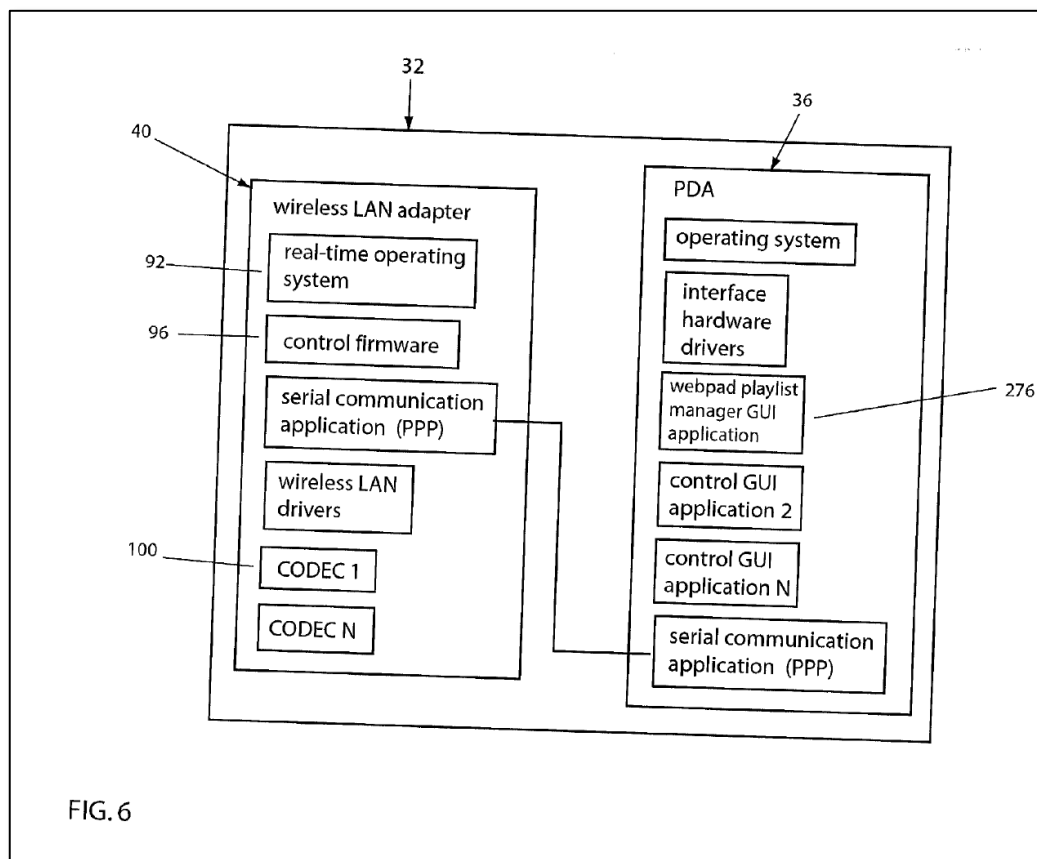
Lutnaes, Fig. 1.

56. In another example, *Boda* teaches a mobile phone with a touch screen. For example, *Boda* teaches a terminal device 52 that is a mobile phone with a touch screen interface 4052. *Boda* (Ex. 1019), [0076] (“In this example the terminal device 52 is a WAP- and SMS-enabled mobile phone. The mobile phone has a touch screen interface 4052 and is wireless connection 5262 e.g. to a GSM (Global System for

Mobile communication) or UMTS (Universal Mobile Telecommunication System) mobile communication network 62.”).

F. Mobile Device Hardware

57. It was well known that mobile phones, PDAs, and other mobile devices included processors, memory, and processing instructions. For example, *Janik* teaches webpad 32 (e.g., PDA) includes a microprocessor 115 and memory such as DRAM memory 116. *Janik*, [0049]-[0051], [0053], [0059], [0063], [0078]-[0079], [0090], [0092] (teaching executing functions using the processor located in the wireless LAN adapter, the processor in the PDA, or both).



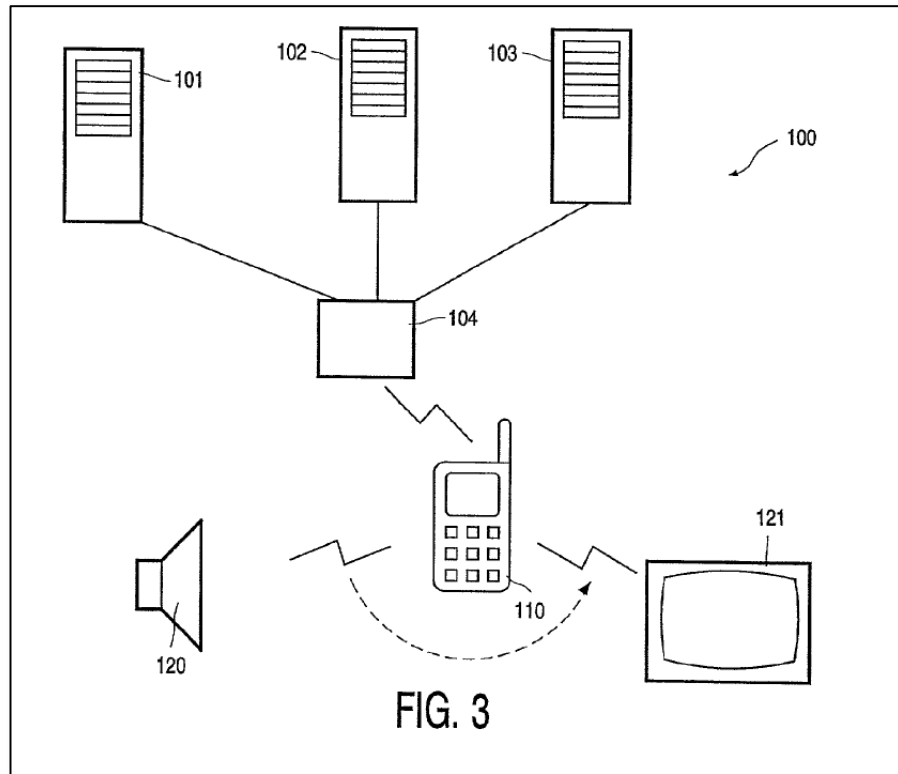
Janik, Fig. 6, *see also* Fig. 5.

58. It was also known to utilize hardware such as transceivers for ultra wide band (UWB) in mobile devices before the priority date of the '648 Patent. For example, *Miller* teaches “the UWB transceiver of FIG. 2 may be used as part of a local area network (LAN) connecting fixed structures or as part of a wireless personal area network (WPAN) connecting mobile devices, for example.” *Miller* (Ex. 1022), 22:4-7. Additionally, *Miller* teaches implementing such a UWB transceiver using a microprocessor system with programming instructions. *Miller*, 22:8-16 (“In any such implementation, all or a portion of the present invention may be conveniently implemented in a microprocessor system using conventional general purpose microprocessors programmed according to the teachings of the present invention[.]”), 25:34-53 (“[T]he network link 1421 may provide a connection through a PAN 1423 to a mobile device 1429 such as a personal data assistant (PDA) laptop computer, or cellular telephone.”).

G. Auxiliary Rendering Devices (aka Helper Servers/Helper Devices)

59. It was also known to utilize the capabilities of “more capable” devices for rendering audio and/or video content before the priority date of the '648 Patent. For example, *Lin* teaches a mobile device 110 that transmits content to an auxiliary rendering device 120/121 because the auxiliary device has “a rendering module 211” with “better rendering capabilities than the rendering module 203 in the mobile

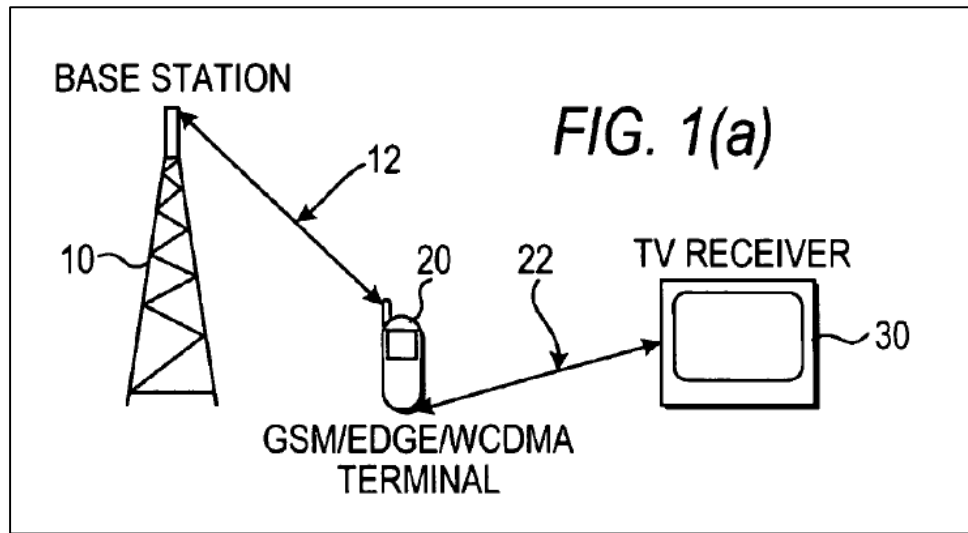
device 110.” *Lin* (Ex. 1013), [0039]. In one example, a loudspeaker is an auxiliary rendering device, which “allows rendering of audio content, such as music or speech. This way, the mobile device 110 does not need to render this audio content on its own loudspeaker, which in the case of a mobile telephone gives a much lower rendering quality compared to a dedicated loudspeaker system.” *Id.* Similarly, *Lin* teaches using an auxiliary rendering device 121 which is a display “that is bigger and has better resolution and color capabilities than the display on the mobile device 110. The mobile device 110 can now let the auxiliary rendering device 121 render visual content, such as images, text or movies, rather than render it itself on its own tiny display.” *Id.* Fig. 3 below depicts mobile device 110 as well as auxiliary rendering devices 120 and 121.



Lin, Fig. 3.

60. In another example, *Palin* teaches a mobile terminal (e.g., mobile phone, laptop computer, PDA) and larger external display device, where it is “particularly advantageous to enable the user to view the content, such as a video clip on a larger display, while the user is actually holding the mobile terminal, and allow the user to select what is viewed using the mobile terminal, or to otherwise use the mobile device while viewing the video clip. This would be best implemented using a wireless link between the mobile terminal and the external display.” *Palin* (Ex. 1014), 1:57-64, 2:16-25, 2:11-15 (“wirelessly linking display devices having different display capabilities to provide better display quality to a user of a mobile

terminal with an economic and efficient short range RF link.”). *Palin* teaches the content transmitted from the mobile device to the display device may be a “stream or plurality of still pictures, or graphics, or a conventional video.” *Palin*, 2:29-32.



Palin, Fig. 1(a).

61. In yet another example, *Mershon* teaches that wireless audio rendering devices (e.g., wireless headphones and speakers) receiving wireless signals from a portable music player were well known common helper devices. *Mershon* (Ex. 1024), 1:10-12, 1:20-28, 1:43-45. Notably, *Mershon* acknowledges that many wireless audio rendering devices were non-Internet enabled and required the use of (1) “a modular telecommunications device for an electronic unit such as a laptop computer” to “allow[] access to network, internet, and other computerized services” or (2) “a hand held communication unit including a modem [and] wireless communication” to “perform[] ... on-line data base services.” *Mershon*, 1:41-52.

H. Codecs

62. It was also known to utilize codecs (encoder/decoder) to perform media transformations such as digital-to-analog conversion and also including audio compression transforming media from high quality to low quality to reduce bandwidth and data rate, for example. One example is *Darby*. *Darby* teaches a mobile device that includes audio and video codecs. *Darby* (Ex. 1028), [0024]. The audio and video codecs “can be selectable rate codecs to permit use of higher data rates when available or when affordable.” *Id.*

63. In another example of codecs, *Lee* teaches an MP3 player that includes a codec which “is composed of an encoder which converts analogue signals into digital signals and a decoder which converts digital signals into analogue signals.” *Lee* (Ex. 1025), 2:57-63, 1:59-61, 3:1-4 (“The decoder in codec 172 converts digital signals into analogue signals, and the consumer hears music through an earphone or a headphone plugged into the audio jack 14.”), 3:28-31 (teaching providing a codec in a cellular phone), 4:1-7.

64. In a further example of using a codec to reduce bandwidth, *Geiger* teaches a codec system may be implemented using a processor, and that the codec can perform compression and decompression. *Geiger* (Ex. 1026), Abstract (“A codec system may be designed for the reduction of data bandwidth and storage requirements and for compressing/decompressing data.”), [0009], [0013]-[0014],

[0071], [0087], [0111] (“The codec system 200 may perform memory compression and decompression ... to improve the effective data bandwidth and efficiency of system memory data transfers.”).

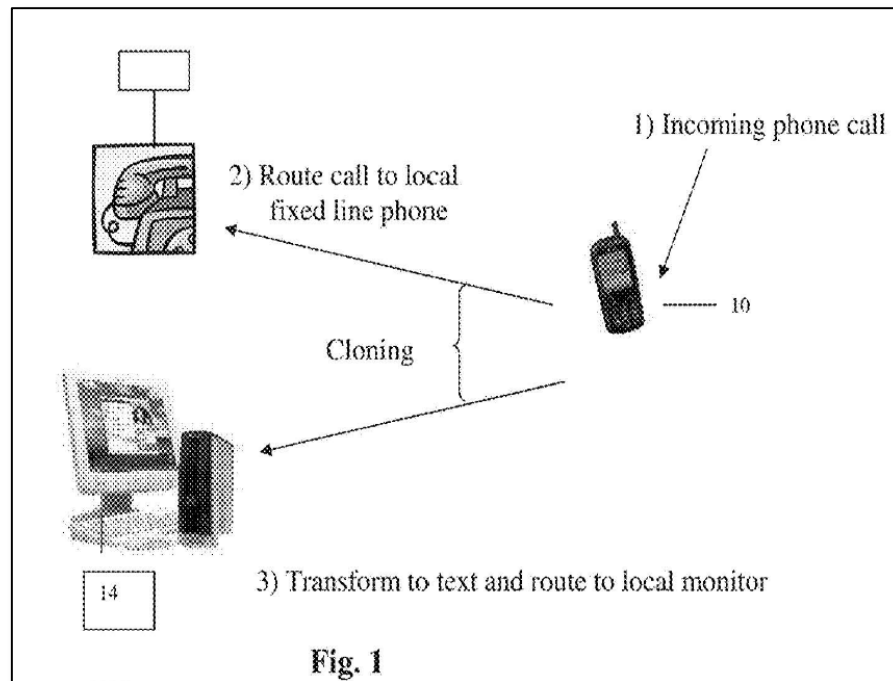
65. In another example, *Jawerth* teaches a color video codec for encoding and decoding video such as 128x117 pixel size and 10 frames per second, achieving 30-50 times compression or even up to 100 times compression or greater for some video sequences. *Jawerth* (Ex. 1027), [0044].

VI. OVERVIEW OF THE '648 PATENT

66. I have reviewed the '648 Patent (Ex. 1001). Description of the '648 Patent that may be pertinent to my analysis are provided below. This discussion does not represent my entire understanding of the '648 Patent.

A. The '648 Patent's Alleged Invention

67. The '648 Patent is directed to indirectly routing media (e.g., audio and/or video) communications originating from an external source from a “limited capability device” (e.g., mobile phone) to a “more capable device” (e.g., standalone display, speakers, etc.). '648 Patent (Ex. 1001), 1:22-26, 4:26-57. Fig. 1 below depicts routing an incoming phone call originally received at a mobile phone to a fixed line phone:



'648 Patent, Fig. 1. Described scenarios include routing audio (e.g., music or voice calls) to a speaker and routing video to a TV or computer monitor. *Id.*, 10:18-49.

B. The '648 Patent's Prosecution

68. I have reviewed the prosecution history of the '648 Patent (Ex. 1002). Pertinent aspects of the prosecution history of the '648 Patent are described below.

69. The '648 Patent claims its earliest priority to a US provisional application (60/398,077) filed July 25, 2002. '648 Patent, (60), 1:8-17. I understand Apple is adopting the earliest possible priority date for the purposes of the IPR, and I have been asked to assume this priority date for my analysis.

70. The Challenged Claims require routing media content (e.g., audio, video, phone call) from a mobile device to an available device connected to the LAN

via an intermediate routing device, where the media content is originated from an external source disconnected from the LAN. '648 *Patent*, Claim 1. The mobile device identifies one or more devices that are compatible to handle the media content and that are connected to the LAN. *Id.* Media content is routed to the one or more available devices via the intermediate routing device. *Id.* During prosecution, the Examiner concluded that the closest prior art references—Hamberg, Mooney, and Mousseau—failed to teach the transfer of media content from a receiving device through an intermediate routing device connected to a local area network to another device. '648 *FH*, 315-316 (Reasons for Allowance). As I opine below, this concept was known in the prior art.

VII. PROPOSED GROUNDS OF UNPATENTABILITY

Proposed Grounds of Unpatentability	
<u>Ground 1</u>	Claims 1, 5-6, 15, 18 are obvious under § 103(a) over <i>Zhang, Fillebrown, and Pasanen</i>
<u>Ground 2</u>	Claims 7, 11, 16, 19 are obvious under § 103(a) over <i>Zhang, Fillebrown, Pasanen, and Skinner</i>
<u>Ground 3</u>	Claims 8, 10 are obvious under § 103(a) over <i>Zhang, Fillebrown, Pasanen, and Rofheart</i>
<u>Ground 4</u>	Claim 13 is obvious under § 103(a) over <i>Zhang, Fillebrown, Pasanen, and Angelo</i>

71. Above, I have reproduced the Proposed Grounds of Unpatentability from the Petition for ease of reference.

VIII. OVERVIEW OF THE PRIOR ART

A. Overview of Zhang

72. *Zhang* teaches a mobile device that can connect with and transfer media content to a network of connected helper servers (“helper environment”) to expand and improve the limited media playback capabilities of the mobile device. *Zhang*, 2:16-19. *Zhang* explains that this helper environment “supports a wide variety of capabilit[ies]... wherein the [mobile] devices remain the focus for both control and data.” *Zhang*, 2:26-30. I note that *Zhang* refers to “handheld” devices and “mobile” devices interchangeably, and a POSITA would have understood that such handheld/mobile devices were portable. *Zhang*, 1:12-18 (teaching examples of “digital handheld devices” including “Personal Digital Assistants (PDAs), cell phones, digital cameras and portable MP3 players”), 3:25-31 (teaching mobile devices include “a PDA 30 and a cellular phone 32”). Thus, a POSITA would have understood that *Zhang* refers to the same types of devices as both mobile devices and handheld devices. Additionally, I note that *Zhang* refers to a more capable media device (e.g., displays, speakers, etc.) as “helper servers,” but *Zhang* also refers to such devices as “helper devices” and “local devices,” and uses all three such terms interchangeably. *Zhang*, 3:25-4:45, 5:58-6:44 (noting that a “helper server” may be a process running within a “helper device”), 7:1-21, 8:13-28. For clarity, and for

consistency with the Petition, I will use “mobile device” and “helper server” throughout.

73. Because *Zhang*, like the '648 Patent, discloses routing media between electronic devices, *Zhang* is in the same field of endeavor as the '648 Patent. Compare *Zhang*, 1:8-10, with '648 Patent, 1:22-26. For example, *Zhang* teaches using a helper environment for “extending the capabilities” of “handheld devices” (i.e., mobile devices) by using “nearby devices” (i.e., helper servers). *Zhang*, 1:8-10, 2:16-30, Figs. 1, 4-5, 6A-6B.

74. Further, both *Zhang* and the '648 Patent attempt to improve upon limitations with transmitting media to mobile devices by re-routing media to devices with better media playback capabilities. Compare *Zhang*, 2:16-19, 3:25-31, 4:35-45, 8:13-22, 10:58-65, Figs. 1, 4-5, 6A-6B, with '648 Patent, 1:22-29, 1:36-51, 5:28-46, 9:51-58. Therefore, *Zhang* is reasonably pertinent to a problem described by the '648 Patent.

B. Overview of Fillebrown

75. *Fillebrown* teaches using a wireless router to indirectly route media between devices on a wireless network (e.g., WLAN). *Fillebrown*, [0049], [0016], [0051], [0053], [0057], Fig. 1. *Fillebrown* teaches using a wireless router is advantageous because wireless routers extend the range of a personal wireless network by amplifying routed signals. *Fillebrown*, [0034], [0061]. Additionally,

Fillebrown teaches a processor to perform programming instructions. *Fillebrown*, [0039]-[0048], [0067]-[0071], [0078]-[0080].

76. Because *Fillebrown*, like the '648 Patent, discloses routing media between electronic devices, *Fillebrown* is in the same field of endeavor as the '648 Patent. Compare *Fillebrown*, Abstract, [0002], [0016]-[0019], [0034], [0076]-[0078], [0081]-[0082], [0085]-[0089], Fig. 1, with '648 Patent, 1:22-26.

77. Further, both *Fillebrown* and the '648 Patent attempt to improve upon the limitation of physically packaging an apparatus for the rerouting of data by realizing the apparatus's functions through software in the form of machine-readable instructions to be read by a processor to wireless communicate information through an intermediate routing device. Compare *Fillebrown*, [0040]-[0048], [0057], [0070]-[0071], Fig. 2, with '648 Patent, 7:1-32, 8:16-34, Fig. 2. Therefore, *Fillebrown* is reasonably pertinent to a problem described in the '648 Patent.

C. Overview of Pasanen

78. *Pasanen* teaches a cellular phone (referred to as a server) that receives a phone call from an external source (e.g., cellular network) and the cellular phone sets up data connections with one or more peripheral devices to transmit phone call audio, for example. *Pasanen*, 4:20-37, 3:49-51, 1:3-25, 9:31-47, 13:1-61, Figs. 1, 3. Additionally, *Pasanen* teaches a processor to perform programming instructions. *Pasanen*, 6:52-61, 7:55-8:10, 12:47-57.

79. Because *Pasanen*, like the '648 Patent, discloses routing media between electronic devices, *Pasanen* is in the same field of endeavor as the '648 Patent. *Compare Pasanen*, Abstract, 1:3-15, 4:20-43, 13:51-61, Fig. 1, *with '648 Patent*, 1:22-26.

80. Further, both *Pasanen* and the '648 Patent recognize the limitations of media display/reproduction within a mobile device and seek to expand the capability of the mobile device through the use of peripheral network of more capable devices. *Compare Pasanen*, 2:27-40, 3:49-55, *with '648 Patent*, 4:26-46. Therefore, *Pasanen* is reasonably pertinent to a problem described in the '648 Patent.

D. Overview of Skinner

81. *Skinner* teaches informing a user of an incoming phone call, for example, by presenting unique sounds, beeps, flashing lights, etc., at a mobile device. *Skinner*, 6:25-65, 3:29-42, 7:15-8:67, Fig. 1. *Skinner* also teaches storing programming instructions in memory for a controller to perform computer executable steps. *Skinner*, Fig. 1, 3:29-52, 5:55-56, 7:15-8:67.

82. Because *Skinner*, like the '648 Patent, discloses routing media between electronic devices, *Skinner* is in the same field of endeavor as the '648 Patent. *Compare Skinner*, Abstract, 1:5-10, 4:10-20, 4:34-42, 5:9-27, 5:63-6:65, 7:30-67, *with '648 Patent*, 1:22-26, Claim 19(f) (text content claimed as media content).

83. Further, both *Skinner* and the '648 Patent address the problem of informing a user of an incoming call. *Compare Skinner*, 6:25-65, 3:29-42, 7:15-8:67, Fig. 1, with '648 Patent, 7:33-52, Claims 7, 16, 19. Moreover, both *Skinner* and the '648 Patent acknowledge that informing functionalities (by alternative means, e.g., flashing light) would benefit those with impaired senses or other disabilities. *Compare Skinner*, 2:21-28, 6:25-65, 9:1-8, Claim 4, with '648 Patent, 5:11-17, 12:12-36. Therefore, *Skinner* is reasonably pertinent to a problem described by the '648 Patent.

E. Overview of Rofheart

84. *Rofheart* teaches a local wireless network, local wireless device, and programming instructions for enabling a user to locate and select one or more of a plurality of compatible remote wireless devices, and to route data streams between the local wireless device and said one or more of a plurality of remote wireless devices. *Rofheart*, 2:4-16, 17:13-22, 14:14-15:22, 17:13-37, Fig. 3. In particular, *Rofheart* teaches a user selects one or more devices with which to connect, and that data including audio and video can be transmitted between such devices. *Rofheart*, 26:18-23, 30:25-30, 22:51-56. *Rofheart* teaches that the user selects one or more remote wireless devices to connect and route media content between using a touch screen interface displaying a plurality of remote wireless devices. *Rofheart*, 18:54-

58, 28:22-57, 30:10-18, Figs. 9-10. *Rofheart* also teaches storing programming instructions in non-volatile memory. *Rofheart*, Fig. 2, 13:29-65, 14:14-35.

85. Because *Rofheart*, like the '648 Patent, discloses routing media between electronic devices, *Rofheart* is in the same field of endeavor as the '648 Patent. *Compare Rofheart*, 2:4-16, 17:13-55, 26:18-23, 28:22-57, 30:25-30, Fig. 9 with '648 Patent, 1:22-26.

86. Both *Rofheart* and the '648 Patent recognize the challenges with routing streaming media between electronic devices and utilizing a user interface to select available wireless devices with which to connect. *Compare Rofheart*, 2:4-16, 17:13-55, 18:54-58, 26:18-23, 27:46-28:57, 30:25-30, Figs. 9-10 with '648 Patent, 1:22-29, 1:35-51, 5:28-46, 9:51-58. Further, both *Rofheart* and the '648 Patent recognize challenges with utilizing a user interface for a user to select available wireless devices with which to connect. *Compare Rofheart*, 18:54-58, 5:37-45, 27:46-28:38, 30:10-52, Figs. 9-10 with '648 Patent, 2:46-49, 3:26-27, 3:34-36, 8:40-44. Therefore, *Rofheart* is reasonably pertinent to a problem described by the '648 Patent.

F. Overview of Angelo

87. *Angelo* teaches using real-time encryption to communicate the secured transmission of audio, video, or a combination of audio and video streams between portable devices. *Angelo*, Abstract, [0009]-[0010], [0022]-0026], Fig. 6.

88. Because *Angelo*, like the '648 Patent, discloses routing media between electronic devices, *Angelo* is in the same field of endeavor as the '648 Patent. *Compare Angelo*, Abstract, [0004], [0009]-[0010], [0016]-[0021], [0029], [0031], *with '648 Patent*, 1:22-26.

89. Both *Angelo* and the '648 Patent recognize the challenges with routing streaming media between electronic devices and encrypting a media data stream. *Compare Angelo*, Abstract, [0004], [0009]-[0010], [0016]-[0021], [0029], [0031] *with '648 Patent*, 1:22-29, 1:35-52, 5:27-46, 9:51-58, 8:21-24, 8:616-63. Therefore, *Angelo* is reasonably pertinent to a problem described by the '648 Patent.

IX. GROUND 1: CLAIMS 1, 5-6, 15, 18 ARE OBVIOUS OVER ZHANG, FILLEBROWN, AND PASANEN

A. Claim 1(Pre) - A method of informing a device about an availability of media content at a mobile device connected to a local area network (LAN), comprising:

90. To the extent the preamble is limiting, as discussed in detail below, *Zhang* in view of *Pasanen* routing an incoming phone call (*media content*) from *Zhang's* "mobile device" in the form of a cellular phone (*mobile device*)² to *Zhang's* "helper server" in the form of a wireless speaker and microphone (*device*) connected via a LAN. Prior to routing the phone call, *Zhang's* cellular phone *informs* the wireless speaker/microphone of the phone call media, ensuring the device is

² Corresponding claim language indicated with italics in parentheses.

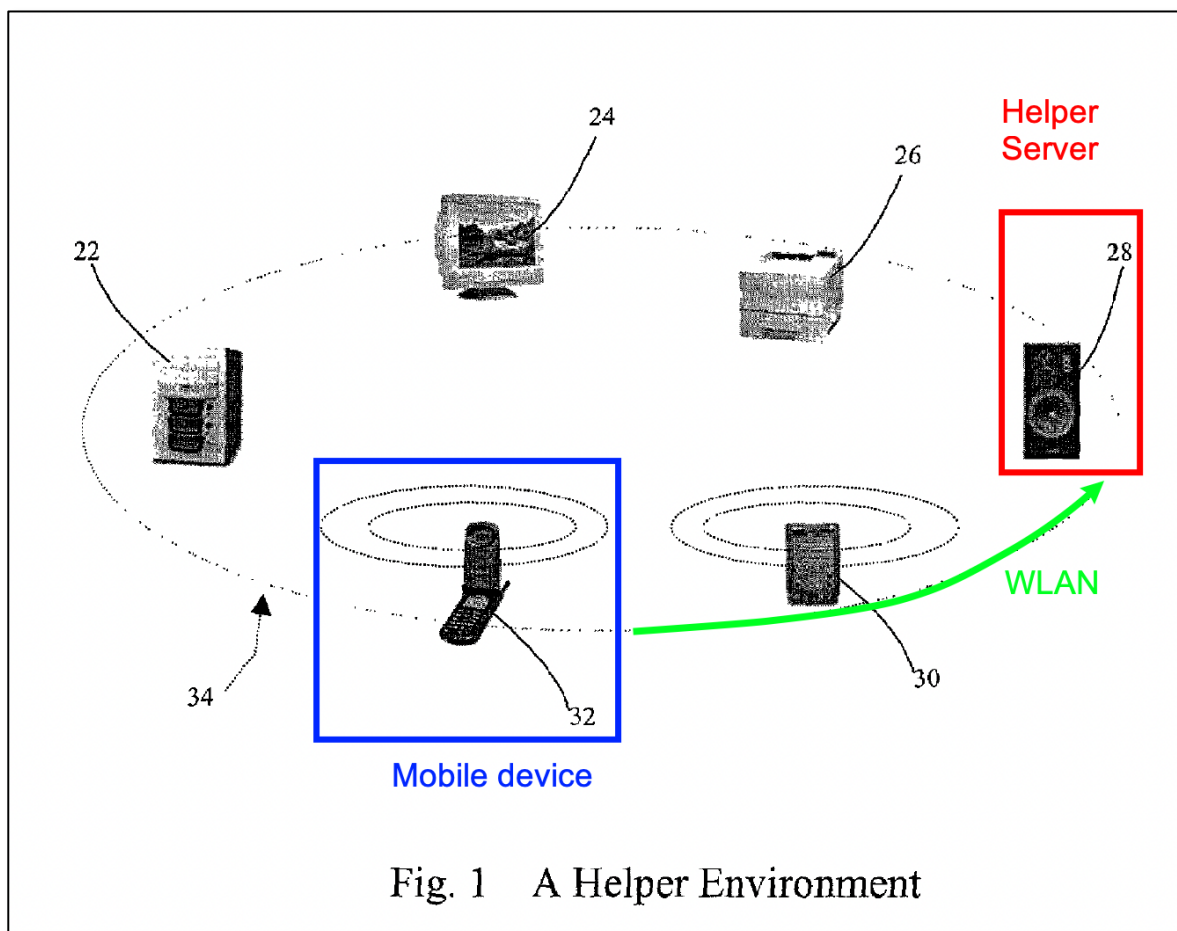
available and compatible to process the phone call audio. As also discussed in detail below, the rerouted audio is wirelessly communicated from the mobile device to the helper server through an intermediate routing device (i.e., a WLAN router) pursuant to *Fillebrown's* teachings. As in the '648 Patent, the *Zhang-Fillebrown-Pasanen* combination improves the user experience, utilizing a wireless speaker/microphone with improved capabilities compared to the limited capabilities of speaker/microphone in the mobile device.

1. Zhang's Mobile Device Discovers Helper Servers and Informs Said Helper Servers About Availability of Media Content

91. *Zhang* teaches a mobile device informs a helper server of an availability of media content at the mobile device, which is connected to a local area network (LAN). *Zhang*, 2:16-19 (noting that *Zhang* “provide[s] a framework in which handheld mobile devices can identify and use their environment, the devices around them, to expand their limited capabilities”), 3:25-43, 4:35-45, Fig. 1. Within “helper environment 34[,]” a mobile device (e.g., cellular phone 32) “can use the devices around them to extend their limited capabilities,” using “helper services” offered by “helper servers[,]” including audio device 28. *Zhang*, 3:25-31, 4:35-38, 8:50-56.

92. *Zhang* teaches that helper servers display/render media content including audio and/or video content, depending on which helper server(s) are utilized. *Zhang*, 3:25-43 (including teaching “audio device 28” is a helper server), 4:1-8 (teaching transferring content to a helper server), 4:32-45. I note that while

Zhang does not expressly use the word “speaker,” a POSITA would have understood that a wireless speaker would have been a common prior art audio device for rendering audio content via a wireless network. For example, see Section V.G (discussing *Lin* and *Mershon*). Additionally, a POSITA would have understood that *Zhang*’s Fig. 1 depicts such a wireless speaker as an example of audio device 28. Fig. 1 is annotated below to highlight an exemplary scenario in which *Zhang*’s cellphone 32 (blue) uses wireless speaker 28 (red) to play audio via wireless network 34 (green, in relevant part):



Zhang, annotated Fig. 1.

93. *Zhang* teaches performing device discovery to locate helper servers and a service query that indicates availability of media content at the mobile device that the mobile device wishes to render/play at the helper server. Namely, *Zhang*'s mobile device "identifies the nearby helper servers" and "determine[s] if they are capable of providing the helper service" that the mobile device requests. *Zhang*, 3:25-64, 4:1-8, 4:32-45, Figs. 4-5. *Zhang*'s service request includes "the MIME type of the user data, the requested service on the data (e.g. displaying, printing or storing), a flag indicating whether the actual data or a URL will follow, the length of the data in bytes, the expected duration of the service, and optionally, authentication information." *Zhang*, 7:1-13. I note that the MIME type for data indicates a type of data such as images, audio, or video. For example, image/jpg, image/gif, audio/mpeg, audio/wav, video/quicktime, and video/x-ms-video (AVI) are examples of MIME types that indicate a type of data (e.g., audio, video, image) and a particular format (e.g., wav, quicktime, jpg). See *Egli* (Ex. 1015), [0101], [0107]-[0108]; *Zintel* (Ex. 1016), 56:6 ("`<mime type='image/jpeg'/>`"), 59:53 ("`<mimetype>image/format</mimetype>`").

94. *Zhang* teaches "actual data" may be transmitted from a mobile device to a "local device" (helper server) (e.g., steps S406, S506), distinguishing this arrangement from an alternative in which the mobile device sends link pointing to

data (e.g., URL [uniform resource locator]), so the helper server can retrieve data directly from the web. *Zhang*, 4:1-8, 4:32-34, 7:1-14 (teaching a service request sent from a mobile device to a helper server that includes the MIME type of the data, requested service on the data, and length of the data in bytes), 7:14 (“Client data can be either actual data or a URL to the data.”), 7:58-60. I note that a POSITA would have been familiar with MIME type—also referred to as media type—as a data field that indicates the type of media to be routed/communicated. Furthermore, a POSITA would have understood such because the MIME type would have indicated the media type such as audio, video, images, etc., and would also have indicated a particular codec or data type (jpg, MP3, etc.). Accordingly, as I discuss in further detail below, a POSITA would have understood that *Zhang*’s service query informs a helper server about availability of media content at the mobile device. *See* Claim 1(d)-1(f) (in-depth discussion below including media content examples); *Zhang*, 3:49-51.

95. Thus, a POSITA would have understood that such locating and querying teaches or at least renders obvious informing a device about an availability of media content (e.g., audio, video, text content, phone calls) at a mobile device. *See also* Claim 1(b) (discussing informing helper server of specific media content available at the mobile device), 1(d)-1(f) (in-depth discussion below including media content examples); *Zhang*, 3:49-51.

2. *Zhang's Network Environment – Wireless Local Area Network (WLAN)*

96. *Zhang* teaches helper environment 34 may utilize Bluetooth™ or another “framework” such as wireless local area network (WLAN) using IEEE 802.11 or HomeRF. *Zhang*, 4:42-58. A POSITA would have been motivated to utilize WLAN to connect multiple devices in a streaming media arrangement. *See* Claim 1(c). Indeed, a POSITA would have understood that a WLAN using IEEE 802.11 or HomeRF would have been a suitable choice for *Zhang's* framework given *Zhang's* express disclosure and because IEEE 802.11 and HomeRF were well-known, well understood, and widely utilized wireless communication network frameworks. A POSITA would have understood that IEEE 802.11 was “[t]he most successful wireless networking technology th[u]s far.” *Gast*, 1. Moreover, I note that pricing considerations would have also help motivate the use of IEEE 802.11 as prices were made affordable after pricing erosion facilitated by Apple since 1999. *Gast*, 6.

97. Implementing *Zhang's* framework as a WLAN (utilizing IEEE 802.11 or HomeRF) to wirelessly connect a plurality of devices in a local communication network and would have allowed *Zhang's* system to take advantage of the well-known benefits of IEEE 802.11 or HomeRF standards. Notably, a POSITA would have understood that at a WLAN using IEEE 802.11 or HomeRF as opposed to Bluetooth would have provided several advantages, including use of OFDM

[orthogonal frequency-division multiplexing] for greater bandwidth resulting in higher data transfer rates, efficient use of channel, lower bit-error rate, and increased network range, while simultaneously having a greater ability to handle a plurality of devices without performance degradation. For example, *Narasimhan* teaches such. *Narasimhan* teaches the “wireless local area network or WLAN is expanding rapidly into a wide variety of implementations and applications. This rapid growth is attributable to several factors, including improved accuracy (lower BER [bit error rate]), increased bandwidth, and falling costs.” *Narasimhan* (Ex. 1031), 1:23-38, *see also id.* 1:39-2:38 (including teaching 802.11a and 802.11g utilized OFDM).

B. Claim 1(a) - using the mobile device for:

98. *Zhang* teaches mobile devices, including PDA 30, cellular phone 32, digital camera, and MP3 player. *Zhang*, 1:8-15, 3:25-43, 4:35-45, 8:50-56; *see also* Claim 1(Pre).

C. Claim 1(b) - identifying one or more available devices compatible to handle the media content and connected to the LAN;

99. As discussed above, *Zhang* teaches helper servers (e.g., audio device 28) (*one or more available devices*) are connected to the framework (e.g., WLAN using IEEE 802.11 or HomeRF). *See* Claim 1(Pre); *Zhang*, 3:25-43, 4:35-50. As further discussed above, *Zhang* teaches a mobile device discovers helper servers and informs said helper servers about availability of media content at the mobile device. *See* Claim 1(Pre).

100. To utilize the “helper services,” provided by *Zhang*’s “helper servers.”

Zhang teaches a mobile device that scans the framework to locate a nearby helper server that “is capable of displaying the content.” *Zhang*, 3:32-43. *Zhang*’s mobile device performs the following key steps:

- (1) ***Device discovery***: The handheld device identifies the nearby helper servers.
- (2) ***Service query***: The handheld device queries the identified helper servers to determine if they are capable of providing the helper service.
- (3) ***Request transfer***: The handheld device selects a helper server and delegates the task to it.
- (4) ***Remote control***: The helper server returns a remote control interface description to the handheld device.

Zhang, 3:44-56, 6:40-44. The first two steps—“device discovery” and “service query”—identify devices *compatible* (i.e., capable) of handling the media content.

Zhang, 3:25-64, 4:1-5, 4:35-45. A POSITA would have been motivated to use the WLAN framework for this helper server communication, rather than Bluetooth for the same reasons discussed above in Claim 1(Pre). I note that a POSITA, using a WLAN framework for device communication would have also used WLAN to discover helper services and establish data connections. A POSITA would have understood that using device discovery would have ensured a consistent and unified protocol, simplifying the system structure so that all operations were be handled on a single network.

101. Thus, *Zhang* teaches a mobile device “determine[s] whether there is a helper device in its environment that can fulfill the requested task.” *Zhang*, 6:35-40, 6:40-44. As I opined above in 1(Pre), a POSITA would have understood that such locating and querying teaches or at least renders obvious identifying a helper server compatible to handle media content.

102. In *Zhang*’s third step, “request transfer,” a helper server responds to the service query, indicating its availability to handle the requested service. Specifically, in response to the service query, the helper “server makes the admission decision S648 and informs the client whether its service request can be granted right away, has to be queued[,], or is denied (e.g. not enough total resource on the server or authentication failure) S646.” *Zhang*, 7:22-25, 7:58-60 (“Once a service request is accepted by a helper server S650, the client is notified S610 and can start transferring service data to the server S612.”). In sum, *Zhang*’s mobile device performs this process to identify helper servers (*devices*) that are both *available* and *compatible to handle the media content*. A POSITA would have understood that, when *Zhang*’s system is implemented via WLAN, such informing is done via the network connection over the WLAN, each of the described control messages (i.e., device discovery, service query, and request transfer) is done via the network connection over the WLAN. This is because the devices are connected in a wireless network “framework” such as a WLAN, and the devices utilize this framework to

communicate with each other. Thus, when implementing *Zhang* using WLAN, the communication between the mobile device and helper server(s) would be via the WLAN as well.

D. Claim 1(c) - wirelessly communicating information to an intermediate routing device connected to the LAN for indirectly routing messages or media content to at least one of the one or more available devices via said intermediate routing device; and

1. Zhang Teaches Wirelessly Routing Messages or Media Content to Available Helper Servers

103. As discussed above, *Zhang* teaches routing media content and commands to helper server via a wireless network such as a WLAN. *See* Claim 1(Pre)-1(b).

104. *Zhang* teaches a (1) helper server accepting a service request, (2) a session initiating between the helper server and mobile device, and (3) the client (e.g., mobile device) “can start transferring service data to the server[.]” *Zhang*, 7:22-25, 7:58-64, 3:55-60, 4:1-34, 9:54-60 (“During the session, both data and control information are exchanged. Because of the simple helper model, each session naturally corresponds to the TCP connection between the client and the server.”). A POSITA would have understood that a TCP connection requires “addressing” data packets to enable data or media to be communicated to devices on a network. Notably, in a TCP/IP network like that discussed in ’648 Patent, each device has a unique IP address, which would be utilized by the mobile device to “wirelessly

communicat[e] information” to the connected helper servers of the network via an intermediate routing device (e.g., wireless router). *See* Section V.D. (discussing how the TCP/IP Protocol uses IP headers to to determine a data packet’s final destination). A POSITA would have understood the use of a destination IP address in a TCP/IP network and would have known that data packets delivered in a TCP/IP network provided the information necessary to route messages and media content through an intermediate routing device. Moreover, *Zhang* teaches data transmitted from a mobile device to a helper server via the session includes media. *Zhang*, 10:58-65, 8:13-18. For example, a POSITA would have understood that the seamless mobility embodiment discussed in *Zhang* allows a user to seamlessly stream a video moving from one helper server to another during the display of the video media.

105. Further, *Zhang* teaches transmitting data, media, and commands from the mobile device to helper servers, and the helper servers present the media content and follow the commands. In one embodiment, PDA 30 “establishes a connection with the helper server 24 and transfers the content to the helper server 24 for display.” *Zhang*, 3:25-60, 4:1-8, 4:32-34, 7:1-13, 8:13-22 (teaching a user remotely controlling the display of streaming data by issuing “stop[,]” resume[,]” and “fast forward” commands to the helper server presenting the media content). *Zhang* also teaches that media played on a helper server can be in the form of “actual data or a URL to the data.” *Zhang*, 7:14. Although *Zhang* teaches that it may be more efficient

for the helper server to retrieve streaming content from the web by processing a URL, non-Internet enabled³ helper servers are not capable of processing URLs and must instead receive streaming data from a device on the local wireless network. *Zhang*, 7:14-21; *see also* Section V.G (discussing that many wireless devices of the time, such as wireless headphones and speakers, were non-Internet enabled). Furthermore, a POSITA would have understood that *Mershon* teaches wireless speakers and headphones had to remain in range of a local wireless audio source because said speakers and headphones could not directly stream audio data from the Web. Accordingly, a POSITA would have understood there would have been a tradeoff involved in not using a URL because while using a URL may be more efficient, doing so excludes non-Internet enabled devices, which cannot retrieve content via a URL on their own. Thus, a POSITA would have been motivated to rely on *Zhang*'s teaching of transmitting "actual data" from the mobile device to the helper server to advantageously utilize non-Internet enabled devices, such as wireless speakers and microphones, as helper servers. Therefore, streaming data

³ "Non-Internet enabled device" is understood to mean a device lacking the hardware and/or software necessary to directly retrieve content from Internet-based services (e.g., Web servers), but can still utilize a wireless local area network to share resources and communicate with other devices.

from the mobile device to a helper server provides a greater choice of helper servers, improving the capabilities of *Zhang*'s system. Although *Zhang* does not expressly describe an arrangement in which media is first streamed to the mobile device and is then re-routed to a helper server, this arrangement was known in the art. As set forth in detail below with reference to Claim 1(e), a POSITA would have been motivated to modify *Zhang* pursuant to *Pasanen* to receive a telephone call on the mobile device (from the telephone network) and to reroute the audio to a helper server (e.g., a wireless speaker/microphone).

106. Regarding claimed intermediate routing device, although *Zhang* does not expressly describe using an intermediate routing device (e.g., a wireless WLAN router) for indirectly routing messages or media content, such an arrangement was well known in the art. Indeed, a POSITA would have understood that routing data through an intermediate router was the typical topology used for WLAN, including IEEE 802.11 and HomeRF. For example, *Fillebrown* teaches a wireless network ("IEEE 802.11, Home RF, or other wireless protocols") where data is transmitted to devices on a network via an intermediate wireless router. As opined above, *Fillebrown* teaches, and a POSITA would have understood, at least one advantage of using an intermediate router in a WLAN was range extension of the network by amplifying routed signals. As set forth in detail below, a POSITA would have been motivated to implement *Zhang* pursuant to *Fillebrown*'s use of a wireless router to

indirectly route messages or media content to one or more available devices. *See* Section IX.D.3.

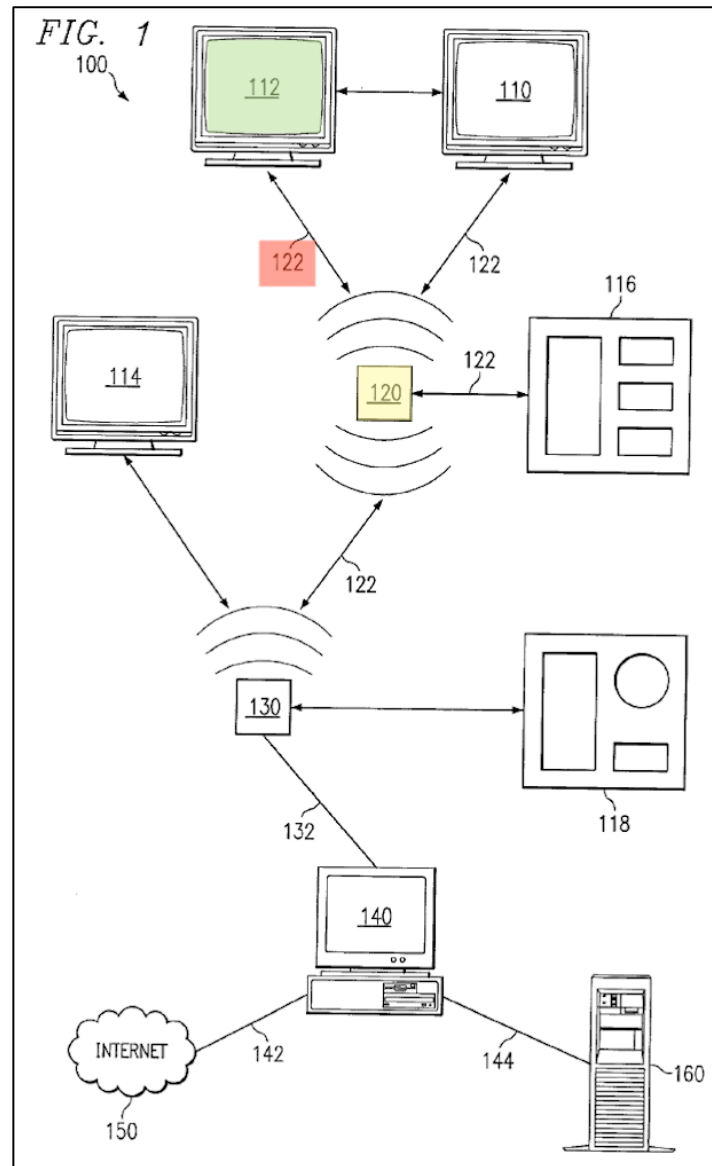
2. Fillebrown's Teachings – Wireless Router for Indirectly Routing Media

107. *Fillebrown* teaches wireless network 100 includes “a plurality of wireless clients, such as wireless tablets and wireless smart appliances” that “communicate via a wireless routing means, such as a wireless router 120, with a wireless server 140[.]” *Fillebrown*, [0049]. *Fillebrown* teaches wireless network 100 uses a wireless communication standard such as “IEEE 802.11, Home RF, or other wireless protocols.” *Id.* *Fillebrown* teaches a mobile device such as a wireless tablet that incorporates wireless technology, including 802.11, to “send and receive audio and video from another system component.” *Fillebrown*, [0016], [0057] (teaching “a wireless client” is “any device capable of wirelessly communicating within a personal wireless network and is also capable of user interaction with other devices within the personal wireless network.”), [0051] (teaching packetizing data such as audio and video to transmit over the wireless network).

108. The wireless router beneficially “extend[s] the range of the personal wireless network through the amplification and re-transmission of received data packets.” *Fillebrown*, [0034], [0061]. As depicted in Fig. 1 below, wireless clients (e.g., wireless tablet 112 (annotated green)) are adapted to wirelessly communicate (122, annotated red) with wireless server 140 and/or another wireless tablet 114 by

routing “data, packets, or information” via wireless router 120 (annotated yellow).

See *Fillebrown*, [0061].



Fillebrown, Fig. 1 (annotated), [0049], [0053].

3. Motivation to Combine Zhang and Fillebrown

109. A POSITA would have been motivated to modify *Zhang* to route data via an intermediate wireless router pursuant to *Fillebrown*. Implementing a wireless

router, as proposed, would provide a significant range advantage over a system lacking an intermediate router. This benefit is realized by amplifying received data packets. *See Fillebrown*, Abstract, [0080]-[0082], and [0061]. The proposed combination is a straightforward application of a known technique (i.e., the ubiquitous WLAN router) to realize this benefit. In fact, a POSITA would have understood that utilizing such intermediate routing devices in WLANs contemplated by *Zhang* (i.e., 802.11 and HomeRF) was the most typical deployment of such networks. *See* ¶104, above. In this respect, *Fillebrown* is merely providing implementation details that *Zhang* expressly suggests via its recommendation of specific WLAN networks that typically include intermediate routing devices such as those described by *Fillebrown*.

110. Given *Zhang*'s teachings of seamlessly moving "video streams" between a mobile device and multiple helper server devices to maintain "display continuity" throughout a building, a POSITA would have been further motivated to modify *Zhang* in view of *Fillebrown* such that the amplified signal of the wireless router taught in *Fillebrown* would improve the signal strength of communications from mobile device taught by *Zhang* to ensure strong, stable signal while a user moves about a building or other area (e.g., house). *Zhang*, 10:58-65. A POSITA would have understood and recognized that both *Zhang* and *Fillebrown* are directed at WLAN systems for communicating and routing data and media. Indeed, a

POSITA would have also understood that the two references being directed at improving the same field of technology would have provided a POSITA significant motivation to explore how one would be improved by the other. *Compare Zhang*, 10:58-65 *with Fillebrown*, [0004]-[0006], [00012], [00063] (“In one embodiment, the wireless server 140 may form part of a Local Area Network (LAN).”).

111. A POSITA also would have had a reasonable expectation of success when making such a modification. First, *Zhang* already teaches a wireless network, such as WLAN (using IEEE 802.11 or Home RF), and *Fillebrown* teaches precisely the same network setup (WLAN using a wireless protocol/standard such as IEEE 802.11 or Home RF). *Zhang*, 4:46-58; *Fillebrown*, [0016], [0049], [0063]-[0064], [0087], [0095]. A POSITA would have understood that both references teach a WLAN implemented on, at least, either IEEE802.11 or Home RF. Accordingly, both references teach the same network setup. Thus, modifying *Zhang* to utilize a wireless router would have been a straightforward modification not requiring undue experimentation.

E. Claim 1(d) - wirelessly signaling the one or more available devices indicating an availability of a media content at the mobile device;

112. As discussed above, *Zhang* teaches routing a media content such as audio from a mobile device to an available helper server. *See* Claim 1(b)-1(c).

113. In general, *Zhang* teaches several “essential steps” the mobile device takes to interact with helper servers. First, the mobile device performs device

discovery and “identifies the nearby helper servers.” *Zhang*, 3:44-48. Second, *Zhang* performs a “service query,” where the mobile device “queries the identified helper servers to determine if they are capable of providing the helper service.” *Zhang*, 3:49-51. *Zhang* teaches that if a located helper server “does offer the needed helper service, the handheld device requests the helper service S404.” *Zhang*, 4:1-8.

114. Regarding wirelessly signaling a helper server indicating an availability of a media content at the mobile device, *Zhang* teaches transmitting a service request to a helper server, and when a server accepts, a session is set up between a “helper client” (mobile device) and helper server using TCP. A POSITA would have understood that wirelessly signaling a service request would have indicated the availability of media content at the mobile device. In particular, *Zhang* teaches “the helper client can [] connect to the helper server through TCP and send its service request. The request may contain the following information for the server admission control: the MIME type of the user data, the requested service on the data (e.g., displaying, printing or storing), a flag indicating whether the actual data or a URL will follow, the length of the data in bytes, the expected duration of the service, and optionally, authentication information.” *Zhang*, 7:3-13. As I discussed above with reference to 1(Pre), a POSITA would have been familiar with MIME type—also referred to as media type—as a data field that indicates the type of media to be routed/communicated. Accordingly, a POSITA would have understood that *Zhang*’s

service query informs a helper server about availability of media content at the mobile device.

115. *Zhang* teaches that “[d]uring the session, both data and control information are exchanged. Because of the simple helper model, each session naturally corresponds to the TCP connection between the client and the server.” *Zhang*, 9:57-60. Additionally, *Zhang* teaches TCP provides a “sequential and reliable transport channel between the client and the server” and that this is “particularly important for command transfer” for the helper server to receive commands reliably and in the proper order. *Zhang*, 9:61-65. A POSITA would have understood that such a connection via TCP would have utilized *Zhang*’s WLAN for setting up the session between the mobile device and helper server. Indeed, a POSITA would have understood that efficiencies are realized by using the selected networking technology (e.g., 802.11 or HomeRF) for all wireless communications related to a given session, including the initial steps of finding helper servers and subsequent steps of actually transferring data/media between devices.

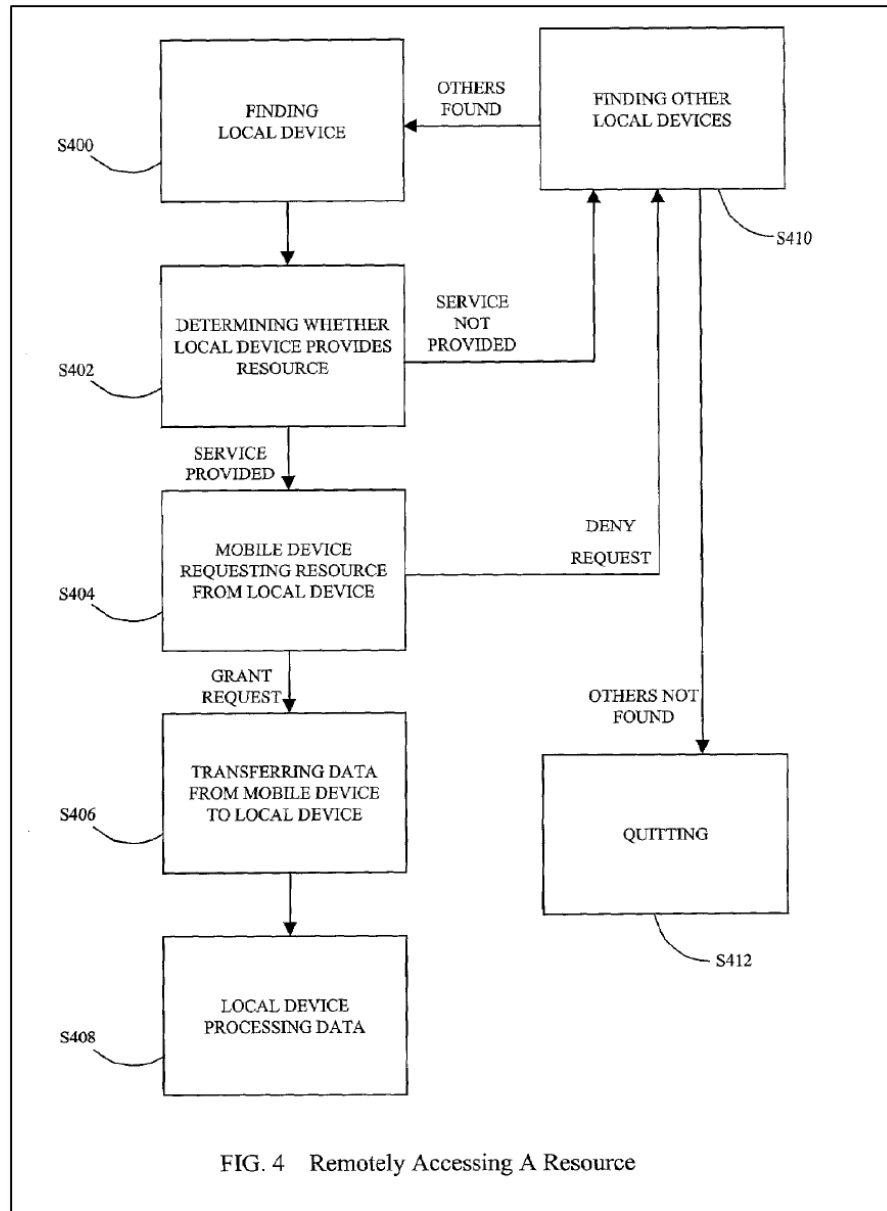
116. *Zhang* teaches embodiments where such sessions are between a single mobile device and helper server at a time or a single mobile device and multiple helper servers at a time. For example, in the embodiments where the mobile device moves across different locations (“nomadic” and “seamless” mobility), *Zhang* teaches sessions that are independent between different helper servers at different

locations (i.e., nomadic embodiment). *Zhang* specifically teaches in the nomadic embodiment, there is no continuity between the first service session (e.g., between mobile device and a first helper server) and the second service session (e.g., between mobile device and a second helper server). That is, a “user moves and decides to change server,” such that the current session with a helper server is terminated before a new session is started with another helper server at the new location. *Zhang*, 10:48-57. However, in the “seamless” embodiment, “state information is retained when the user moves causing a change in servers[,]” such that “video streams may move from one helper to another with display continuity.” *Zhang*, 10:58-65. Thus, multiple sessions may be active between a single mobile device and a plurality of helper servers. Indeed, a POSITA would have understood that the seamless mobility embodiment of *Zhang* would require at least two active sessions to facilitate the seamless transfer between one or more helper servers. In either case, the connection between the mobile device and helper server is via a session (i.e., wireless communication link).

117. Further, *Zhang* teaches that during a session, a mobile device transmits data and control commands to a helper server. *Zhang*, 3:32-43 (“[T]he PDA 30 becomes a remote control device to control the display of the content on the helper server 24.”), 3:55-60 (“The handheld device builds a Graphical User Interface (GUI) from the interface description and remotely controls the task on the helper server

according to user interaction with the handheld device.”), 6:14-20, 6:27-34, 8:50-61 (“[I]f the client device is a PDA, a simple graphical interface with control buttons such as ‘play’, ‘pause’ and ‘fast forward’.”), 9:54-60, 2:31-45, Figs. 6A-6B, 7.

118. Specifically, accepting a service request prepares a helper server for receiving content and commands from a mobile device by initiating a session between said handheld device and said helper server. For example, *Zhang* teaches a “local device” (e.g., helper server) granting a service request results in “transferring data from mobile device to local device” at step S406. *Zhang*, 4:5-8, 4:32-34 (teaching the same, but for the embodiment of Fig. 5).



Zhang, Fig. 4, see also Fig. 5.

119. A POSITA would have understood that *Zhang* would have used a wireless router per *Fillebrown's* teachings when performing such wireless signaling indicating availability of media content. See Claim 1(c).

F. Claim 1(e) - wherein the media content is originated from an external source disconnected from the LAN;

1. '648 Patent's Media Content

120. According to the '648 Patent, a phone call is one example of media content that originates from an external source disconnected from the WLAN. *See* Claims 5-6. As set forth below, a POSITA would have been motivated to modify *Zhang* pursuant to *Pasanen* such that *Zhang's* mobile device (e.g., a cellular phone) receives a phone call and allows the user to participate in the call via a wireless speaker/microphone.

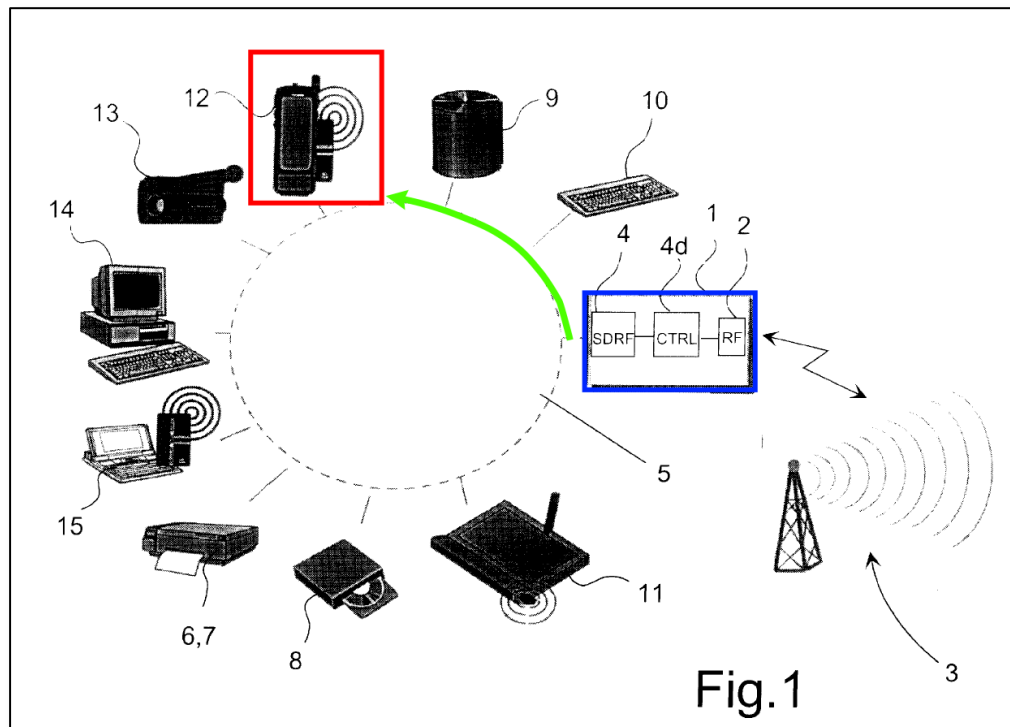
2. Zhang Teaches a Cellular Phone

121. While *Zhang* teaches that its mobile device may be a cellular phone (*Zhang*, 3:25-29), *Zhang* does not expressly describe receiving a phone call with that cellular phone. A POSITA would, however, have understood that receiving phone calls is one function *Zhang's* cellular phone is capable of. Indeed, a cellular transceiver for completing calls via a cellular phone network is one key feature that distinguishes “cellular phones” from other mobile devices. A POSITA would have understood that receiving calls and the associated audio data from a cellular phone network would be media content originating from an external source not connected to the LAN. As set forth below in detail, a POSITA would have been motivated to modify *Zhang's* mobile device (e.g., cellular phone 32) to receive media content

originating from an external source (e.g., cellular communication network). *See* Section IX.F.4.

3. Pasanen Teaches a Mobile Phone That Receives Phone Calls from Mobile Network (External Source) and Routes the Call Audio to a Wireless Audio Interface (Speaker/Microphone)

122. *Pasanen* teaches server device 1 such as a mobile station that comprises means 2 for “setting up a data transmission connection with a mobile communication network 3, and means 4 for setting up a local area network 5 between the server device 1 and the peripheral devices.” *Pasanen*, 4:20-26. Local area network 5 is wireless. *Pasanen*, 3:49-51, 1:3-25, 9:31-47. *Pasanen* teaches that its peripheral devices may include a “wireless audio interface 12 equipped with e.g. a microphone and an earpiece to be used instead of the microphone 1a and earpiece 1b of the mobile station 1 for example during a call.” *Pasanen*, 4:31-34, Fig. 2a (depicting microphone 1a and earpiece 1b of mobile station 1). Fig. 1 below depicts wireless local area network 5, server device 1 (blue), and a peripheral device including wireless audio interface 12 (red) used for the phone call audio:



Pasanen, Fig. 1 (annotated).

4. Motivation to Combine Zhang-Fillebrown-Pasanen

123. A POSITA would have been motivated to modify *Zhang-Fillebrown* per *Pasanen*'s teachings to receive a phone call (media content) on *Zhang*'s cellular phone from a source disconnected from the WLAN (cellular/mobile phone network) and to permit the user to participate in the call through an audio helper server (e.g., wireless speaker/microphone) connected via *Zhang*'s WLAN. The proposed modification is an intuitive extension of *Zhang*'s express teachings that aligns with *Zhang*'s hardware and furthers *Zhang*'s express goal. Indeed, the primary focus of *Zhang*'s disclosure is a mobile device that can connect with and transfer media content to a network of connected helper servers ("helper environment") to expand

and improve the limited media playback capabilities of the mobile device. *Zhang*, 2:16-19. Specifically, a POSITA would have understood that the object of *Zhang*'s invention was "to expand the[] limited capabilities" of "handheld mobile devices." *Id.* *Zhang* expressly teaches that its mobile device can be a cellular phone and that its helper servers include audio devices. *Zhang*, 3:25-29, Fig. 1. *Pasanen* similarly teaches a mobile device receiving externally sourced media content (e.g., phone call) that connects to audio interface 12 (e.g., speaker/microphone) via a WLAN, allowing the user to participate in the call via interface 12's "microphone and [] earpiece . . . instead of the microphone 1a and earpiece 1b of the mobile [device.]" *Pasanen*, 4:20-37, 13:1-61, 5:62-6:22, Figs. 1, 3. Accordingly, a POSITA would have understood that both *Zhang* and *Pasanen* were aimed at improving systems including audio devices, such as speakers, and microphones. Like *Zhang*, *Pasanen* teaches that its peripheral network seeks to overcome limitations of its mobile devices. *Pasanen*, 2:27-40 (describing the limitations of portable devices). A POSITA would have recognized that the audio benefits of *Pasanen*'s audio interface 12 for phone calls would have benefitted *Zhang*'s system in the same way it benefits *Pasanen*'s, allowing a user to participate in a call via more capable speaker and microphone, rather than the mobile device's more limited input and output. In this way, a POSITA would have understood that integrating the teachings of *Pasanen* would have furthered the main goal of *Zhang*'s helper network, as described above.

124. Such a modification would have had a reasonable expectation of success at least because *Zhang's* cellular telephone already includes hardware and programming instructions to make and receive phone calls and also to communicate with helper servers via *Zhang's* WLAN framework. Further, *Pasanen*, like *Zhang*, teaches a plurality of peripheral devices connected to a network, such as a WLAN (*Fillebrown* also teaches a WLAN). For example, *Pasanen* features a wide array of wireless audio interface with microphone and earpiece, video camera, portable computer, printer, telecopier device, CD-ROM reading device, etc. all connected to the wireless local area network provide by server device 1. *Pasanen*, 4:20-62, Fig. 1, Fig. 2a. Thus, modifying *Zhang-Fillebrown* per *Pasanen's* teachings would have utilized *Zhang-Fillebrown's* existing hardware. I note that a POSITA would have been able to utilize and implement *Pasanen's* teachings in a WLAN with hardware already used by the *Zhang-Fillebrown* combination. Additionally, infrastructure for making and receiving cellular phone calls was in place well before the '648 Patent's priority date, so modifying *Zhang-Fillebrown* per *Pasanen's* teachings would not have required undue experimentation. Indeed, receiving cellular phone calls was commonplace and well understood before the '648 Patent's priority date.

G. Claim 1(f) - wherein the media content selected from a group consisting of: audio content and video content.

125. As discussed above, *Zhang-Fillebrown-Pasanen* teaches a mobile device receives audio content (e.g., phone call) that originates from an external

source disconnected from the WLAN and communicates the audio between the mobile device and audio helper server (e.g., wireless speaker/microphone). *See* Claims 1(e), 5-6 (“wherein the media content is a phone call”).

H. Claim 5 - The method of claim 1, wherein the media content is a phone call; further comprising routing the phone call to the one or more available devices in response to a receipt of a response to the signaling received from the one or more device.

126. *Zhang-Fillebrown-Pasanen* teaches media content such as a phone call and routing the phone call to one or more available devices, such as *Pasanen*’s wireless audio interface 12. *See* Claim 1. A POSITA would have understood that a phone call would have been routed to an available device after receipt of a response to the signaling received from the one or more available devices (e.g., wireless audio interface 12) in accordance with the mapping above. *See* Claim 1. A POSITA would have understood that *Zhang*’s signaling is provided through several “essential steps” that the mobile device takes to interact with helper servers, where in one step *Zhang* performs a “service query,” where the mobile device “queries the identified helper servers to determine if they are capable of providing the helper service.” *Zhang*, 3:49-51. As discussed above, *Pasanen* expressly discloses the situation where the media content is a phone call. Accordingly, Claim 1 above describes the limitations of this claim, at least through the routing of a phone call through the audio interface featuring a microphone an earpiece disclosed in *Zhang-Fillebrown-Pasanen*

combination. Indeed, *Zhang* teaches signaling between a mobile device and helper server. *See* Claim 1.

I. Claim 6 - The method of claim 1, wherein the media content is a phone call; further comprising routing the phone call to the one or more available devices while the phone call is ongoing using the mobile device.

127. *Zhang-Fillebrown-Pasanen* allows a user to route the audio of a phone call to a wireless audio helper server, such as *Pasanen's* wireless audio interface 12. *See* Claim 1. A POSITA would have been motivated to provide the user an option to invoke the helper server when the phone call is ongoing, providing the user control of whether and when to use the wireless speaker/microphone, rather than the mobile device's native input/output. A POSITA would have understood that routing a phone call to helper server during the phone call would provide greater expanded abilities allowing the user to start the call using the mobile device's input/output and to invoke the wireless helper server only if its improved audio capabilities are necessary (or beneficial) on a call-by-call basis. Implementing the proposed combination such that a phone call is ongoing when the user routes audio to a helper server is also necessary to support *Zhang's* "seamless" mobility embodiment, where "continuity" is maintained across multiple devices while media is streamed. *See* Claim 1. A POSITA would have understood that *Zhang's* disclosure of seamless mobility embodiment would apply to different media types including a phone call. *Zhang* states that "seamless mobility will be particularly useful, for example, in a

streaming situation in which video streams may move from one helper another with display continuity.” *Zhang*, 10:63-65. Such “for example” and “particularly useful” language indicate that the embodiment is inclusive rather than exclusive to video content. Accordingly, a POSITA would have understood that *Zhang-Fillebrown-Pasanen*’s seamless mobility would have applied equally to other media streaming applications, including a phone call.

J. Claim 15(Pre) - A mobile apparatus for informing a device about an availability of media content, comprising:

128. The mappings for Claim 15 below focus on apparatus elements that perform the same/similar functions discussed for Claim 1.

129. To the extent the preamble is limiting, *Zhang* teaches a mobile device (mobile apparatus) that informs a helper server (device) of an availability of media content at the mobile device, which is connected to a wireless local area network (WLAN). *See* Claim 1(Pre). The claimed media content is mapped above. *See* Claim 1(e). *See also* Claim 15(a) below.

K. Claim 15(a) - a receiver adapted to receive wirelessly, from an external source, media content selected from a group consisting of: audio content and video content; and

1. *Zhang*’s Teachings – Mobile Device

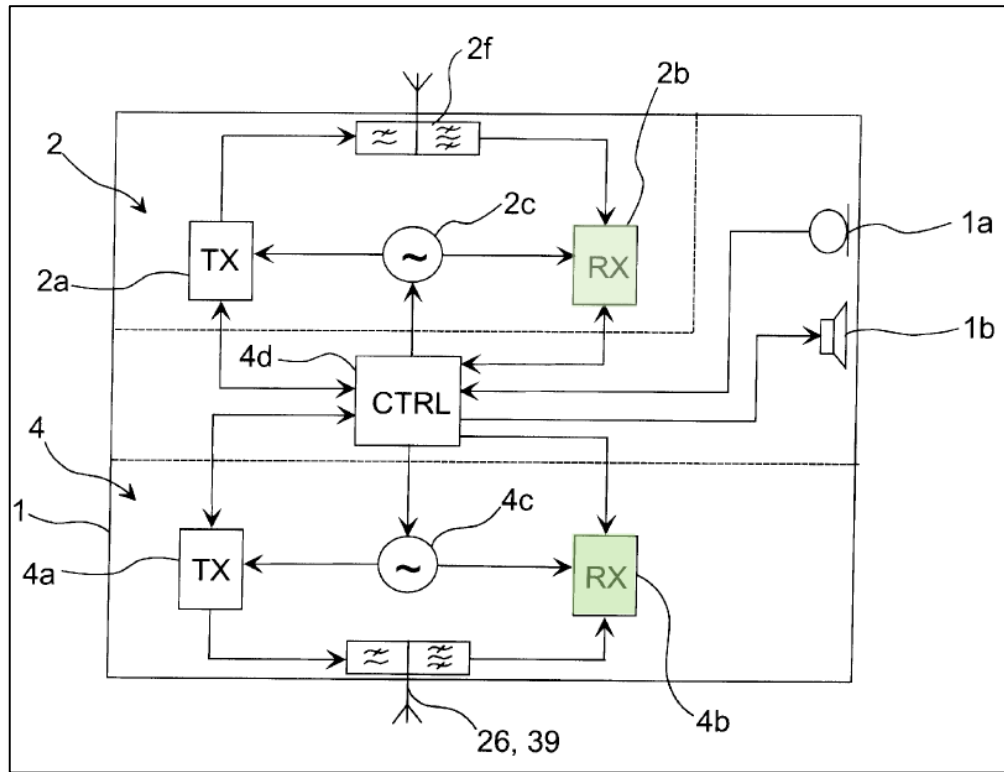
130. *Zhang* teaches a mobile device, such as a cellular phone. *Zhang*, 3:25-31, 4:35-38. A POSITA would have understood that a cellular phone would have included a receiver adapted to wirelessly receive audio content. *See* Claim 1(Pre).

Indeed, a POSITA would have understood that a mobile device such as *Zhang's* would have included hardware such as a transceiver or receiver for wirelessly receiving a media data stream. Furthermore, as discussed above, *Pasanen* teaches wirelessly receiving media content including audio and/or video content from an external source. *See* Claim 1(e).

131. To the extent it is argued that *Zhang* does not expressly teach hardware and software implemented by a receiver in a mobile device to wirelessly receive media content from an external source, it would have been obvious to implement *Zhang's* cellular phone pursuant to *Pasanen*, which expressly teaches such hardware and software.

2. Pasanen's Teachings – Mobile Phone Includes Receiver For Receiving Phone Call from Cellular Network

132. *Pasanen* teaches a mobile device includes a receiver receiving media content from an external source such as a phone call from a mobile communication network. *Pasanen*, 4:20-62, 5:62-6:22, 13:2-13, 13:51-55, Fig. 3. *Pasanen's* mobile station is depicted in Fig. 2a (shown below) with receivers 2b (radio receiver of the long-distance link module, e.g., a GSM cellular network) and 4b (radio receiver of the short-distance link module, e.g., WLAN) (both annotated green) adapted to receive externally sourced media (e.g., phone calls):



Pasanen, Fig. 2a (annotated).

3. Motivation to Combine Zhang and Pasanen

133. As discussed above, *Zhang* teaches that its mobile device can be a cellular phone, but does not describe necessary hardware within the cellular phone such as a cellular receiver. *See* Claim 1(e). A POSITA would have been motivated and found it obvious to implement a cellular receiver, such as that described by *Pasanen*, in *Zhang*'s cellular phone such that *Zhang-Pasanen*'s mobile device would be adapted to wirelessly receive externally sourced media content consisting of audio content. A POSITA would have understood that modifying *Zhang*'s mobile device with *Pasanen*'s receiver would have improved *Zhang*'s similar mobile device

(e.g., cell phone) in the same way as *Pasanen's* mobile apparatus. I note that implementing a cellular receiver not only *improves Zhang's* mobile device, but *enables Zhang's* mobile device to receive calls from the cellular/mobile network. Moreover, taking the receiver teaching from *Pasanen* enables *Zhang's* expressly described wireless communications. Thus, such use of a known technique would have solved a known problem in the art, and combining *Zhang* and *Pasanen* would have been well within the skillset of a POSITA. I note that such hardware components were widely available and commonly used for wireless devices such as a mobile phone. Further, such a modification would have been combining prior art elements (e.g., mobile device, receiver) according to known methods to yield the predictable result of a mobile device wirelessly receiving external media content (e.g., incoming phone calls).

134. Such a modification would have had a reasonable expectation of success because *Zhang* and *Pasanen* teach similar mobile devices (e.g., cellular phones, mobile stations), and because it was well known and commonplace for cellular phones to include hardware and/or programming instructions to receive phone calls from cellular/mobile networks. Indeed, one of the main functions of a mobile phone is to transmit and receive wirelessly. *See* Section V.F where I discussed such mobile device hardware.

L. Claim 15(b) - a controller adapted to identify one or more available devices connected to a local area network (LAN) and compatible to handle the media content;

1. Zhang's Teachings – Mobile Device

135. *Zhang* teaches a mobile device, such as a cellular phone, that identifies one or more available devices connected to a local area network and compatible to handle media content. *Zhang*, 3:25-31, 4:35-38; *see* Claim 1(Pre) and 1(a). A POSITA would have understood that a cellular phone would have included a controller adapted to identify one or more available devices connected to a local area network and compatible to handle the media content. Controllers (in the form of a microprocessor or processor) were commonly included components in mobile devices, such as cellular phones and PDAs. *See* Section V.F where I discussed such prior art mobile devices that included hardware including a processor.

136. To the extent it is argued that *Zhang* does not expressly teach the hardware and software to identify devices connected to a LAN, *Pasanen* teaches such hardware and software in the form of controller 4d, as discussed below. *Pasanen*, 5:52-61, 10:52-56, 12:47-57.

2. Pasanen's Teachings – Controller for Identifying Available Peripheral Devices

137. *Pasanen* teaches a controller programmable to identify one or more available devices connected to a local area network (LAN) and detect status data of LAN-connected devices. *Pasanen*, 5:52-61, 10:52-56, 12:47-57. Notably, *Pasanen's*

controller “detect[s] the status of [] peripheral device[s] 6-15 and transmit[s] the status data e.g. to the server device 1” through link agents “compris[ing] e.g. programs formed in the application software of the controller of the device.” *Pasanen*, 5:52-57. Moreover, “[w]hen receiving a data signal, the controller 4d turns on a switch S4, wherein the data signal to be received is led to the controller 4d of the short-distance link module for examining and processing the received data (link agent).” *Pasanen*, 10:52-57. A POSITA would have understood that the controller’s reception and processing of the data signals from peripheral devices would result in the controller determining the identity of one more available LAN-connected devices. Finally, “[a]s controllers 4d, 16d” “[p]articularly in applications where the link module 11 is integrated in the server device 1... the operations of the controller of the link module can be implemented at least partly also in the application software of the controller 4d, 16d of the device.” *Pasanen* 12:47, 12:52-57. I note that a POSITA would have understood that *Pasanen*’s teachings of the application software of the controller implementing the identifying functions would necessitate programming instructions for the controller.

138. Accordingly, the operations of controller 4d may be programmed by software to carry out instructions, as exemplified by *Pasanen*’s teachings describing running programs to (1) detect the status of peripheral devices and (2) examine and process received data.

3. Motivation to Combine Zhang and Pasanen

139. A POSITA would have been motivated and found it obvious to implement a controller pursuant to *Pasanen* in *Zhang's* cellular phone to perform *Zhang's* identifying functionality. *See* Claim 1(b). As I noted earlier, controllers in the form of processors or microprocessors were commonly included components in mobile devices, such as cellular phones and PDAs. *See* Section V.F where I discussed such prior art mobile devices that included hardware including a processor. A POSITA would have understood that modifying *Zhang's* mobile device with *Pasanen's* controller would have improved *Zhang's* similar mobile device (e.g., cell phone) in the same way as *Pasanen's* mobile apparatus. A POSITA would have understood that implementing a controller not only *improves* *Zhang's* mobile device, but *enables* *Zhang's* mobile device to perform the tasks expressly described by *Zhang*. Specifically, without some form of controller, *Zhang's* mobile device would not have been capable of performing its expressly described functionalities. Therefore, a POSITA would have understood that the inclusion of *Pasanen's* teachings of a controller would have enabled the many functions described in *Zhang*. Such a modification would have been combining prior art elements (e.g., mobile device, controller, application software) according to known methods to yield the predictable result of performing *Zhang's* identifying functionality. I note that *Pasanen* teaches using software instructions and hardware for identifying, and

modifying *Zhang* per *Pasanen's* teachings would have similarly yielded a predictable result of utilizing hardware and optionally software, such as taught by *Pasanen*, to perform identification functionality. Such a use of a known technique of using such utilizing hardware and optionally software components in mobile devices would have improved *Zhang's* similar mobile device in the same way as *Pasanen's*. Indeed, *Pasanen* teaches identifying compatible peripheral devices with which to connect, and a POSITA would have been motivated to modify *Zhang* per *Pasanen's* teachings to achieve the same benefits.

140. Such a modification would have had a reasonable expectation of success because *Zhang* and *Pasanen* teach similar devices and because using a controller for such functionality was well known in the prior art per *Pasanen's* teachings.

141. Further, *Zhang* and *Pasanen* both teach similar mobile devices (e.g., PDAs), such that modifying *Zhang* in view of *Pasanen's* teachings would have been straightforward and would have had a reasonable expectation of success. A POSITA would have understood that including such hardware and optionally software in a mobile device would have been straightforward, including because such components were commonly already present in mobile devices to perform wireless identifying functions. Indeed, such prior art teachings were a known solution to a problem and would have been within the skillset of a POSITA to implement.

M. Claim 15(c) - wherein the controller is adapted to instruct communicating wirelessly information to an intermediate routing device connected to the LAN for indirectly routing messages or media content to at least one of the one or more available devices via said intermediate routing device;

1. Zhang-Pasanen's Teachings – Controller for Communicating Wireless Information

142. *Zhang-Pasanen* teaches that a mobile apparatus would have included a controller adapted to identify one or more available devices connected to a local area network and compatible to handle the media content. *See* Claim 15(b). *Zhang-Pasanen* does not expressly teach using an intermediate routing device (e.g., router, wireless router) connected to the LAN for indirectly routing messages or media content, but a POSITA would have been motivated to modify *Zhang-Pasanen* per *Fillebrown's* teachings, as discussed above. *See* Claim 1(c), 15(b). Further, a POSITA would have been motivated to modify *Zhang-Pasanen's* controller to instruct communicating wirelessly to an intermediate routing device (e.g., router) connected to the LAN to indirectly route messages or media content to one or more available devices per *Fillebrown's* teachings, as discussed below. As I opined above in Claim 1(Pre) and 1(c), modifying *Zhang-Pasanen* to include a wireless router would have provided significant advantages over a routerless system.

2. *Fillebrown's Teachings – Wireless Router for Indirectly Routing Media*

143. In *Fillebrown*, “[g]enerally, in the personal wireless network 100, a plurality of wireless clients, such as wireless tablets and wireless smart appliances communicate via a wireless routing means, such as a wireless router 120, with a wireless server 140, sometimes through a wireless transceiving means 130.” *Fillebrown*, [0049]. *Fillebrown's* wireless tablets use processor 208 “to interconnect and drive other components of the wireless tablet 200.” *Fillebrown*, [0054], [0067]. I note that *Fillebrown* teaches that Fig. 2 is an example block diagram of a wireless tablet such as 110/112/114. A POSITA would have understood that the exemplary wireless tablet of Fig. 2 was a mobile device. Processor 208 (incorrectly labeled “ μ PROCESSOR 205” in Fig. 2) is implemented to accept data inputs, compress data packets, route the data packets to transceiver 240 (of a wireless tablet, such as wireless tablet 110/112/200), receive video and data packets from transceiver 240, and decompress received data packets. *See Fillebrown*, [0067]. *See Claim 1(c)*.

144. Accordingly, a POSITA would have understood that processor 208 of the wireless client is a controller adapted to instruct transceiver 240 to wirelessly communicate with wireless router 120 (intermediate routing device). *Fillebrown*, Fig. 2.

3. Motivation to Combine Zhang-Pasanen and Fillebrown

145. To the extent it is argued *Zhang-Pasanen* does not teach a controller adapted to instruct communicating wirelessly information to an intermediate routing device, a POSITA would have been motivated to modify the controller of *Zhang-Pasanen* to capture *Fillebrown*'s advantages. I note that the same reasons to combine *Zhang* and *Fillebrown*, as opined on above in claim in 1(c) apply similarly here. Combining prior art elements (mobile device, helper server, controller, wireless router) according to *Fillebrown*'s known methods would have yielded the predictable result of a wireless network with a mobile device possessing a controller to instruct the communication of data (e.g., audio and/or video) to helper servers via a wireless router. A POSITA would have understood that modifying the controller of *Zhang-Pasanen* would have been possible through modifying existing software (through *Pasanen*'s teachings) or hardware to achieve the improvements taught by *Fillebrown*. Such a modification to *Zhang-Pasanen* would have been use of known prior art elements including a controller instructing the transmitting of media content between devices via a wireless network while utilizing a well-known wireless router to indirectly route the traffic between the devices. As *Zhang*, *Pasanen*, and *Fillebrown* all teach similar mobile devices, modifying *Zhang-Pasanen* in view of *Fillebrown*'s teachings would have been straightforward and would have had a reasonable expectation of success. Indeed, such prior art teachings were a known

solution to a problem and would have been within the skillset of a POSITA to implement. *See* also Section V. A POSITA would have further understood that modifying *Zhang-Pasanen* would have captured *Fillebrown's* advantages.

146. A POSITA also would have had a reasonable expectation of success when making such a modification. *Zhang-Pasanen* already teaches a wireless network, such as WLAN (using IEEE 802.11 or Home RF), and *Fillebrown* teaches precisely the same network setup (WLAN using a wireless protocol such as IEEE 802.11 or Home RF). *Zhang*, 4:46-58; *Fillebrown*, [0016], [0049], [0064], [0087], [0095]. Thus, modifying *Zhang-Pasanen* in view of *Fillebrown* to utilize a controller (processor 208) adapted to communicate with a wireless router would have been a straightforward modification not requiring undue experimentation, especially because using a wireless router in a WLAN was a well-known technique.

N. Claim 15(d) - wherein the controller is adapted to wirelessly signaling the one or more available devices indicating an availability of the media content at the mobile device;

147. As discussed above, *Zhang-Pasanen* teaches wirelessly signaling the one or more available devices indicating an availability of the media content at the mobile device. *See* Claim 1(d). As I previously opined in Claim 1(d) concerning signaling the one or more available devices, a POSITA would have understood that *Zhang* taught the required signaling required in Claim 15(d). A POSITA would have understood that the express teaching of a controller to perform *Zhang's* functions

was provided by the *Zhang-Pasanen* combination as discussed in 15(b)-(c). Therefore, a POSITA would have understood that the mobile device of *Zhang-Pasanen* would have included a controller (and transceiver) to perform the wireless signaling of the one or more available devices indicating an availability of the media content at the mobile device. *See* Claim 1(d).

148. To the extent it is argued that *Zhang-Pasanen* does not teach a controller adapted to wirelessly signal the one or more available devices indicating an availability of the media content at the mobile device, a POSITA would have been motivated to modify *Zhang-Pasanen* in view of *Fillebrown's* teachings of a controller and would have had a reasonable expectation of success when doing so for the same reasons discussed above. *See* Claims 1(d), 15(b), 15(c).

O. Claim 15(e) - wherein the media content is originated from an external source disconnected from the LAN.

149. *Zhang-Pasanen* teaches media content originates from an external source disconnected from the LAN. *See* Claims 1(e), 15(a).

P. Claim 18 - The mobile apparatus of claim 15, wherein the media content is audio content selected from a group consisting of: a phone call data, bidirectional voice data, bidirectional audio data and a radio broadcast.

150. *Zhang-Fillebrown-Pasanen* teaches phone call data, bidirectional voice data, and bidirectional audio data. *See* Claims 1, 15. In particular, *Zhang-Fillebrown-Pasanen* teaches the wireless audio interface 12 includes a microphone and speaker

for a user to use when making a phone call with the cellular phone (mobile device) instead of using the microphone and speaker of the mobile device. *Pasanen*, 4:20-37; *see* Claims 1, 15.

X. GROUND 2: CLAIMS 7, 11, 16, AND 19 ARE OBVIOUS OVER ZHANG, FILLEBROWN, PASANEN, AND SKINNER

A. Claim 7 - The method of claim 1, wherein the one or more available devices is triggered by the signaling to perform one or more of the following: flash light, ring, and play a loudspeaker sound.

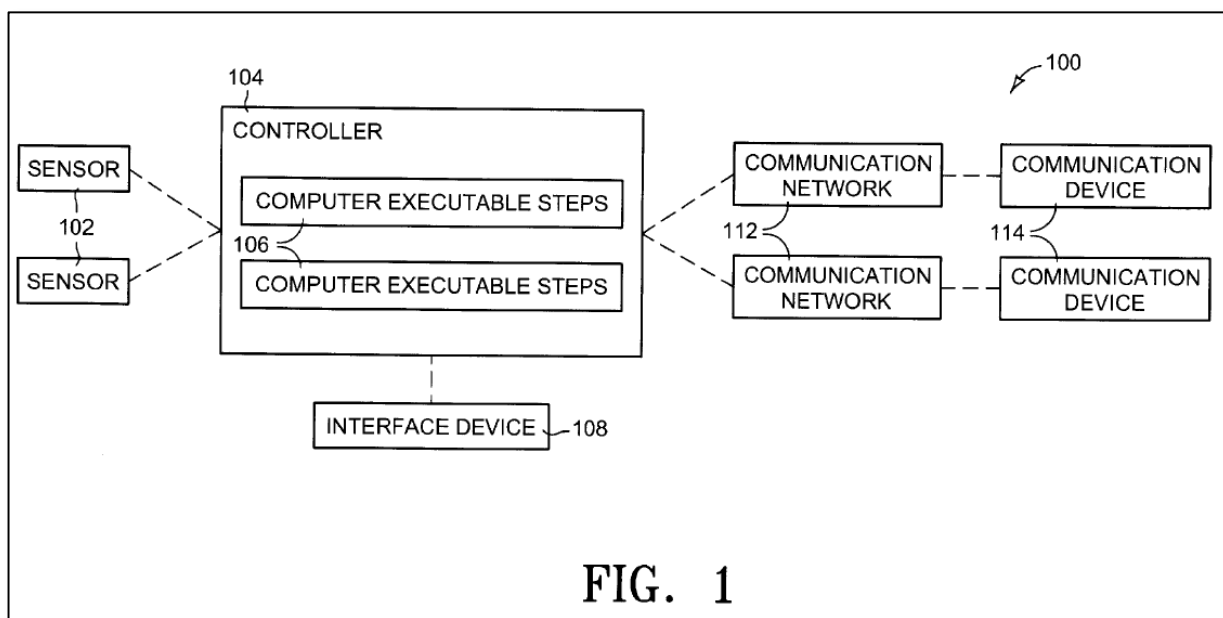
151. *See* Claim 1 regarding the claimed available device(s).

1. Skinner's Teachings – Informing User of Incoming Phone Call

152. *Skinner* teaches sensors 102 that detect an event (e.g., incoming phone call), and controller 104 that “can be a micro-processor or the like.” *Skinner*, 3:29-56, 4:10-53. *Skinner* teaches sensors 102 and controller 104 may be together as a single device. *Id.* Controller 104 signals a communication device 114 (e.g., watch device, cellular phone, pager) via communication network 112 (e.g., pager network, telephone network, cellular telephone network, local area network (LAN), or other wireless network) regarding an event (e.g., incoming phone call) occurring. *Skinner*, 3:63-4:1, 4:10-20, 5:63-6:10, Fig. 1.

153. As a result of the signaling from controller 104, communication device 114 informs a user of an event (e.g., incoming phone call) detected by sensors 102 by presenting a “message,” which *Skinner* teaches may be any combination of one

or more of audible (e.g., unique sound, beeps), visual (light that flashes in a given sequence), mechanical or electrical sensory-based, and may include text indicating the event that occurred. *Skinner*, 6:25-65, 3:29-42, 7:15-8:67. Fig. 1 below depicts sensors 102, controller 104 (including computer executable steps 106), communication network 112, and communication device 114:



Skinner, Fig. 1.

2. Motivation to Combine Zhang-Fillebrown-Pasanen and Skinner

154. A POSITA would have been motivated to modify *Zhang-Fillebrown-Pasanen* per *Skinner*'s teachings to perform audible and/or visible indications (e.g., flashing light, ring, playing sound via a loudspeaker, and/or text-based message) to inform a user of availability of media content at a mobile device (e.g., incoming phone call). Indeed, a POSITA would have understood that the alerting system of

Skinner would have improved the *Zhang-Fillebrown-Pasanen* system by improving the user's ability to easily discern of an incoming call. Such a modification would have been use of a known technique of using auditory and/or visual alerts to inform a user of an event occurring and would have improved *Zhang-Fillebrown-Pasanen* in the same way as *Skinner*. Indeed, in the *Zhang-Fillebrown-Pasanen* system, it would have been advantageous to provide alerts to a user, as taught by *Skinner*, at a helper server and/or a mobile device to indicate media content (e.g., phone call) is available at a mobile device. Moreover, I note that a POSITA would have understood that modifying *Zhang-Fillebrown-Pasanen* in view of *Skinner* would have advantageously helped user's with one or more sensory or physical impairments be effectively informed of content availability. *Skinner*, 2:21-28, 6:25-65, 9:1-8, Claim 4. *Skinner* teaches advantages of such alerts to inform a user of an event occurring and provides various user-customizable settings so a user decides how to receive such alerts (e.g., auditory and/or visual alerts). A POSITA would have understood that these alerts and user-customizations would have further improved the modified *Zhang* system by giving users improved awareness of device availability guided by user preferences regarding the availability of helper servers. Accordingly, a POSITA would have been motivated to modify *Zhang-Fillebrown-Pasanen* in view of *Skinner*.

155. Such a modification would have had a reasonable expectation of success because *Zhang-Fillebrown-Pasanen* teaches various devices, including a mobile device and helper servers (e.g., display, speakers, PC, laptop, wireless audio interface), and *Skinner* teaches similar devices performing auditory and/or visual alerts for communication devices 114, such as cellular phones, pagers, PDAs, mobile computers, desktop computers, watch devices, and other “internet-enabled” devices including internet-enabled watch device and internet-enabled television. *Skinner*, 6:7-24. Given these similarities, a POSITA would have recognized that the benefits realized by *Skinner* would have been applicable to *Zhang-Fillebrown-Pasanen* as well. Such a modification would have required merely straightforward changes to programming instructions and/or hardware, such as implementing *Skinner*’s programming instructions. I note that changes or modifications to programming instructions (i.e., software) and hardware would have been well within the skillset of a POSITA to perform. Indeed, devices such as TVs and speakers already would have included auditory functionality to play alert sounds, and devices with a display (e.g., TV, laptop, watch) would already have had a display to render text or other visual messages/alerts. I note that *Lin* (discussed above) indicates that such auxiliary devices would have been able to render and display such messages. *Lin*, [0039]. Therefore, a POSITA would have been motivated to modify *Zhang-Fillebrown-*

Pasanen in view of *Skinner* and would have had a reasonable expectation of success in doing so.

B. Claim 11 - The method of claim 1, wherein the one or more available devices are triggered by the signaling to inform a user about an availability of media content at the mobile device.

156. *Zhang-Fillebrown-Pasanen-Skinner* teaches one or more available devices (e.g., helper servers) are triggered by signaling to inform a user of availability of media content at the mobile device. For example, *Zhang's* modified helper servers alert a user that an event such as an incoming phone call is received, and the alerts include audible, visual (e.g., light that flashes in a given sequence), mechanical, or electrical sensory-based. *Skinner*, 7:30-67. *See* Claims 1, 7. A POSITA would have understood that such alerts inform a user of media content (e.g., incoming phone call) available at the modified *Zhang's* mobile device. Further, I note that a POSITA would have understood that any one of the alerting methods (e.g., flashing light, ring, playing sound via a loudspeaker, electrical sensory, and/or text-based message) discussed by *Skinner* would have informed a user about an availability of media content at the mobile device. *Skinner*, 2:21-28, 6:25-65, 9:1-8.

C. Claim 16 - The mobile apparatus of claim 15, wherein the one or more available devices is triggered by the mobile device to perform one or more of the following: flash light, ring, and play a loudspeaker sound.

157. *See* Claims 1, 7, 11, 15.

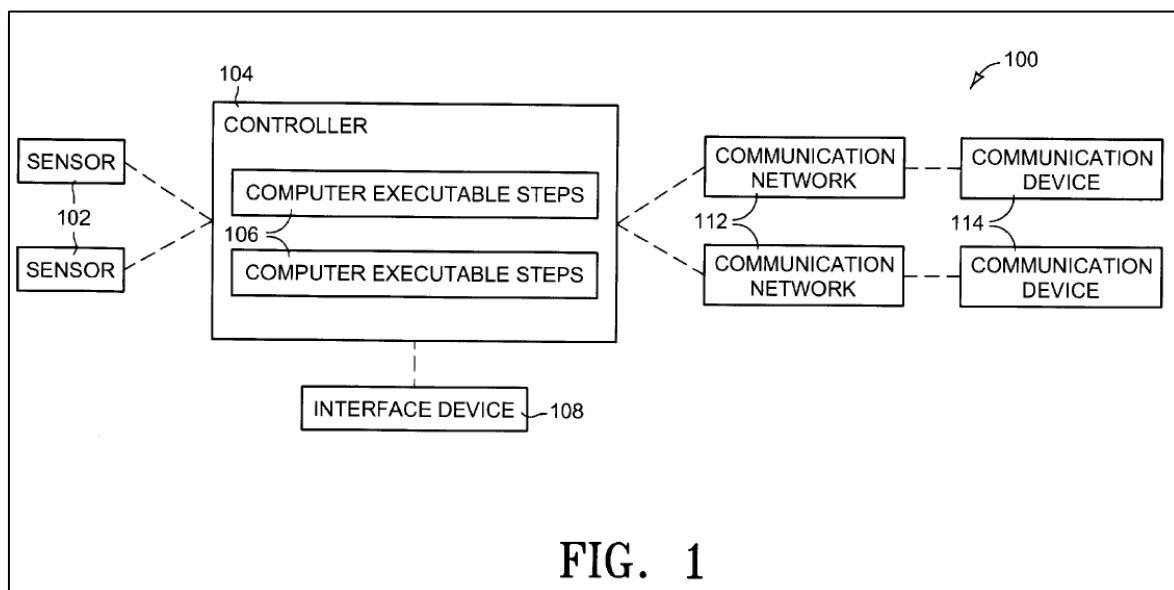
D. Claim 19(Pre) - A computer program product for a device for informing a user about an availability of media content at a mobile device, the computer program product comprising:

158. The '648 Patent describes realizing the apparatus “as software[,]” but does not elaborate further. '648 Patent, 8:27-31. As set forth below, a POSITA would have understood the functions performed by the proposed combination are also governed by software or at least that it would have been obvious to implement these functions in software (“computer program product”). Indeed, a POSITA would have understood that *Pasanen's* teaches that operations of the controller may be implemented in application software. Further, a POSITA would have understood that said application software discussed in *Pasanen* would have included program instructions.

159. *Zhang* does not expressly teach program instructions for performing its functions, but a POSITA would have understood that *Zhang's* mobile device (e.g., cell phone) would have included programming instructions and a processor for performing its functions. Indeed, a POSITA would have been aware of other prior art references offering exemplary instances of mobile devices including programming instructions and a processor for performing its respective functions, including *Pasanen* (*Pasanen*, 6:52-61, 7:55-8:10, 12:47-57), *Rofheart* (*Rofheart*, Fig. 2, 13:29-65, 14:14-35), *Fillebrown* (*Fillebrown*, [0039]-[0048], [0067]-[0071], [0078] [0080]), and *Skinner* (discussed below). Alternatively, as discussed below, to

the extent the preamble is limiting, a POSITA would have been motivated to modify the *Zhang* combination to utilize programming instructions to perform the functions mapped for Claim 1 above and Claim 19 herein in view of *Skinner*.

160. See Claim 1(Pre) (informing a device about an availability of media content at a mobile device). Additionally, *Skinner* teaches informing a user about an availability of media content at a mobile device using alerts (e.g., visual, auditory), as discussed above for Claims 7 and 11, and teaches computer executable steps (106, 206) for performing such alerts to inform a user. *Skinner*, 7:15-8:67, 3:29-42, Fig. 1. See Claims 7, 11. *Skinner* also teaches controller 104 (alone or combined with sensor 102) can incorporate a micro-processor and memory. *Skinner*, 3:29-52, 5:55-56 (expressly teaching controller 104 includes memory).



Skinner, Fig. 1. I note that a POSITA would have understood that the controller of Fig. 1 of *Skinner* would comprise a microprocessor and memory to execute and store the “computer executable steps” of 106. Moreover, *Skinner* acknowledges that said computer executable steps concerning the alter messages are programmable and configurable by the user. *Skinner*, 8:40-42.

161. Thus, to the extent computer-readable programming instructions and hardware (e.g., processor, memory) are not taught in *Zhang-Pasanen*, a POSITA would have been motivated to modify *Zhang-Pasanen* to include programming instructions for performing alerting functions including alerting a user and appropriate hardware for accomplishing this functionality (e.g., processor, memory), such as taught by *Skinner*. As I opined above, using computer-readable programming instructions executed by a processor was use of a known technique to solve a known problem in the prior art, and such was well within the skill set of a POSITA. Such a use of a known technique would have improved *Zhang-Pasanen*’s mobile device in the same way as *Skinner*’s by utilizing computer-readable programming instructions stored in memory and executed by hardware (e.g., processor) to perform the modified *Zhang*’s mobile device functions mapped for Claims 1, 19 (including alerting a user of availability of media content at a mobile device). Indeed, such a modification would have been combining prior art elements

(mobile device, processor, memory) according to known methods to yield predictable results.

162. The proposed modification would have had a reasonable expectation of success because using a processor to execute programming instructions stored in memory was well known and well understood in the prior art, with *Skinner* providing express teachings. Indeed, a POSITA would have been aware of other prior art references of exemplary instances of mobile devices including memory for storing instructions and a processor for performing its functions, including *Fillebrown* (*Fillebrown*, [0039]-[0048], [0057], [0067]-[0071], [0078] [0080]), *Pasanen* (*Pasanen*, 6:52-61, 7:55-8:10, 12:47-57), and *Rofheart* (*Rofheart*, Fig. 2, 13:29-65, 14:14-35); see also Section V.F. Additionally, *Zhang*, *Pasanen*, and *Skinner* teach similar portable devices, such that modifying *Zhang-Pasanen* per *Skinner's* teachings would have been straightforward and not required undue experimentation.

E. Claim 19(a) – a non-transitory computer readable storage medium having stored thereon:

163. *Zhang-Pasanen-Skinner* teaches a non-transitory computer readable storage medium having program instructions stored thereon (e.g., *Skinner's* controller memory of controller 104). See Claim 19(Pre); *Skinner*, 5:55-56, Fig. 1. A POSITA would have been motivated to modify *Zhang-Pasanen* per *Skinner's* teachings for the reasons discussed above. See Claim 19(Pre). Alternatively, to the extent it is argued *Skinner's* teachings are insufficient, a POSITA would have been

motivated to modify *Zhang-Pasanen-Skiner* per *Fillebrown*'s teachings of non-transitory computer readable memory for the reasons discussed below and which are incorporated herein. *See* Claim 19(b).

F. Claim 19(b) - first program instructions executable by a processor to wirelessly communicating information to an intermediate routing device connected to a local area network (LAN) for indirectly receive messages or media content routed from one or more available devices connected to the LAN via the intermediate routing device; and

164. *See* Claims 1(c), 15(a), 19(Pre). Although *Zhang-Pasanen-Skiner* is silent on an intermediate routing device and its program instructions, *Fillebrown* expressly teaches such an intermediate routing device and program instructions executable by a processor for performing the claimed wireless communication functionality. *See* Claim 1(c).

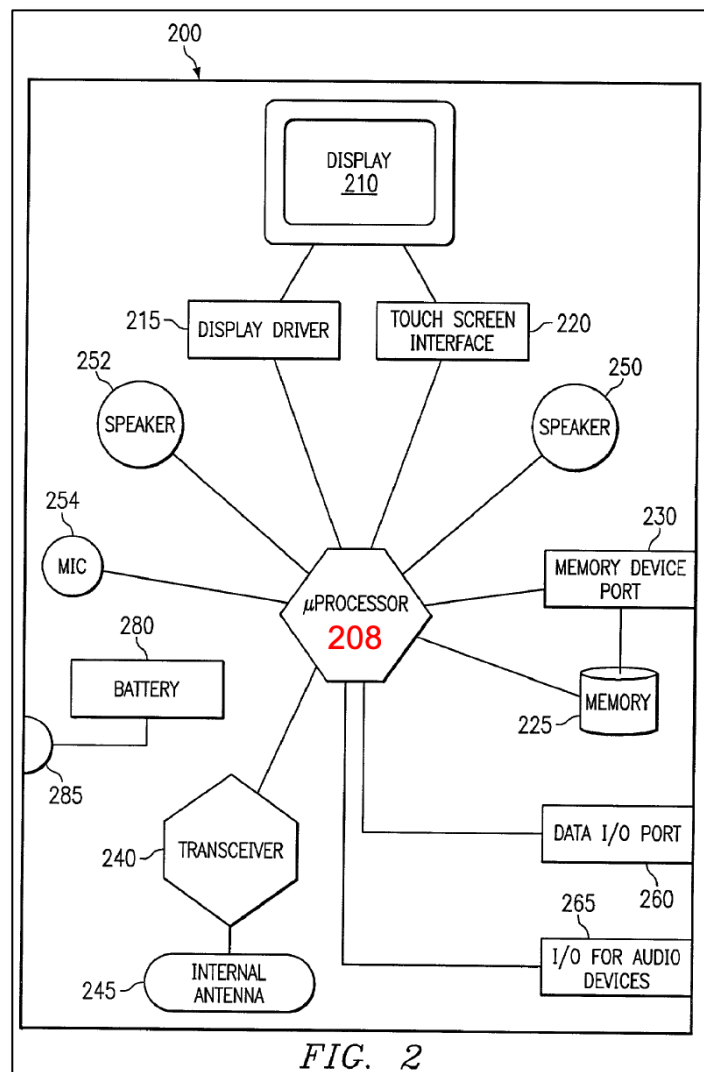
165. In detail, a POSITA would have been motivated to modify *Zhang-Pasanen-Skiner* per *Fillebrown*'s teachings of computer hardware and machine-readable instructions. Indeed, *Fillebrown* teaches a computer system typically includes hardware and software. *Fillebrown*, [0040] ("A computer system (or, system) typically includes hardware capable of executing machine-readable instructions, as well as the software for executing acts (typically machine-readable instructions) that produce a desired result. In addition, a computer system may include hybrids of hardware and software, as well as computer sub-systems."). Additionally, *Fillebrown* expressly teaches executing machine-readable program

instructions including software, software and hardware hybrid systems, and hardware on a mobile device such as a wireless tablet or other wireless client device. *Fillebrown*, generally [0040]-[0048], [0057]. Specifically, *Fillebrown* notes, “the methods of the invention may be practiced by placing the invention on a computer-readable medium...includ[ing] passive data storage, such as a random access memory (RAM) as well as semipermanent data storage such as a compact disk read only memory (CD-ROM).” *Fillebrown*, [0047]. I note that a POSITA would have understood the read only memory discussed in *Fillebrown* was a form of non-transitory computer readable storage medium. Indeed, a POSITA would have understood that a compact disc stored computer programming instructions or other data in a persistent manner, and as such was known to be non-transitory. This is in contrast to memory such as common RAM (random access memory), which (without a battery or other technique) would not store programming instructions after the device is powered off, for example, and would not have been understood to be non-transitory.

166. *Fillebrown* also teaches a block diagram of wireless tablet 200 (which is one implementation of wireless tablet 110/112/114) that includes microprocessor 208 and memory 225 for storing “[s]oftware programs, external operating systems, data, audio recordings, movies, or other prerecorded information[.]” *Fillebrown*, [0071], [0070] (“The processor 208 is augmented through a memory device 225.

The memory 225 preferably provides both RAM and ROM so that the processor 208 may have access to a predefined set of start-up instructions, as well as access to storage for programs that load onto the wireless tablet 200.”), [0070] (“[M]emory 225 may also store other software programs that are used by the wireless table[t][.]”).

Fig. 2 below depicts wireless tablet 200, including processor 208 and memory 225:



Fillebrown, Fig. 2 (annotated).⁴ A POSITA would have understood that *Fillebrown's* memory includes ROM, which is non-transitory memory. Additionally, a POSITA would have understood that additional programs “may be placed on the wireless tablet 200 through a memory device placed in the memory device port 230. The memory device port 230 is preferably a compact-flash port.” *Fillebrown*, [0071]. A POSITA would have understood that compact-flash memory retains data even when the device is powered down, making it a type of non-volatile and non-transitory memory. Further, a POSITA would have understood that *Fillebrown's* preference for a compact-flash port would also have also allowed a user to attach additional non-transitory memory to *Fillebrown's* tablet 200.

167. A POSITA would have understood that “program instructions” would have been program instructions either alone or as part of a larger set of instructions for performing particular functions when executed by a processor. For example, *Fillebrown* teaches non-transitory memory with program instruction for performing various functions. *Fillebrown*, [0070]. A POSITA would have understood that a

⁴ A POSITA would have understood *Fillebrown's* Fig. 2 has a typographical error, where “processor 205” should be “processor 208.” See *Fillebrown*, generally [0067]-[0070] (205 refers to the housing of wireless tablet 200). Fig. 2 has been annotated accordingly.

specific location (or locations) in memory would not have been required, but a processor would have been able to locate instructions wherever stored in memory, such as *Fillebrown's* memory 225 or memory device port 230. Thus, a POSITA would have understood that the claimed “first program instructions” through “third program instructions” (Claim 19(b)-19(d)) would have been met by program instructions in a single program or multiple programs stored in one or more non-transitory computer-readable storage mediums. Indeed, regardless of the exact storage location(s) (for example, whether stored as a single set of instructions or multiple sets of instructions), such instructions would have been stored in non-transitory memory, such as taught by *Fillebrown*. Because *Fillebrown* teaches computer-readable instructions stored in non-transitory memory and executable by a processor for performing the claimed functions of *Zhang-Pasanen-Skinner-Fillebrown*, a POSITA would have understood that the mapping for method claim 1(c) would have included “program instructions executable by a processor to” perform the claimed functionality of Claims 1(c) and 19.

G. Claim 19(c) - second program instructions executable by the processor to wirelessly receive signal from the mobile device indicating an availability of a media content at the mobile device;

168. See Claims 1(d), 15, 19(Pre)-19(b) (program instructions executable by a processor to wirelessly receive signal from the mobile device indicating an availability of media content at the mobile device).

H. Claim 19(d) - third program instructions executable by the processor to inform the user of said device about an availability of a media content at the mobile device with one or more of the following: flash light, ring, and play a loudspeaker sound;

169. *See* Claims 1(d), 7, 11, 15, 16, 19(Pre) (program instructions executable by a processor to inform the user of the mobile device about availability of media content at the mobile device with a flash light, ring, and/or playing a loudspeaker sound).

XI. CLAIM 19(E) - WHEREIN THE MEDIA CONTENT IS ORIGINATED FROM AN EXTERNAL SOURCE DISCONNECTED FROM THE LAN;

170. *See* Claims 1(e), 15, 19(Pre)-19(b). The modified *Zhang* teaches media content originated from an external source disconnected from the LAN (e.g., phone call).

A. Claim 19(f) - wherein the media content selected from a group consisting of: audio content, text content and video content.

171. *See* Claims 1(f), 15, 19(Pre)-19(b). As set forth above, the proposed combination of *Zhang* and *Pasanen* is directed to the disclosure of media content consisting of audio content. *See* Claims 1(f), 15(a).

XII. GROUND 3: CLAIMS 8, 10 ARE OBVIOUS OVER ZHANG, FILLEBROWN, PASANEN, AND ROFHEART

A. Claim 8 – The method of claim 1, further comprising setting up a wireless communication link between the at least one of the one or more available devices based on a user interaction made with the mobile device or the one or more available devices and causing a routing of the media content to the at least one device via the wireless communication link.

172. Although *Zhang* does not describe the mobile device interface used to control the helper environment (e.g., by a user to select a helper server), such user interfaces were well known in the art, including as described by *Rofheart*. As set forth below, a POSITA would have been motivated to implement *Rofheart's* device selection user interface in *Zhang's* mobile device, allowing the user to implement functionalities described by *Zhang* and *Pasanen* (e.g., invoking an audio interface for a phone call).

1. Setting Up a Wireless Communication Link

173. *Zhang* teaches that a mobile device transmits a service request to at least one helper server, and said helper server responds by accepting the service request if said helper server is capable of performing the requested helper service. *See Claim 1.*

174. *Zhang* teaches setting up a session (“wireless communication link”) between a “helper client” (mobile device) and helper server using TCP (or UDP). *Zhang*, 9:51-10:7. I note that I also opined above regarding TCP and UDP being streaming protocol. *See Section V.D.* *Zhang* teaches that a session is created between a mobile device and helper server “from the time the client request is accepted by the server and ends when the user finishes using the helper service.” *Zhang*, 9:54-60. In particular, *Zhang* teaches that a user may terminate the session with a helper server based on a “client request.” *Zhang*, 9:55-60. Further, *Zhang* teaches that

“[d]uring the session, both data and control information are exchanged” via “the TCP connection between the client and the server.” *Id.* A POSITA would have understood that such a connection via TCP/IP or UDP/IP (i.e., streaming protocol) would have utilized *Zhang*’s WLAN (i.e., local wireless communication network) for setting up the session (i.e., wireless communication link) between the mobile device and selected helper server (i.e., selected compatible device). Indeed, a POSITA would have understood that streaming protocols such as TCP/IP and UDP/IP were utilized with network protocols such as WLANs, such that communications between devices connected to the WLAN would have utilized the WLAN as the network along with streaming protocols such as TCP/IP or UDP/IP.

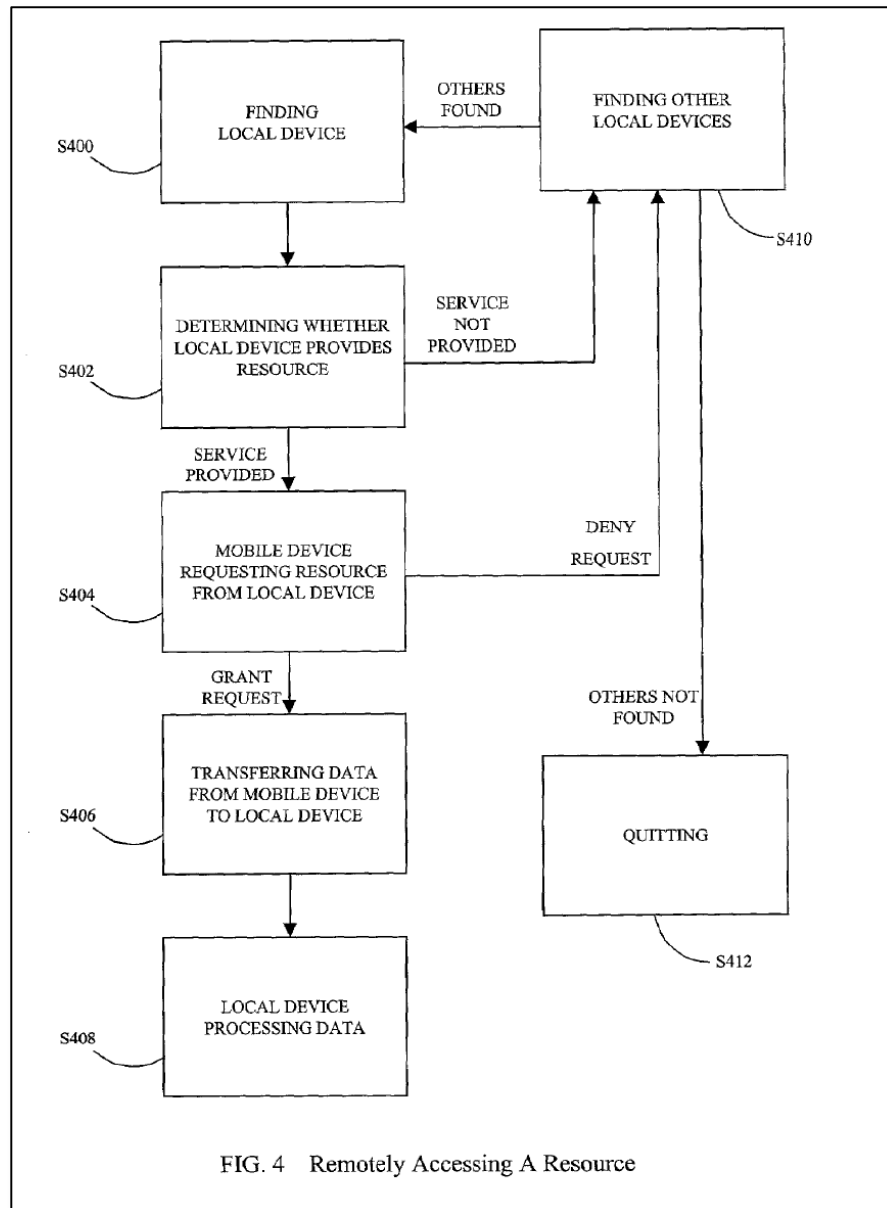
175. *Zhang* teaches embodiments where such sessions are between a single mobile device and helper server at a time or a single mobile device and multiple helper servers at a time. For example, in the embodiments where the mobile device moves across different locations (“nomadic” and “seamless” mobility), *Zhang* teaches sessions that are independent between different helper servers at different locations (i.e., nomadic embodiment). *Zhang* specifically teaches in the nomadic embodiment, there is no continuity between the first service session (e.g., between mobile device and a first helper server) and the second service session (e.g., between mobile device and a second helper server). That is, a “user moves and decides to change server,” such that the current session with a helper server is terminated before

a new session is started with another helper server at the new location. *Zhang*, 10:48-57. However, in the “seamless” embodiment, “state information is retained when the user moves causing a change in servers[,]” such that “video streams may move from one helper to another with display continuity.” *Zhang*, 10:58-65. Thus, multiple sessions may be active between a single mobile device and a plurality of helper servers. As I opined above in Claim 1(d), a POSITA would have understood that the seamless mobility embodiment of *Zhang* would require at least two active sessions to facilitate the seamless transfer between one or more helper servers. In either case, the connection between the mobile device and helper server is via a session (i.e., wireless communication link).

176. A POSITA would have understood that such a session between a mobile device and a helper server is a wireless communication link via said local wireless communication network (e.g., WLAN, *see* Claim 1(Pre)-1(a)). I note that *Zhang’s* session provides a wireless communication link between devices and that the session information is transmitted via the WLAN, which is the wireless network that the helper servers and mobile device are connected to and the network via which said devices communicate with each other. Specifically, accepting a service request prepares a helper server for receiving content and commands from a mobile device by initiating a session between said handheld device and said helper server. For example, *Zhang* teaches a “local device” (e.g., helper server) granting a service

request results in “transferring data from mobile device to local device” at step S406.

Zhang, 4:5-8, 4:32-34 (teaching the same but for the embodiment of Fig. 5).



Zhang, Fig. 4, *see also* Fig. 5.

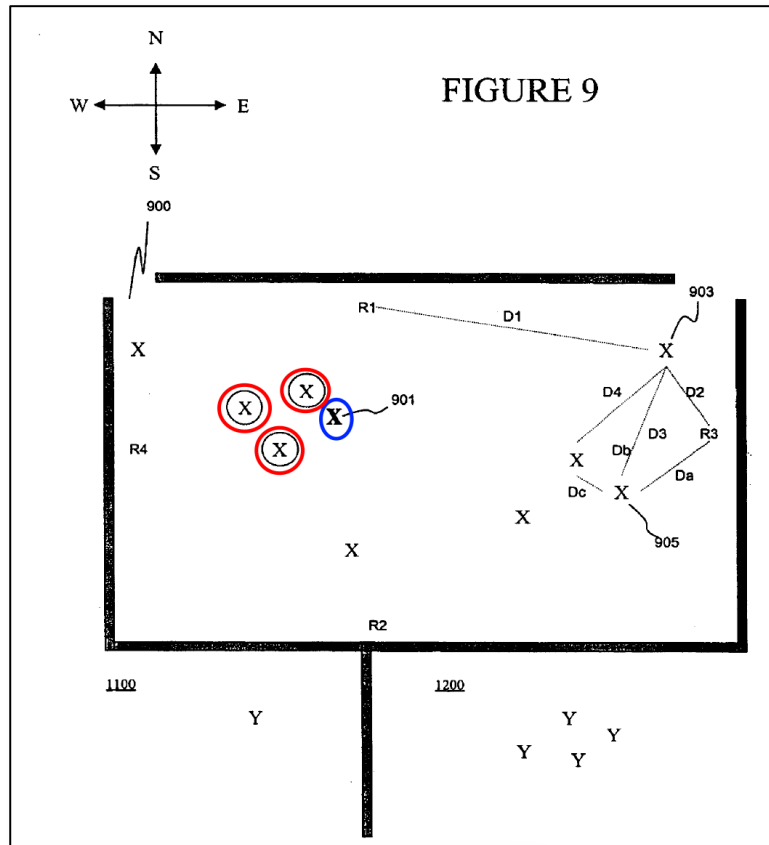
2. User Interaction – Rofheart’s Teachings

177. *Zhang-Fillebrown-Pasanen* in view of *Rofheart* teaches a user selecting one or more helper servers to connect to for data transfer (e.g., routing audio) by selecting said helper servers on a display screen of a mobile device. Indeed, *Rofheart*’s teachings of a user selecting remote devices to communicate with using a position display map, as discussed below, would have taught a POSITA a method to allow user interaction to select available devices. Further, in the case where the media content is a phone call, *Zhang-Fillebrown-Pasanen* would have been modified per *Rofheart*’s teachings to select a device to route the phone call to (e.g., wireless audio interface). As I opined in Claims 1(e), 5, and 6, wherein the media content is a phone call, a POSITA would have understood and been motivated to route audio content to audio-capable helper servers. By extension, a POSITA would have understood that the ability to have the user select which audio device to send a phone call (e.g., wireless audio interface) would have advantageously improved the *Zhang-Fillebrown-Pasanen* combination.

178. *Rofheart* teaches that a user may select one or more of a plurality of devices. *Rofheart*, 18:54-58 (“[A] local device may display a positional map of all users in relation to the local device so that the user of the local device may select those remote devices that the user wants to communicate with[.]”), 5:37-45, 28:22-38 (teaching local device 901 “displays a graphical map of the position of each

remote device in conference room 900 from which the user of the local device may choose remote devices to enable communications with.”). Accordingly, *Rofheart* teaches a graphical user interface (GUI) where a user selects which device(s) to connect to. The local device’s “display 213 has touch screen capabilities that allow the user to select a remote device by contacting the display with a pointing device, for example.” *Rofheart*, 30:10-18. “If the user of the local device 901 selects a device on the display of the local device, then the local device 901 enables communications with that device as shown in step 1013.” *Rofheart*, 30:18-24, 27:46-28:38.

179. After a user selects one or more devices, local device’s display 213 is updated, “indicat[ing] which remote devices are enabled as positional information is updated.” *Rofheart*, 30:33-49 (noting enabled devices may be circled on the display). Fig. 9 below shows local device (annotated blue), remote devices with which connections are established (annotated red), and other remote devices without established connections (indicated with “X,” but not highlighted):



Rofheart, Fig. 9 (annotated).

180. *Rofheart* teaches the communications between the local device and remote devices include “transmitting and receiving communications such as text, video and voice on the unique links associated with the enabled remote devices as seen in step 1019.” *Rofheart*, 30:25-49. If a user wishes to change which devices with which to connect, the change can occur at any time by selecting or deselecting said remote device(s) on display 213. *Rofheart*, 30:49-52.

3. Routing of the Media Content

181. As set forth above with reference to Claims 1 and 5-6, when the media content is a phone call, *Zhang-Fillebrown* would have been modified according to the *Pasanen*'s teachings (to the extent it is argued *Zhang* does not teach or render obvious receiving/making a phone call). Thus, *Zhang-Fillebrown-Pasanen* teaches receiving a phone call at a mobile device and routing the phone call audio to a helper server (e.g., wireless audio interface). See Claim 1.

4. Motivation to Combine Zhang-Fillebrown-Pasanen-Rofheart

182. A POSITA would have found it obvious to modify *Zhang-Fillebrown-Pasanen* such that a user would have selected, using the mobile phone user interface, one or more of said plurality of devices to connect to route media (e.g., phone call). *Rofheart*, 5:37-45. *Zhang* teaches that a mobile device locates a helper server to connect to for using the helper server's service capabilities (e.g., audio reproduction). See Claim 1. *Zhang-Fillebrown-Pasanen* teaches a mobile device that receives a phone call from a source external to the WLAN. See Claims 1, 5, 6. Modifying *Zhang-Fillebrown-Pasanen* in view of *Rofheart*'s teachings of user selection would have been the use of a known technique of selecting one or more of a plurality of helper servers or other remote devices to which to route media content (e.g., phone call) to improve *Zhang-Fillebrown-Pasanen* in the same way as *Rofheart*. A POSITA would have recognized the benefit of providing users control

to select one or more of a plurality of devices, rather than always connecting to the first identified available compatible device, as taught by *Zhang*, beneficially permitting users control of which device will handle the call. Thus, a POSITA would have understood that when modifying *Zhang-Fillebrown-Pasanen* in view of *Rofheart*, the same advantages of *Rofheart*'s system would have also applied to the *Zhang* combination.

183. Furthermore, a POSITA would have been motivated to modify *Zhang-Fillebrown-Pasanen* per *Rofheart*'s teachings of making a selection of one or more devices to connect to by using a GUI that includes a menu. Such would have been using a well-known technique of allowing a user to make a selection on the modified *Zhang*'s mobile device by selecting devices via the menu on the GUI. *Rofheart*, Fig. 9, 28:22-33. Such a use of a known technique would have advantageously improved *Zhang-Fillebrown-Pasanen*'s similar system in the same way as *Rofheart*'s system. Indeed, such a modification would have allowed a user to make a selection by using a GUI that includes a menu. I note that I discussed above that GUIs were well known and utilized for mobile devices before the priority date of the '648 Patent. See Section V.E.

184. Further, said modification would have had a reasonable expectation of success because *Zhang-Fillebrown-Pasanen* already teaches receiving and rerouting streamed media content (e.g., video/audio/phone call) and *Zhang-Fillebrown-*

Pasanen as modified by *Rofheart* teaches selecting one or more helper servers for said media routing. *See* Claim 1.

B. Claim 10 - The method of claim 1, wherein the identifying comprises triggering a display of a menu by the one or more available devices or the mobile device to allow a user to perform a user interaction.

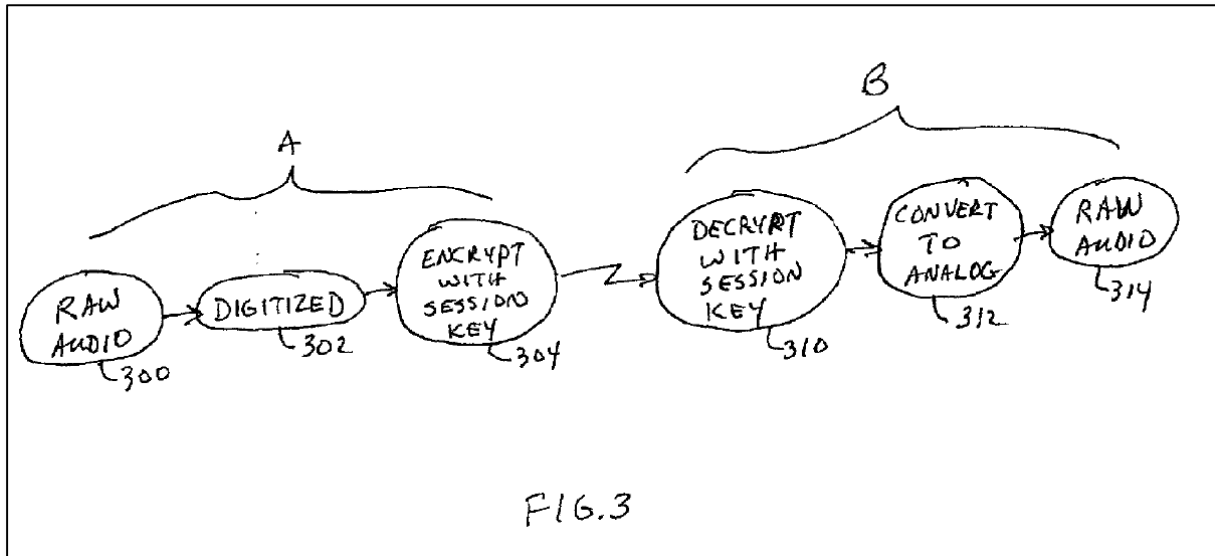
185. *Zhang-Fillebrown-Pasanen-Rofheart* performs user interactions on a display of a mobile device to select one or more devices from a group of available devices to connect to for media routing. *See* Claim 8.

XIII. GROUND 4: CLAIM 13 IS OBVIOUS OVER ZHANG, FILLEBROWN, PASANEN, AND ANGELO

A. Claim 13 - The method of claim 1, further comprising encrypting and routing the media content to the one or more available devices.

186. *See* Claim 1. *Angelo* teaches secured transmission of audio (e.g., voice), video, or a combination of audio and video communicated between portable devices by utilizing encryption. *Angelo*, Abstract, [0004], [0009]-[0010], [0016]-[0021], [0029], [0031]. In particular, *Angelo* teaches encrypting real-time, two-way communications between portable devices such as PDAs. *Angelo*, [0009]-[0010], [0015] (including teaching direct and indirect connections between devices and that real-time indicates not introducing delays that interfere with the usefulness of the audio stream, for example), [0016]-[0021]. *Angelo* teaches using “[a]ny suitable type of real-time encryption technique” such as using a “session key.” *Angelo*, [0022]-[0026]. *Angelo* teaches enhancing security by dynamically changing the session key

during communications. *Angelo*, [0027]. Fig. 3 below depicts a real-time encryption process between two devices. *Angelo*, [0014], [0025].



Angelo, Fig. 3.

187. A POSITA would have been motivated to modify *Zhang-Fillebrown-Pasanen* per *Angelo's* teachings to capture *Angelo's* advantages including the expressly taught advantage of providing a secure environment for communications between portable devices so that “information cannot be intercepted and accessed by an unauthorized entity, or at least not easily accessed by an unauthorized entity.” *Angelo*, [0007]-[0010]. Such a use of a known technique of encrypting communications between portable devices would have advantageously improved *Zhang-Fillebrown-Pasanen's* similar system in the same way as *Angelo's*. Indeed, a POSITA would have understood that such a modification would have been advantageous to prevent or at least make it more difficult for an unauthorized entity

to view content streamed between devices. For example, a user may not want a neighbor, coworker, or, in particular, a malicious user to access the streaming content a user sends to a helper server in the *Zhang* combination.

188. A POSITA would have had a reasonable expectation of success when making such a modification to implement encryption because *Angelo* teaches such a technique for portable devices, and *Zhang-Fillebrown-Pasanen* utilizes portable devices. Further modifying *Zhang-Fillebrown-Pasanen* per *Angelo* would have predictably enhanced such security to cover audio, voice, video, phone calls, or a combination of audio/video with encryption. Indeed, a POSITA would have expected that such security would have been useful regardless of the type of media transmitted between devices. The proposed modification would have required only minor modifications, including changes to software or other programming instructions to utilize *Angelo*'s security software 108 executed by a processor to provide encryption functionality. I note that *Angelo* teaches storing software in non-volatile memory and that the software is executed by a processor (e.g., CPU). Thus, such a modification would have been well within the skillset of a POSITA and would not have required undue experimentation to implement. Indeed, a POSITA merely would have included security software, such as taught by *Angelo*, in the *Zhang* combination (which includes a processor and non-volatile memory) to achieve *Angelo*'s advantages with a reasonable expectation of success.

XIV. CONCLUSION

189. I hereby declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct, and that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I understand that willful false statements are punishable by fine or imprisonment or both. *See* 18 U.S.C. § 1001. If called to testify as to the truth of the matters stated herein, I could and would testify competently.

Date: July 3, 2024

Respectfully submitted:



Dr. Sayfe Kiaei

Exhibit A

Dr. Sayfe Kiaei
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Sayfe Kiaei

Professor, Motorola Endowed Chair Professor

School of Electrical, Computer and Energy Engineering, Arizona State University, Tempe, AZ

FIELDS OF SPECIALIZATION

- **Integrated Circuits (IC), Radio Frequency**, Analog & Digital IC, Mixed-Signal IC, VLSI, Processor, ASIC, RFIC, Receiver, Transmitter, Synthesizer, RF system, VLSI, Processor, DSP processor
- **Power Management**: Power Management IC, Battery Management, Energy System, Energy Management
- **Sensors & Bioelectronics**: RFID, ZIGBEE, Bluetooth, Biosensors, Hearing Aid sensors, Implanted devices electronics, Medical Implanted Communication System (MICS)
- **Signal Processing**: Digital Signal Processing, Adaptive Signal Processing, Video & Audio Signal Processing, Adaptive Audio Array processing, Audio and Acoustic & Speech processing.
- **Communication Systems**: 1G-5G, 2-way radio, BT, WIFI, Sensors, ZIGBEE, wireless sensors, CABLE, DSL, Optical

DEGREES

- **Ph.D.**, Electrical and Computer Engineering, Washington State University, 1987
- **M.S.**, Electrical and Computer Engineering, Washington State University, 1984
- **B.S.E.E.**, Electrical Engineering, Northeastern University, Washington State University, 1982

ACADEMIC POSITIONS

Fall 2001-Present: Professor, Motorola Endowed Chair Professor in Analog and RFIC School of Electrical, Computer and Energy Engineering, Arizona State University, Tempe, AZ

- **Research Projects:**
 - Integrated Circuits: Analog and digital IC, Radio Frequency IC, RF transceiver, VLSI, Processor System Architecture, ASIC
 - Power Management IC, Battery Management & Sensing, Integrated Power Electronics
 - Sensors, Bioelectronics, Biosensors, Hearing Aid Electronics, Implanted devices electronics
 - Digital Signal Processing, Audio processing, adaptive signal processing, Array processing, Adaptive Audio Array processing, Audio and Acoustic & Speech processing,
 - Communication system, 1G, 2G GSM, 3G (UMTA, WBCDMA), 4G LTE, 5G, wireless mobile system, LTE, WiFi, Bluetooth, Wireless system standards, MODEM standards, CABLE MODEM DOCIS, DSL
- Research Funded by NSF, USAID, DARPA, JPL, NASA, Motorola Inc., Intel Inc., Broadcom, Qualcomm, Raytheon, General Dynamics, Texas Instruments, and over 10 other industries.

2004-2020, Director and founder of NSF IUCRC Center Connection One, School of Electrical, Computer, and Energy Engineering, Arizona State University, Tempe, AZ; <https://connectionone.org>

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- The NSF Connection One Industry/University Cooperative Research Center was established the center in 2002 with focus on communication system, integrated Circuits and Systems, wireless system, RF, sensors, and related areas. The center has five university member with over 30 industrial members. Total funding over \$10M.

2021-Present, Director and PI, USAID, Center of Excellence for Energy (COE) in Egypt , Funding \$22.5M

- Director and PI: COE - Energy Center funded by the USAID.
 - USIAD Centers of Excellence for Energy (COE) - established the Center of Excellence for Energy (COE/E) in Egypt with funding and support from the United States Agency for International Development (USAID/Egypt) in November 2021. COE/E is a partnership between ASU-US and three Egyptian partner universities (EPUs): Ain Shams University (ASU-EG), Aswan University (AU), and Mansoura University (MU).

2014-2020, Director, USAID, US-PCASE: Center for Advance Studies in Energy, Funding \$18M.

<https://uspcase.asu.edu/>

- **Director and PI:** PCASE - Partnership Center for Energy systems, Energy Center funded by the USAID.
- USIAD Centers for Advanced Studies in Energy program (USPCAS-E) is a partnership between Arizona State University and two leading Pakistani universities: the National University of Science and Technology (NUST) Islamabad and the University of Engineering and Technology in Peshawar (UET).
- PCASE has developed two new Graduate schools of Energy. Within 5 years, the center has over 1000 MS and PHD Students, with 14 new energy degrees in MS and PhD, two new building with 20+ energy labs in the power system, grid, power electronics, renewable energy, PV, Wind, Hydro, bio-fuel, fuel cell, batteries and storage, and thermal areas.

2008-2012: Associate Dean of Research, Ira A. Fulton Schools of Engineering, Arizona State University

Responsible for leading the research infrastructure, promoting and developing research programs with industry and federal agencies, leading large multi-university proposals, investing and providing seed funding to foster new research areas, and promoting graduate program in the college of engineering. Research Enterprise support included:

- Increase College of Engineering research funding from \$50M to over \$80M.
- Working with Vice President for Research, Dean's, and directors on University-wide research initiatives.
- Established the first NSF Engineering Research Center (ERC) at the ASU on Solar Energy QESST. Managed, organized and planned the ERC proposal process. ASU is the lead school partnering with MIT, Georgia Tech, U of Delaware, Cal-Tech, U of New Mexico, and UA.
- Lead several trans-disciplinary 4M research projects (4M: multi-million, multi-investigator, multi-disciplinary, multi-university grants) in energy, security, and related initiatives.
- Oversight of over 20 existing research centers in the college of Engineering.
- Engage with industry and federal government to establish new research collaborations.
- Organized workshops and supported proposals for NSF, NIH, DOE, DOD, DARPA, etc.
- Organized workshops for new assistant professors to apply for NSF CAREER Awards. ASU CAREER awards grew from 3 annual awards in 2008 to over 15 CAREER awards by 2012.
- Research Administration and pre-award proposal administration for the schools. Developed a decentralized research administration and advancement team for the Schools supporting 5 schools, 12 departments, over 220 engineering faculty, with funding over \$70M.

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- Annual budget over \$7M for supporting research centers, seed funding for new center, cost sharing, proposal support, equipment and infrastructure support, graduate scholarships, and research administration.
- ADR Staffs included, Director of industrial and government liaison, Director of research administration, and 14 research advancement staff.
- Graduate Programs: Recruiting, Fellowships, marketing, outreach, coordination with departments

1997-2001, Adjunct Professor, Electrical and Computer Engineering Dept., The University of Texas, Austin, Texas, Taught graduate courses at UT Austin on Introduction to Telecommunication System and Digital Communications. Co-advised two Ph.D. program committees in IC design and Telecomm (while at Motorola)

1987-1993, NSF Center For Digital / Analog IC (CDADIC) Co-Director, NSF IUCRC Center director at Oregon State University. The CDADIC was established the center in 1987 with focus on integrated circuits at WSU, UW, and OSU with over 20 industrial members - <https://cdadic.oregonstate.edu/>

1987-1993, Assistant / Associate Professor (Tenured) Electrical and Computer Engineering Department, Oregon State University, Corvallis, OR

- Research and classes in Electronics, DSP, Communication system and networks, Wireless systems, MODEMS. Graduated 30 MS and Ph.D. students.
- Faculty Chair, Computer Engineering Program, Developed a new Computer Engineering Program at OSU in 1987

INDUSTRIAL POSITIONS

1993-2001: Motorola Inc., Senior Member of Technical Staff, Personal Communication Sector, Austin, Texas - Worked projects related to wireless communications, two-way push-to-talk radios, wireless networks, ADSL and MODEM RF, and related areas.

- **Motorola Cellular Division, Wireless Technology Center (WITC), 1997-2002.** Responsible for development of integrated circuits and systems for wireless handset. Lead number of projects including cellular (2G, 3G, 4G), wireless connectivity (Bluetooth and WIFI transceiver), GPS and location Receiver, wireless networks, 2-way radios and related areas. Worked on the development of various subcomponents including system design, link budget, RF front-end, RF receiver, RF transmitter, digital audio processing, audio processing, DSP, frequency synthesizer, ADC, DAC, filtering, analog front-end, power management, battery management, and baseband processor, baseband circuits and systems.
- **Motorola Semi-conductor products sector (SPS), Broadband Products Operations, 1995-1997,** Worked on the development of XDSL (ADSL, VDSL, G.lite), MODEM, and Optical broadband communication systems including OFDM, modulation, synchronization, equalization and the development of a single chip ADSL transceiver (*CopperGold™*). The transceiver contained Analog Front End (A/D, D/A, Hybrid), custom DSP, baseband processor, DMT, modulation/demodulation, FFT, IFFT, echo canceler, time domain equalizer, front-end constellation mapping, Trellis code modulation, Viterbi decoder), audio processing, DSP, signal processing, and an on-chip DSP core.
- **Land Mobile Products Sector LMPS 1993-1995,** Responsible for Wireless digital two-way radios, developed RFIC, RF receiver, RF transmitter, digital audio processing, audio custom IC, DSP, frequency

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synthesizer, ADC, DAC, hot spot wireless network, next generation of digital two-way radios, "Talk about Radios", Japanese cellular systems (PHS).

- **Standards**, Represented Motorola in various standards including 2G-4G, GPS, Bluetooth working group, WiFi, 802.11, and DSL standards including T1E1, International Telecommunication Unit (ITU), T1E1, ETSI, 3GPPP, Universal ADSL Working Group (UAWG), Bluetooth working group, G.Lite working group, etc.
- **University relations**, Responsible for the development of collaborative research programs with several universities. Responsible for funding research in the areas of Wireless Transceiver IC Design, RF, and mixed-signal and baseband system architecture.

1985-87: Member of Research Staff, Boeing Co., Bellevue, Wa, Flight Systems Research and Technology Center, summer. Design Engineer, Hardware and CAD tool development for system control.

AWARDS

- IEEE Fellow 2004-Present
- IEEE Fellows CAS Committee Chair, 2009-2012
- Global Standards Award, For contributions in the International Telecommunication Unit (ITU) for Asymmetric Digital Subscriber Line (ADSL) G.Lite Standards. Motorola Inc., 1999.
- 10X Cycle Reduction Award, for development of new IC design process from DSP algorithm to IC layout, Motorola Inc., 1995.
- IEEE Darlington best paper Award, IEEE Circuits and Systems Society Best Paper Award, 1995. For "Characterization and Comparison of CMOS FSCL Circuits with Conventional CMOS for mixed-signal ICs," Published at: *IEEE Trans. on Circuits and Systems II*, Sept. 93.
- Carter Best Teaching Award, College of Engineering Best Teacher Award, Oregon State University, 1992. For "*outstanding and inspirational teaching in the College of Engineering*". Award is selected by the confidential vote of all of the undergraduate students in the College of Engineering among over 125 professors in the College.
- Industrial University Fellowship (IUF) Award, National Science Foundation, 1993.
- Research Initiation Award, National Science Foundation, 1990-93.
- Outstanding Graduate Student Scholarship, Azur-Data Inc. WSU, 1984

RESEARCH PROJECTS

Partial list of Research Awards (1987-Present):

- **2021-2026 – COE – Center of Excellence for Energy, U.S. Agency for International Development (USAID)**
 - PI and Director, \$22.5M.

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- **2020-2022 - Center for Next Generation Wireless Spectrum Sharing (5-6G Spectral sharing) The National Science Foundation (NSF)**
 - SII Planning, PI, \$300K.
- **2002-2020 – Industry/University Cooperative Research Center (IUCRC), The National Science Foundation (NSF) - Connection One**
 - NSF contribution \$1.5M.
 - Annual Industry Contribution: Total over \$7M.
- **2015-2016 – Integration of Smart Dynamic Optical Communication, The National Science Foundation (NSF)**
 - Integration of Smart Dynamic Optical Communication Networks for Intelligent Distribution of Power Workload and Data in Disaster, \$200K
- **2015-2020 – U.S. Agency for International Development (USAID)**
 - PCASE – Center for Energy systems, PI and Director, \$18M.
- **2013-2014 Arizona Space Grant Consortium, NASA**
 - Goddard Space Flight Center, RADHARD electronics, \$200K
- **2012-2015 – Solar Energy, Private Donor**
 - Solar Energy Development on international projects, \$2M
- **2011-2014 – Self-Characterization for Calibration MEMS Sensors, Semi-Conductor Research Corporation**
 - Self-Characterization for Calibration and Process Feedback of MEMS Devices, bio-sensor , \$300K
- **2011-2013 - Bio-Sensors for Vital Signs Monitoring Device Design, The National Science Foundation (NSF)**
 - Remote wireless Bio-Sensors for Vital Signs Monitoring Device Design, \$250K
- **2010-2011 – Adaptive Compensation of Analog circuits, The National Science Foundation**
 - Adaptive Compensation of Analog circuits imperfections using DSP methods, \$150K,
- **2010-2011 – Adaptive Self-Healing Wireless Sensor, The National Science Foundation**
 - Autonomous Self-Healing Sensor Network Radio and Mixed-Signal Readout System Design National Science Foundation (NSF), \$300K
- **2010-2020 – Solar Testbed, The National Science Foundation (NSF), \$45M (**
 - QESST NSF ERC Center on Solar Energy, Testbed Director
- **2010-2015 – REU, undergraduate research projects, The National Science Foundation (NSF)**
 - Research Experience for Undergraduate Students, projects: adaptive audio, Glucose Amp-meter and impedeometer, total \$400K
- **2008-2013 - Solar System, The Science Foundation of Arizona (SFAZ)**
 - PEPER- Photovoltaic Environmental Performance and Reliability for the Arizona-Wide Electric Grid, \$1.2M.

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- **2008-2009 - Medically implanted bio-sensor, The National Science Foundation (NSF)**
 - Medically implanted bio-sensor, wireless implanted bio-sensors, Wireless Glucose sensors, MICS, \$200K
- **2007-2011 – MEMS implanted hearing aid and bio-sensors, The National Science Foundation (NSF)**
 - Micro-Power Multi-Phase on-chip MEMS Hearing Aid, Adaptive hearing aid audio processor, 2007-2011, \$500K.
- **2007-2009 – Implantable Bio-Sensors, The National Science Foundation (NSF)**
 - High Efficiency Power Delivery and Front-End Module Design for Implantable Bio-Sensors \$480K
- **2005-2009 - MIMO Wireless network, The National Science Foundation (NSF)**
 - Cognitive MIMO Communications for Dynamic-Spectrum Wireless Networks \$150K
- **2005-2009 - Radio Network, The National Science Foundation (NSF)**
 - Autonomous Self-Healing Sensor Network Radio, , \$250K
- **2005-2008 Integrated LiDAR on a chip, BAE Systems**
 - Integrated on-chip Time Measurement Circuits LiDAR; \$650K
- **2005-2008 – Power Management Circuits, Freescale Semiconductor**
 - PWM, Battery & Power management, \$150K
- **2005-2006 – RADHARD Electronics, DOD: Defense Advanced Research Projects Agency (DARPA)**
 - Radhard by Design - MRC/DARPA, Total funding \$1.5M
- **2005-2010 - Wireless Integrated Nano Technology Center, State of Arizona**
 - WINTECH- Wireless Integrated Nano Technology Center Support, 450K annually, total \$2.5M
- **2004-2005 – RFIC, NASA**
 - Integration of Ultra-Low power RF CMOS, \$127K
- **2004-2008 – Implanted Neural-Enabled Prostheses bio-sensor, Deference Advance Research Project Agency (DARPA)**
 - Implanted Neural-Enabled Prostheses biosensor with Sensorimotor Integration, \$500K
- **2004-2008 – NEMS RF Filters, Deference Advance Research Project Agency (DARPA)**
 - Nano-Mechanical RF Band pass resonator for 2GHZ RF Applications, with JPL, \$2.2 M,
- **2003-2005 - Imllanted Neuro-Sensor, DOD-ARMY-ARL: Army Research Office (ARO)**
 - Implanted Neuro-sensor, \$175K
- **2002-2005 – RFIC, WiFi, Intel Corporation**
 - Design of Multi-Standard RF Front-End Circuits for Cellular and WiFi, \$300K
- **2002 – Geo-location, GPS, SRC**
 - LOW POWER ULTRA - WIDE BAND GEOLACTION SYSTEMS, \$65K.
- **2001-2003 – UWB, WIFI, SRC (Semi-conductors research Corp)**

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- Ultra-Wideband Transceivers for cellular and WiFi 802.11, \$225K
- **1987-1993 - Design of Analog/Digital IC's, The National Science Foundation**
 - Center for the Design of Analog/Digital IC's (CDADIC) 1987-1995, At Oregon State, \$1.5M
- **1992-1994 – RFIC, Motorola Land Mobile Products Sector, LMPS**
 - Low Power IF processing for Direct Digital Transceivers, \$100K,
- **1993 – Mixed-Signal IC, Hewlett-Packard**
 - Hewlett-Packard Faculty Chair position in Mixed-Signal IC, HP, \$500K
- **1992-1993 - Faculty industry Fellowships, The National Science Foundation**
 - National Science Foundation, Motorola Inc. Faculty Industry Fellowship, \$250K,
- **1992-1993 - Research Initiation Award (RIA) , The National Science Foundation**
 - National Science Foundation, Research Initiation Award (RIA) (same as current CAREER Award), Synthesis and Automatic Derivation of Multi-Rate VLSI Arrays for DSP Algorithms, \$320K.
- **1988-1992 – Center for the Design of Analog/Digital IC's (CDADIC)**
 - CDADIC, various projects on Low-Noise Source Coupled Logic (SCL), Mixed-Mode IC's, CDADIC \$350K.
- **1988- Spectrum and time analyzers, Tektronix Inc.**
 - Decimation Filters for A/D Noise Enhancements, Tektronix, Inc., \$100K,
- **1987-1993 – DARPA, MOSIS, Tektronix, IT, Motorola**
 - Various grants for IC Fabrication (DARPA/MOSIS, VLSI)
 - Testing equipment (Tek, HP)
 - DSP system development (TI, Motorola)

PROFESSIONAL RECOGNITION

- IEEE Fellow, 2004-Present
- IEEE Fellow Committee Chair, CAS, 2008-2010
- IEEE Fellow Committee member, 2007-2010.
- IEEE Senior Member, 1993-Present, IEEE Member 1987-1992.
- IEEE Faculty Advisor, Oregon State University, 1987-1990

IEEE Editorials

- IEEE Microwave Magazine, Editor,
- IEEE System Journal, Associate Editor, 2010-2011.
- IEEE Transactions on VLSI, Associate Editor, Jan 2001-2008.

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- IEEE Communication Magazine, Editor, Feature Issues on “Circuits for Wireless and Wireline Communications,” April 1999.
- IEEE Transactions on Microwave Theory and Techniques, editor, Special Issue on: "Radio Frequency IC Design,” Dec. 1998.
- IEEE Transactions on Circuits and Systems-II, editor, Special Issue on: “Low-Power Wireless Communication Systems,” June 1997.
- Associate Editor, IEEE Transactions on Circuits and Systems-II, 1993-1996.
- *Editor and Reviewer for many IEEE journals and conferences*
- *Founding member of IEEE RF Integrated Circuits Symposium*
- *Associate Editor, IEEE Communications, Tutorial & Surveys Magazine, 2006-2009.*

Conference Organizations

- RFIC Executive Committee members, 2000-2017
- RFIC Steering Committee Member, RFIC symposium, 1996-2017.
- RFIC Founding member, 1995-96.
- Technical Program Chair, IEEE International Sym. on Circuits and Systems, Phoenix, AZ, 2002.
- ISSCC Admin Council, Conferences Committee 2000-2005.
- General Chair, Radio Frequency IC (RFIC) Symposium, Seattle, WA, 2002.
- Technical Program Chair, RFIC Symposium, Phoenix, AZ, 2001.
- Finance Chair, RFIC symposium, Boston, MA, 2000.
- Publicity Chair, RFIC symposium, Los Angeles, CA, 1999.
- Transactions Chair, RFIC symposium, Baltimore, MD, 1998.
- General Chair, Int. Sym. on Low-Power Electronics and Design (ISLPED), Bio-Sensors, Monterey, CA, 97.
- Executive Committee Member, Int. Symp. On Low-Power Electronics and Design, 96-2000.
- Technical Program Committee Member of the following conferences:
 - International Conference on Circuits and Systems: 1996, 2000, 2001, 2004-2008
 - RFIC Symposium, 1996-2018
 - Application Specific Array Processing (ASAP): 2000-2002
 - Technical Program Chair, Int. Sym. on Low-Power Electronics and Design, Monterey, CA, 96.
 - Arizona Telecom Comm (ATIC)
 - GLS VLSI 1998, Lafayette, Louisiana, 1998
 - VLSI Design 98, Chennai, India, Jan. 1998.
 - ICECS, Lisbon, Portugal, 98.
 - Application Specific Array Processing, 1995-97, 2000
 - Vehicular Technology Conference, 1995-97.

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- Inter. Conf. on Intelligent Information Systems, D.C., 1994-95.
- IEEE Pacific Rim Conference on Communications & Computers, Victoria, BC, Canada, 1991.

Invited talks, Panelist, Session Chairs, Workshop Speaker

- Conference chair, Technical Program committee chair and TPC member, tutorials, workshops, session chair, etc. in RFIC, ISSCC, ISCAS, VLSI, ICASSP, Low-Power Symposium, ICC, Application Specific IC's, IMS, MTT, etc.

CONSULTANT

- Medtronic's, Analog bio-sensors, MICS, 2005.
- Intel Inc. Chandler, AZ, 2002-2006: Development of 3G-4G Wireless transceiver.
- Sony Inc., San Diego, CA and Tokyo, Japan, 2002-2004: Review and development of various telecom cellular system architecture including 3G system architecture, and GPS system.
- Motorola Inc. 2002-2005: Supporting development of BT, WiFi, E911, GPS integrated circuits and systems for the cellular and mobile handsets.
- Hewlett Packard, Corvallis, OR – 1990-1993: Various project on development of custom analog and digital IC's for printer and inkjet system. Some of this work was under consultation, and some under various research grants with Oregon State University.
- Tektronix Inc, Beaverton, OR - 1988-1990: Design and Implementation of Data acquisition system for Spectrum analyzer, development of custom DSP algorithm for the Tektronix spectrum analyzer including system architecture, simulation, analysis, and design of oversampled data acquisition system.
- Boeing Commercial Aircraft, BCAC, Renton, WA - 1985-1987: Development of Airplane Controller Model, Simulation and Implementation of Flight control, Model reduction, and system control.

EXPERT WITNESS (Patent, IP)

Patent litigation, patent validity, infringement, IPR, expert reports, deposition, testimony, and trade secrets at ITC, District court, and USPTO in the following areas (Complete list of cases available):

- **Electronics:** Analog and Digital IC, Radio Frequency Integrated Circuits RFIC, Power Management, Battery Management, PMIC
- **Bioelectronics:** Bi-sensors, Glucose monitoring system, Heart monitoring system, Hearing AID
- **Wireless communication:** 3G, 4G, 5G, OFDM, WiFi, 802.11, Bluetooth, Wireless LAN, Wi-Fi, 802.11, Bluetooth, ZIGBEE, Wireless Standards (ITU, ETSI, 3GPP, LTE) including AMPS, GSM, CDMA, WCDMA, LTE, 1G, 2G, 3G, 4G, BT, WiFi (802.11), Satellite communications, Satellite Transceiver, ECHO and Multi-path cancellation
- **Wireline Communications:** MODEM, Digital Subscriber Line, ADSL, VDSL, MODEM, Wireline standards including DSL, MODEM and DOCSIS, and related standards ITU/ETSI
- **GPS & Location:** GPS system, GPS receiver, location determination

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- **MEMS:** MEMS, Bulk Acoustic Wave Filters, SAW, MEMS resonators, MEMS sensors, MEMS accelerometer
- **Signal processing & Communication:** Audio and acoustic signal processing, Audio Array processing, adaptive signal processing, Communication networks, Communication system

PATENTS, PUBLICATIONS

Patents and Patent Applications

id	title	assignee	inventor/author
AU-2003222007-A8	Oscillator frequency correction in gps signal acquisition	Motorola Inc	Sayfe Kiaei, Thomas M King, George J Geier
WO-03093858-A3	Oscillator frequency correction in gps signal acquisition	Motorola Inc	Thomas M King, George J Geier, Sayfe Kiaei
WO-2004048909-A3	Compressed vector-based spectral analysis method and system for nonlinear rf blocks	Univ Arizona, Shahin Farahani, Sayfe Kiaei, Nazanin Darbanian	Shahin Farahani, Sayfe Kiaei, Nazanin Darbanian
US-2006226909-A1	Monolithic supply-modulated rf power amplifier and dc-dc power converter ic	Siamak Abedinpour, Sayfe Kiaei	Siamak Abedinpour, Sayfe Kiaei
US-7218085-B2	Integrated ZVS synchronous buck DC-DC converter with adaptive control	Arizona Board Of Regents	Siamak Abedinpour, Sayfe Kiaei
US-7372333-B2	Monolithic supply-modulated RF power amplifier and DC-DC power converter IC	Arizona Board Of Regents, Acting For And On Behalf Of Arizona State University	Siamak Abedinpour, Sayfe Kiaei
US-7528754-B1	Finite impulse response digital to analog converter	Arizona Board Of Regents	Bertan Bakkaloglu, Sayfe Kiaei, Shahin Taleie
US-2018049703-A1	Wireless in-shoe physical activity monitoring	Timothy W. Markison, Sayfe Kiaei, Gary McCoy	Timothy W. Markison, Sayfe Kiaei, Gary McCoy
US-10264996-B2	Method and apparatus for wirelessly monitoring repetitive bodily movements	Sayfe Kiaei	Sayfe Kiaei
US-2019231226-A1	Method and apparatus for wirelessly monitoring repetitive bodily movements	Sayfe Kiaei	Sayfe Kiaei
US-10653337-B2	Local object detection system	Timothy W. Markison, Sayfe Kiaei, Gary McCoy	Timothy W. Markison, Sayfe Kiaei, Gary McCoy
US-2020266708-A1	Electronic circuit and method of controlling three-level switching converters	Arizona Board Of Regents On Behalf Of Arizona State University	Parisa Mahmoudidaryan, Sayfe Kiaei, Bertan Bakkaloglu
US-11108325-B2	Electronic circuit and method of controlling three-level switching converters	Arizona Board Of Regents On Behalf Of Arizona State University	Parisa Mahmoudidaryan, Sayfe Kiaei, Bertan Bakkaloglu
US11129547B2	Wireless in-shoe physical activity monitoring	Sigmasense LLC	Timothy W. Markison, Sayfe Kiaei, Gary McCoy

Standards Contributions

1. “Spectral Compatibility of ADSL: Frequency Overlap vs. FDM,” T1E1, Dec. 97.
2. “Echo Cancellation for G.Lite Universal ADSL,” OFDM, Universal ADSL Working Group, Atlanta, GA, Jan 98.
3. “8-bit QAM Constellation effects on reach for universal ADSL,” OFDM, Universal ADAL Working Group, Atlanta, GA, Jan 98.
4. “Trellis Code Modulation coding gain for OFDM,” Universal ADSL Working Group, Atlanta, GA, Jan 98.
5. “Monte Carlo Modeling and simulation of twisted pair wiring for OFDM,” Universal ADAL Working Group, Atlanta, GA, Jan 98.
6. “Overlap Upstream/Downstream spectral allocation for OFDM ADSL ,” International Telecommunication Unit, Chicago, March 98.
7. “Echo Cancellation for ADSL OFDM,” International Telecommunication Unit, Antwerp, Belgium, 98.
8. “Performance of Echo Cancellation ADSL in OFDM system in the presence of Near End Cross Talk (NEXT),” International Telecommunication Unit, Honolulu, Hawaii, June 98.
9. Presentations and editorials at various XDSL and OFDM standards: ITU, ETSI, UAWG, and T1E1, 97-99.
10. Presentations and editorials at various 3G and 4G and wireless standards including ITU, 3GPPP, 802.11, BT,

Books

“Design, Modeling and Testing of Data Converters, P Carbone, S Kiaei,” F Xu - 2014 – Springer, © Springer-Verlag Berlin Heidelberg 2014

Refereed Journal Papers

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1. CMOS Full-Duplex Mixer-First Receiver With Adaptive Self-Interference Cancellation S. -A. Ayati; A. Alizadeh; S. Kiaei, IEEE Transactions on Circuits and Systems I, Jan 2021.
2. A 10-W X-Band Class-F High-Power Amplifier in a 0.25μm GaAs pHEMT Technology, A. Alizadeh; M. Yaghoobi; M. Meghdadi; A. Medi; S. Kiaei, IEEE Transactions on Microwave Theory and Techniques, Jan 2021.
3. An X-Band Class-J Power Amplifier With Active Load Modulation to Boost Drain Efficiency A. Alizadeh; S. Hassanzadehyamchi; A. Medi; S. Kiaei, IEEE Transactions on Circuits and Systems I: Sep 2020
4. In-Field Recovery of RF Circuits from Wearout Based Performance Degradation D. Chang; J. N. Kitchen; S. Kiaei; S. Ozev, IEEE Transactions on Emerging Topics in Computing, Jun 2020
5. A 50-V Isolation, 100-MHz, 50-mW Single-Chip Junction Isolated DC-DC Converter With Self-Tuned Maximum Power Transfer Frequency, C. Liu; D. Mandal; Z. Yao; M. Sun; J. Todsén; B. Johnson; S. Kiaei; B. Bakkaloglu, IEEE Transactions on Circuits and Systems II: Express Brief, May 2019
6. Wideband Hybrid Envelope Tracking Modulator With Hysteretic-Controlled Three-Level Switching Converter and Slew-Rate Enhanced Linear Amplifier, P. Mahmoudidaryan; D. Mandal; B. Bakkaloglu; S. Kiaei, IEEE Journal of Solid-State Circuits, 2019.
7. Low-Power/Low-Voltage Integrated CMOS Sense Resistor-Free Analog Power/Current Sensor Compatible With High-Voltage Switching DC-DC Converter, S. Singh; D. Mandal; B. Bakkaloglu; S. Kiaei IEEE Transactions on Circuits and Systems I, 2019
8. Adaptively Biased Output Cap-Less NMOS LDO With 19 ns Settling Time, D. Mandal; C. Desai; B. Bakkaloglu; S. Kiaei, IEEE Transactions on Circuits and Systems II: Express Briefs, 2019
9. Chirag Desai; Debashis Mandal; Bertan Bakkaloglu; Sayfe Kiaei, "A 1.66 mV FOM Output Cap-Less LDO With Current-Reused Dynamic Biasing and 20 ns Settling Time," IEEE Solid-State Circuits Letters Year: 2018, Volume: 1, Issue: 2, Pages: 50-53
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11. Ayati, Mandal, Bakkaloglu, Kiaei, "Integrated Quasi-Circulator With RF Leakage Cancellation for Full-Duplex Wireless Transceivers," IEEE Trans of Microwave theory and techniques, Dec 2017.
12. "A 50-mA 99.2% Peak Current Efficiency, 250-ns Settling Time Digital Low-Dropout Regulator With Transient Enhanced PI Controller", ChaiYong Lim ; Debashis Mandal ; Bertan Bakkaloglu ; Sayfe Kiaei; IEEE Transactions on Very Large Scale Integration (VLSI) Systems; Year: 2017, Volume: 25, Issue: 8; Pages: 2360 - 2370
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 28. Sang-Soo Je; Rivas, F.; Diaz, R.E.; Jiuk Kwon; Jeonghwan Kim; Bakkaloglu, B.; Kiaei, S.; Junseok Chae; , "A Compact and Low-Cost MEMS Loudspeaker for Digital Hearing Aids," *Biomedical Circuits and Systems, IEEE Transactions on* , vol.3, no.5, pp.348-358, Oct. 2009
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40. Bandwidth extension technique for polar modulated RF transmitters ; Bakaloglu, B.; Kiaei, S.; Dwyer, R.; Electronics Letters; Volume: 42 Issue: 8 13 April 2006 ; Page(s): 476- 478 ;
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Conference Publications

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2. 27.5 A 91%-Efficiency Envelope-Tracking Modulator Using Hysteresis-Controlled Three-Level Switching Regulator and Slew-Rate-Enhanced Linear Amplifier for LTE-80MHz Applications P. Mahmoudidaryan; D. Mandal; B. Bakkaloglu; S. Kiaei, 2019 IEEE International Solid- State Circuits Conference - (ISSCC), 2019
3. Integrated High-Efficiency Single-Inductor CCM Boost Converter for Multi-Junction PV Energy Harvesting, Q. Peng; D. Mandal; P. Mahmoudidaryan; B. Bakkaloglu; S. Kiaei, 2019 IEEE Applied Power Electronics Conference and Exposition (APEC), 2019
4. Sense resistor-free analog power sensor for boost converter with 14.1% gain error and 9.4% offset error, Shrikant Singh ; Debashis Mandal ; Bertan Bakkaloglu ; Sayfe Kiaei; 2018 IEEE 9th Latin American Symposium on Circuits & Systems (LASCAS), 2018
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127. "VLSI Design of Bit/Serial Adaptive IIR Filters," Proc. of IEEE Pacific Conference on Communications, Computers, and Signal Processing, Victoria, Canada, pp. 650-652, June 1989. [R. Badyal, S. Kiaei]
128. "CCA Approach for ARMA Spectral Analysis," Proc. of IEEE International Symposium on Circuits and Systems, Portland, OR, pp. 1319-1322, May 1989. [S. Kiaei, L. Luo]
129. "Canonical Correlation Analysis (CCA) for ARMA Spectral Estimation," IEEE International Symposium on Circuits and Systems, May, 1989. [Kiaei, S.; Luo, L.]
130. "VLSI Implementation of Adaptive Bit/Serial IIR Filters," IEEE Pacific Rim Conference on Communications, Computers and Signal Processing, June 1989. [Badyal, R.; Kiaei, S.]
131. "VLSI design of WAP for Recursive Equations," VLSI Signal Processing, 1988. [S. Kiaei, U. Desai]
132. "Independent Data Flow Wavefront Array Processors for Recursive Equations," Proc. of 20th Annual Conference on Information Sciences and Systems, Princeton University, NJ, 1986. [S. Kiaei, U. Desai]
133. "A Stochastic Realization Approach to Reduced-Order Hierarchical Estimation," Proc. of 24th IEEE Conference on Dec., Ft. Lauderdale, FL, pp. 416-421, December 1985. [U. Desai, S. Kiaei]
134. "Hierarchical Estimation Algorithms," Proc. of IEEE Conference on Man, Cybernetics, and Systems, Tucson, AZ, October 1985. [U. Desai S. Kiaei]
135. "Approximation of Markovian Models with Non-Constant Parameters," Proc. of 23rd IEEE Conference on Dec., Las Vegas, NV, pp. 1642-1644, December 1984. [U. Desai, S. Banerjee, S. Kiaei]
136. "A Canonical Correlation Approach to Reduced-Order LQR Design," Proc. of 23rd IEEE Conference on Dec., Las Vegas, NV, pp. 1523-1528, December 1984. [U. Desai, S. Banerjee, S. Kiaei]

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GRADUATE STUDENT ADVISEES & RESEARCH PROJECT

(Partial list of Students graduated, current employment to the best of my knowledge)

1. J. Durgam, VLSI Design of Dynamically Reconfigurable Array Processors, MSEE, 1988. Intel.
2. J. Gilbert, Minimization Techniques for PLAs, MSEE, 1988, Tektronix Inc.
3. L. Luo, CCA Methods for ARMA Spectral Estimation, MSEE, 1989. Berkeley Research Center
4. E. Zahl, Enhancement Methods for A/D Noise Reduction, MSEE, 1989. AT&T
5. L. Aihua, Synthesis of MRAs, MSEE, 1990. Intel.
6. F. Aslam, Image Restoration Methods, MSEE, 1990.
7. S.H. Chee, FSCL Circuits for Mixed-Mode IC's, MSEE, 1990. Linear Tech.
8. C. Dawson, MSEE, 1990. Boeing
9. A. Chow, Source-Coupled Logic ALU, MSEE, 1990. Intel
10. S. Maskai, Decimation Filters Using FSCL Circuits, MSEE, 1991. Intel
11. L. Louis, VLSI Implementation of Toeplitz Matrices, MSEE, 1991.
12. R. Badyal, Bit/Serial VLSI Design of IIR Filters, MSEE, 1992, HP
13. Lap Mui, Piece-Wise Linear Schedule for VLSI Arrays, MSEE, 1992. HP
14. S. Abdennadher, Adaptive Sigma-Delta Modulators, MSEE, 1992. Level One / Intel.
15. H. Bribech, Second Order Adaptive A/D Schemes, MSEE, 1992.
16. B. Hickman, MSEE, 92. Tektronix
17. M. Maleki, Current-Mode Flash A/D, MSEE, 1992. University of Oregon
18. Man Wong, Low-Noise Decimation Filter for Mixed-Mode ICs, MSEE, 1993, Motorola.
19. Anu Krishna Swamy, Low Noise IC Blocks for Mixed-mode IC's, MSEE, 1993, Ph.D., 1997.
20. Manu Srivastava, Comparison of Differential Logic (FSCL, CVSL, DSLL), MSEE, 1994, Intel.
21. Joel Oren, VLSI Design of Asynchronous FIR Filters, MSEE thesis, Feb. 1994. E-Systems.
22. Y. Zheng, VLSI Design and Synthesis of Multi-Rate Arrays, Ph.D. March 94, Hughes Research.
23. Satish Kulkarni, Low-Sensitivity Filters, MSEE, 1995, Motorola.
24. Amit Dutta, Multi-user Interference Cancellation, Ph.D, Dec. 97, Faculty, India.
25. Dwight Poplin, Multiplierless MPEG Decoder, MSEE, 1996. HP.
26. Maxim Scarpa, Adaptive I/Q Miss-match Correction for Direct Conversion Receivers, MSEE 1998.
27. Jeff McNeal, Sigma-Delta Frequency-to-Time Conversion, MSEE, 1998. Level One Comm.
28. Julia Vogel, Adaptive DC offset Cancellation, MSEE, 1998. Faculty in Germany.
29. Takao Inoue, MS, Echo Cancellation for ADSL, 1998. MSEE, The U of Texas at Austin.
30. Navid Lashkarian, Frequency off-set estimation and Synchronization of OFDM systems, Ph.D., June 1999. Broadcom Inc. & Faculty at UC San Jose.

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31. Guner Arslan, (co-advisor with B. Evans), "Fast Equalization for DMT systems, with applications to ADSL," Ph.D. The University of Texas at Austin, 2000
32. Salem Abdennadher, I/Q Mismatch Correction for RF Wireless transceivers, Ph.D., Level One Comm/Intel.
33. Can Sandalci, DSL Line Driver, Ph.D., 2001, Intel.
34. Dean Badillo, Low-Cost VCO Ring Oscillators, PhD, 2004, Intel, Chandler,
35. Siamak Abedinpour, PhD, 2005 Freescale, Tempe, Arizona
36. Hemanth Shivalingaiah, Multi-Band Low Noise Amplifiers, Ph.D., 2006, Intel,
37. Shahin Farahani, PhD, 2006, Qualcomm Inc,
38. Nazanin Darbanian, M.S. Freescale, Tempe, Arizona
39. Joe Rutkowski, Joseph, MS, 2004, Phillips.
40. Chaudhuri, Bikram, Synthesizer, MS/PhD, MS 2004.
41. Zhang, Jiandong, MEMs, MEMS, December-04
42. Afsahi, Ali, MS/PHD, UC San Diego, QUALCOMM, Connection One
43. Chen, Xiaomin, UWB, PHD, 2007, SRC/Motorola
44. Jali, Hilda, Power Management, MS, June-05,
45. Xuejin Wang, RF Optimization, 2006 CAD tools, PhD, Neo-Linear
46. Umar Lyles, Power Amplifier, MS, 2006. Texas Instruments
47. MS, Erika Munoz, RADHARD, 2007, Intel
48. Waleed Khali, (Co-Advisor), Professor at Ohio State
49. Jennifer Kitchen, PhD, 2009, Professor at ASU
50. Shahin Mehdizad Taleie, RFDAC, PhD, 2009, Qualcomm
51. Ilker Deligoz, PHD, 2009, Qualcomm
52. Hyung Kim, PhD, Jan 2010, Intel
53. Jung Le, PhD 2010, Intel, TI
54. Syed Naqvi, PhD, 2012, Intel.
55. Todd Martin, MS, 2011, TI
56. Seungkee Min, PhD, 2011, Intel
57. Ali Meamar, Post Doc, RFIC 2013
58. Hitesh Khunti, MS 2013, Qualcom
59. Debashis Mandal, Post Doc, Research faculty 2015-2018
60. Edgar Martinez, PhD, 2015, Qualcomm
61. Chirag Desai, MS, 2016, Qualcom
62. Sanjay Avasarala, MS, 2016

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- 63. Li Ming, MS, 2017
- 64. Qirong Peng, MS, 2017,
- 65. Yu Geng, PhD, 2018
- 66. Amir Ayati, PhD Aug 2018; Qualcomm
- 67. Pasisa Mahmoudi, PhD, May 2019, Qualcomm
- 68. Chai Yong, MS: 2015, PHD: 2019, Qualcomm
- 69. Shrikant Singh, MS: 2016, PhD, 2019, Movandi
- 70. Amir Alizadeh, Research Faculty 2019-Present
- 71. Ata S. PhD, 2021, Ata Sarrafinejad, PhD, 2021

UNIVERSITY COMMITTEES

Various Committees at ASU, Oregon State University, etc.

INDUSTRY COMMITTEES

- Arizona Telecommunications and Information Council (ATIC), Board Member
- CAS Fellows Committee (ends December 31, 2006)
- *IEEE CAS Phoenix Chapter Organizers (the committee is in the process of determining new chair – current chair not active)*
- *Executive Committee, RFIC 2006.*
- *Technical Program Comm, IEEE RFIC 2006.*
- *Executive Committee, Conferences, International Solid State System's Conference.*
- *IEEE CAS Society, VLSI Technical Comm. Member*
- *Editorial Board, IEEE Communications Surveys & Tutorials*
- *Radio Frequency Integrated Circuits- RFIC 2006*
- *IEEE RF Integrated Circuits Conference, Committee Chair for two workshops*
- *International Microwave Symposium, IMS-MTT 2006*
- *Int. Symposium on Circuits and Systems - ISCAS 2006*
- *Wireless Networks & Emerging Technologies, WNET06*
- *Midwest Symposium on Circuits and System*
- *Arizona Governor IT Advisory Committee – GITA*
- *Arizona Telecom – ATIC*

INSTRUCTIONAL SUMMARY

- Digital IC Design, Analog IC Design, Advance CMOS Analog IC, VLSI, RFIC Design
- Wireless Transceiver Design, Wireless Communications, GPS, Telecomm Systems, Digital Communication

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- Signal Processing, Advance digital signal processing, Communication, Digital Communication, Digital Audio Processing, Adaptive array processing
- Computer Architecture, Microprocessor System Architecture, Pipeline Array Processing