

Declaration of Dr. Michael Buehrer

U.S. Patent No. 7,628,333

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.

Petitioner

v.

DH INTERNATIONAL LTD.

Patent Owner

Case No. IPR2025-00173

U.S. Patent No. 7,628,333

**DECLARATION OF DR. MICHAEL BUEHRER
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF
U.S. PATENT NO. 7,628,333**

TABLE OF CONTENTS

I.	INTRODUCTION.....	10
A.	EDUCATIONAL BACKGROUND AND PROFESSIONAL EXPERIENCE	10
II.	METHODOLOGY AND MATERIALS CONSIDERED.....	16
III.	OVERVIEW AND LEGAL STANDARDS.....	18
A.	PERSON OF ORDINARY SKILL IN THE ART	19
B.	OBVIOUSNESS	19
C.	ANALOGOUS ART.....	25
D.	CLAIM CONSTRUCTION	25
IV.	LEVEL OF A PERSON OF ORDINARY SKILL.....	26
V.	OVERVIEW OF THE TECHNOLOGY.....	28
A.	PORTABLE ELECTRONIC DEVICES FOR WIRELESS DATA CONVEYANCE	28
B.	CIRCUITRY IN PORTABLE ELECTRONIC DEVICES FOR WIRELESS DATA CONVEYANCES.....	33
C.	TRIGGERING DATA CONVEYANCE AND USER AUTHENTICATION IN PORTABLE ELECTRONIC DEVICES.....	38
VI.	OVERVIEW OF THE '333 PATENT.....	44
VII.	THE PROSECUTION HISTORY OF THE '333 PATENT.....	48
A.	PROSECUTION HISTORY OF THE '333 PATENT	48
VIII.	SUMMARY OF UNPATENTABILITY.....	50
IX.	OVERVIEW OF THE PRIOR ART	50
A.	OVERVIEW OF <i>MCGREGOR</i>	50
B.	OVERVIEW OF <i>PALMER</i>	53
C.	OVERVIEW OF <i>TUTTLE</i>	57
X.	THE CHALLENGED CLAIMS ARE UNPATENTABLE	59
A.	GROUND 1: CLAIMS 1, 2, AND 4-10 ARE OBVIOUS UNDER PRE-AIA 35 U.S.C. § 103 OVER <i>MCGREGOR</i> IN VIEW OF <i>PALMER</i>	59
i.	Claim 1	60
ii.	Claim 2	99
iii.	Claim 4	99
iv.	Claim 5	100
v.	Claim 6	102

vi.	Claim 7	105
vii.	Claim 8	106
viii.	Claim 9	106
ix.	Claim 10	107
B.	GROUND 2: CLAIMS 3 AND 11-13 ARE OBVIOUS UNDER PRE-AIA 35	
	U.S.C. § 103 OVER <i>McGREGOR</i> IN VIEW OF <i>PALMER</i> AND IN FURTHER VIEW OF	
	<i>TUTTLE</i>	111
i.	Claim 3	112
i.	Claim 11	118
ii.	Claim 12	122
iii.	Claim 13	123
XI.	CONCLUSION.....	128

CLAIM LISTING

Claim 1:

Claim 1(Pre): A portable electronic device, comprising:

1(a) an electronic circuit capable of storing data therein, capable of processing data, and capable of data input and output;

1(b) a control device operatively linked to said electronic circuit, with an invariable activation command being issued when said control device is selectively triggered;

1(c) a user interface device operatively linked to said electronic circuit;

1(d) a data transceiver operatively linked to said electronic circuit, said data transceiver being for exchanging data between said electronic circuit and an external data exchange device, and for receiving a selectively emitted activation cue from a source external to said portable electronic device;

1(e) a data conveyance switching element operatively linked to said electronic circuit, said switching element being in an activated state upon an activation cue having been received by said data transceiver, and being in an inactive state when no activation cue was received by said data transceiver; and

1(f) power means for providing power to said portable electronic device;

1(g) wherein upon said control device being selectively triggered to issue and invariable activation command: if said switching element is in said activated state, a

data exchange will be initiated through the instrumentality of said data transceiver for exchanging data between said electronic circuit and an external data exchange device;

1(h) if said switching element is in said inactive state, data will be conveyed from said electronic circuit to said user interface device for communicating information to the portable electronic device holder.

Claim 2:

A portable electronic device as defined in claim 1, wherein said user interface device is a display screen.

Claim 3:

A portable electronic device as defined in claim 1, wherein said data transceiver comprises a data transmitter, a data receiver distinct from said data transmitter, and a cue receiver distinct from said data receiver.

Claim 4:

A portable electronic device as defined in claim 1, wherein said control device is a biometric parameter detector.

Claim 5:

A portable electronic device as defined in claim 4, wherein said biometric parameter detector is a fingerprint scanner capable of obtaining a fingerprint scan,

and whereby said control device is triggered when the fingerprint scan matches a fingerprint image pre-saved in said electronic circuit.

Claim 6:

A portable electronic device as defined in claim 1, wherein said control device is a manually activated button, and whereby said control device is triggered when the button is pressed.

Claim 7:

A portable electronic device as defined in claim 1, wherein said electronic circuit comprises said switching element.

Claim 8:

A portable electronic device as defined in claim 7, wherein said electronic circuit comprises a microchip, and wherein said switching element is a series of instructions programmed onto said microchip.

Claim 9:

A portable electronic device as defined in claim 1, wherein said switching element comprises a logical circuit.

Claim 10:

Claim 10(Pre): A data exchange system comprising:

10(a) a data exchange device comprising a first electronic circuit, a first data transceiver and a cue emitter; and

10(b) a portable electronic device, comprising:

10(c) a second electronic circuit capable of storing data therein, capable of processing data, and capable of data input and output;

10(d) a control device operatively linked to said second electronic circuit, with an invariable activation command being issued when said control device is selectively triggered;

10(e) a user interface device operatively linked to said second electronic circuit;

10(f) a second data transceiver operatively linked to said second electronic circuit;

10(g) a data conveyance switching element operatively linked to said second electronic circuit, and

10(g)(i) switching element being in an activated state upon an activation cue having been received by said second data transceiver, and being in an inactive state when no activation cue was received by said second data transceiver; and

10(h) power means for providing power to said portable electronic device;

10(i) wherein upon said control device being selectively triggered to issue said invariable activation command: if said switching element is in its activated state, a data exchange will occur between said first data transceiver and said second data

transceiver, thereby exchanging data between said data exchange device and said portable electronic device;

10(j) if said switching element is in its inactive state, data is forwarded to said user interface device for communicating information to the portable electronic device holder.

Claim 11:

Claim 11(Pre): A method for data exchange with a portable electronic device of the type comprising; an electronic circuit capable of storing data therein, capable of processing data, and capable of data input and output, a control device operatively linked to said circuit, a user interface device operatively linked to said circuit, communication ports operatively linked to said circuit, a switching element operatively linked to said electronic circuit and being in a default inactive state, and power means for providing power to said portable electronic device, said method comprising the steps of:

11(a) awaiting for an activation cue to be received at a predetermined one of said communication ports;

11(b) if an activation cue is received at one of said communication ports, changing the state of said switching element from its default inactive state to an activated state; and

11(c) selectively triggering said control device to issue an invariable activation command, whereby said method will further comprise one of the two following steps: if said switching element is in its activated state, initiating a data exchange with an external data exchange device through at least one of said communication ports; and

11(d) if said switching element is in its inactive state, conveying data from said electronic circuit to said user interface device for communicating information to the portable electronic device holder.

Claim 12:

A method as defined in claim 11, wherein said activation cue is received at one of said communication ports distinct from another one of said communication ports used for data exchange with the external data exchange device.

Claim 13:

A method as defined in claim 11, wherein the additional following step occurs after selectively triggering said control device if said switching element is in said activated state: conveying data from said electronic circuit to said user interface device for communicating information to the portable electronic device holder.

I, Dr. Michael Buehrer, declare the following:

I. INTRODUCTION

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 Appendix A. Below is a summary of my education, work experience, and other qualifications

3. I am currently a Professor of Electrical Engineering and the former (2014-2022) Director of *Wireless @ Virginia Tech*.

4. My academic and professional background is in Electrical and Computer Engineering, and I have been working in those fields since the completion of my Ph.D. over 25 years ago. Below, I provide a short summary of my education and experience that I believe to be most pertinent to the opinions I have formed in this case.

5. I received a B.S. in Electrical Engineering from The University of Toledo in 1991, an M.S. in Electrical Engineering from The University of Toledo in 1993, and a Ph.D. in Electrical Engineering from Virginia Polytechnic Institute and

State University in 1996. The focus of my graduate work was wireless communication systems. My Ph.D. thesis involved the application of multiuser detection (an advanced signal processing approach to interference mitigation) to CDMA-based cellular systems.

6. After completion of my Ph.D. in 1996, I joined Bell Laboratories, the research division of Lucent Technologies, where I worked for five years as a Member of Technical Staff and later as a Distinguished Member of Technical Staff. My work there focused on developing advanced technologies for cellular telecommunications, including for 3G cellular standards. For example, while at Bell Labs, I developed and implemented algorithms for intelligent antenna systems that increased the voice capacity (*i.e.*, number of simultaneous phone calls) and data capacity of cellular systems. These algorithms were included in Lucent Technologies' 3G CDMA cellular base station. I also developed techniques known as transmit diversity techniques that increased reliability (*i.e.*, reduced the probability of a dropped call) of cellular systems. These transmit diversity techniques were standardized in the 3GPP2 cellular standard known as cdma2000. During that time, I supported the standardization of my ideas by writing contributions to the working groups developing the standards and attending standards meetings. In particular, I participated in the 3GPP2 standardization

process. During that time, I worked with colleagues to include my ideas on the use of transmit diversity in CDMA systems in the 3GPP2 standard.

7. I am currently a Professor in the Bradley Department of Electrical and Computer Engineering at Virginia Polytechnic Institute and State University, where I have taught and conducted research in the area of wireless communications, geolocation and radar for over 20 years. Specifically, I have taught courses that cover wireless communications and signal processing (including the underlying concepts) at the undergraduate and graduate levels. For example, I teach a sophomore-level course which introduces the concepts of signals and systems, a junior-level course which introduces the basic concepts of communication systems, senior-level and graduate-level courses that cover advanced digital communication topics, and also graduate-level courses that teach the advanced technologies underlying the latest wireless systems, such as Fourth and Fifth Generation (4G/5G) cellular communication standards (*e.g.*, LTE, LTE-Advanced, New Radio) and Wi-Fi. I also teach graduate courses on advanced topics such as Information Theory, Machine Learning Applied to Communication Systems, Spread Spectrum Communications and CDMA. Furthermore, I have taught short courses covering topics such as position location and position location using ultra-wideband signals.

8. Additionally, I have conducted research into Ultra-Wideband (UWB) signal propagation, UWB receiver design, and UWB signal processing across a

number of funded research projects. I also developed a UWB-based ranging system as part of an automated cargo container transfer system for the United States Navy. Further, I have developed geolocation systems in a number of research projects including designing a prototype system for localizing first responders, developing localization techniques for 5G and 6G cellular networks, localization sub-systems for in-home smart health systems, algorithms for enhancing cellular-based localization, algorithms for localization in the presence of interference and harsh propagation, and a second UWB-based positioning system.

9. From 2014 until 2022, I also served as the director of *Wireless @ Virginia Tech*, a comprehensive research group focusing on wireless communications, which consists of 14 faculty members and approximately 85 graduate students. My specific research focuses on advanced wireless communications and geolocation techniques. This research has examined both advanced theoretical concepts as well as the application of these concepts to the latest wireless standards. As an example of the latter, I (along with my students) have conducted research applying multiuser/multi-antenna signal processing to LTE. I have also applied advanced geolocation techniques to LTE systems.

10. My research work has been funded by national agencies including the National Science Foundation (NSF), the Defense Advanced Research Projects

Agency (DARPA), the Office of Naval Research (ONR), the Army Research Lab, the Air Force Research Lab as well as many industrial sponsors.

11. During 2009, I was a visiting researcher at the Laboratory for Telecommunication Sciences (LTS), a Federal Research Lab that focuses on telecommunication challenges for national defense. While at LTS, my research focus was in the area of cognitive radio with a particular emphasis on statistical learning techniques.

12. I have authored and co-authored over 300 publications in my area of expertise, which have been published in the leading journals in my field including *IEEE Transactions on Communications*, *IEEE Transactions on Wireless Communications*, *IEEE Transactions on Information Theory*, *Proceedings of the IEEE*, and *IEEE Transactions on Signal Processing*, and at all of the major conferences in my field. These publications include the areas of wireless position location (*i.e.*, geolocation). This research has been cited over 12,000 times. A complete list of my publications over the last 30 years is included in my Curriculum Vitae. I am a Fellow of the IEEE (so named “for contributions to wideband signal processing in communications and geolocation”). Additionally, in 2023 I received the prestigious MILCOM Lifetime Award for Technical Achievement. This award recognizes individuals who have made important technical contributions to military communications over the course of their careers. Earlier this year I was a co-recipient

of both the Vanu Bose Award for the best paper and the Fred Ellersick Award for the best paper, both at the 2023 Military Communications Conference. I was also a co-recipient of the Vanu Bose Award for the best paper at the 2021 Military Communications Conference.

13. In 2010, I was awarded the Ellersick Best Paper Award in the Unclassified Technical Program, at the IEEE Military Communications Conference. I received the SDR Forum Best Paper Award in 2007 and the Outstanding Paper Award at the SDR Forum in 2008. I received the Dean's Award for Teaching Excellence in April 2014 and the Dean's Award for Outstanding New Assistant Professor, College of Engineering in 2003. While at Bell Laboratories, I was awarded the Bell Labs President's Silver Award for outstanding research contributions and the 1999 Best Paper Award in the Bell Labs Technical Journal.

14. I also hold 18 issued patents in the area of wireless communications, many of which relate to wirelessly locating a wireless device.

15. I formerly served as an area editor for *IEEE Transactions on Wireless Communications* supervising a team of 12 editors. I also recently served as a guest editor for a special issue of the *Proceedings of the IEEE* and as a guest lead editor for a special issue of the *IEEE Journal on Special Topics in Signal Processing* relating to non-cooperative position location networks. I was formerly an associate editor for *IEEE Wireless Communications Letters*, *IEEE Transactions on Vehicular*

Technologies, IEEE Transactions on Communications, IEEE Transactions on Signal Processing, and IEEE Transactions on Education.

16. Additionally, I formerly served as the guest editor for the *IEEE Journal on Special Topics in Signal Processing*. I served as the Technical Program Chair for the Signal Processing for Communications Symposium at the 2017 IEEE International Conference on Communications. Previously, I was the Organizer and Technical Co-Chair for both the 2015 and 2016 IEEE Global Communications Conference Workshop on Localization and Tracking: Indoors, Outdoors and Emerging Networks (LION). I have also served on the technical program committees of several other conferences and workshops in my field.

17. My opinions are based on my years of education, research, and experience, as well as my study of relevant materials. In forming my opinions, I have also considered the materials identified in this declaration and in the Petition.

18. 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 AND MATERIALS CONSIDERED

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

20. For this work, I have been asked to review U.S. Patent No. 7,628,333 (“’333 Patent”) (Ex. 1001) and the ’333 Patent’s prosecution history (“’333 File History”) (Ex. 1002). My opinions support Apple Inc.’s petition for *Inter Partes* Review, which challenges all 13 claims of the ’333 Patent (“Challenged Claims”). In developing my opinions relating to the ’333 Patent, I have considered the materials cited or discussed herein, including those listed below.

Exhibit 1001	U.S. Patent No. 7,628,333 (“the ’333 Patent”)
Exhibit 1002	File History for U.S. Patent No. 7,628,333
Exhibit 1004	U.S. Patent Publication No. 2002/0180584 to McGregor et al. (“ <i>McGregor</i> ”)
Exhibit 1005	U.S. Patent Publication No. 2003/0226041 to Palmer et al. (“ <i>Palmer</i> ”)
Exhibit 1006	U.S. Patent No. 6,078,791 to Tuttle & Lake (“ <i>Tuttle</i> ”)
Exhibit 1007	<i>Intentionally left blank</i>
Exhibit 1008	U.S. Patent Publication No. 2002/0116330 to Hed & Pavelle (“ <i>Hed</i> ”)
Exhibit 1009	U.S. Patent No. 5,690,773 to Fidalgo & Oi (“ <i>Fidalgo</i> ”)
Exhibit 1010	U.S. Patent No. 5,767,503 to Gloton (“ <i>Gloton</i> ”)
Exhibit 1011	U.S. Patent No. 6,097,292 to Kelly et al. (“ <i>Kelly</i> ”)
Exhibit 1012	U.S. Patent No. 6,375,082 to Kobayashi et al. (“ <i>Kobayashi</i> ”)
Exhibit 1013	U.S. Patent No. 5,748,737 to Daggar (“ <i>Daggar</i> ”)
Exhibit 1014	U.S. Patent No. 6,704,608 to Azuma (“ <i>Azuma</i> ”)
Exhibit 1015	U.S. Patent No. 5,280,527 to Gullman et al. (“ <i>Gullman</i> ”)
Exhibit 1016	U.S. Patent No. 6,631,849 to Blossom (“ <i>Blossom</i> ”)
Exhibit 1017	U.S. Patent Publication No. 2002/0095587 to Doyle et al. (“ <i>Doyle</i> ”)
Exhibit 1018	U.S. Patent Publication No. 2002/0038369 to Sung & Lee (“ <i>Sung</i> ”)

21. I have considered these materials from the viewpoint of a POSITA as of the priority date of the ’333 Patent. For the purposes of this declaration, I have

been asked to assume that the priority date of the '333 Patent is April 14, 2003. I note that my opinions provided in this declaration are made from the perspective of a POSITA as of this priority date of the '333 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 '333 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

22. 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

23. I understand that the '333 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") at the time the claimed invention was made. 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.

24. 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

25. 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.

26. 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.

27. 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.

28. 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.

29. 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.

30. 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

31. 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

32. 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.

33. I understand that the Petition proposes that the phrase “invariable activation command” should be interpreted broadly enough to capture a command to transmit data through either a first or second data conveyance operation, where the decision of which operation to use is outside of user control. I have adopted this interpretation of “invariable activation command” in my opinions below. For all other claim language, I have applied the plain and ordinary meaning as defined in the preceding paragraph.

IV. LEVEL OF A PERSON OF ORDINARY SKILL

34. Based on my review and analysis of the '333 Patent, the prior art cited herein, and the ordinary skill factors described in this section, a POSITA in the field of the '333 Patent at the time of the earliest possible priority date (April 14, 2003) would have been knowledgeable in the fields of wireless data communication and mobile device design. In my experience working, teaching, and performing research in this field, most workers of ordinary skill in the art as of the earliest possible priority date of April 14, 2003, would have had a bachelor's degree in electrical engineering, computer engineering, or an equivalent, as well as two years of industry

experience and who would have had a working knowledge of wireless communication devices and networks. A person with less, relevant practical experience but with additional education can also qualify as a POSITA in the field of the '333 Patent. When I refer to the understanding of a POSITA, I am referring to the understanding of such a person as of April 14, 2003.

35. As of April 14, 2003, 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. For example, as discussed above, since August 2001, I have held a faculty position at Virginia Polytechnic Institute and State University, Bradley Department of Electrical and Computer Engineering, where I have taught and conducted research in the area of wireless communications, geolocation and radar for over 20 years. Specifically, I have taught courses that cover wireless communications and signal processing (including the underlying concepts) at the undergraduate and graduate levels. I hold 18 issued patents in the area of wireless communications and signal processing, many of which relate to wirelessly locating a wireless device. I formerly served as an area editor for *IEEE Transactions on Wireless Communications*, supervising a team of 12 editors. I also recently served as a guest editor for a special issue of the *Proceedings of the IEEE* and as a guest lead editor for a special issue of the *IEEE Journal on Special Topics in Signal Processing* relating to non-cooperative position location networks.

I was formerly an associate editor for *IEEE Wireless Communications Letters*, *IEEE Transactions on Vehicular Technologies*, *IEEE Transactions on Communications*, *IEEE Transactions on Signal Processing*, and *IEEE Transactions on Education*.

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

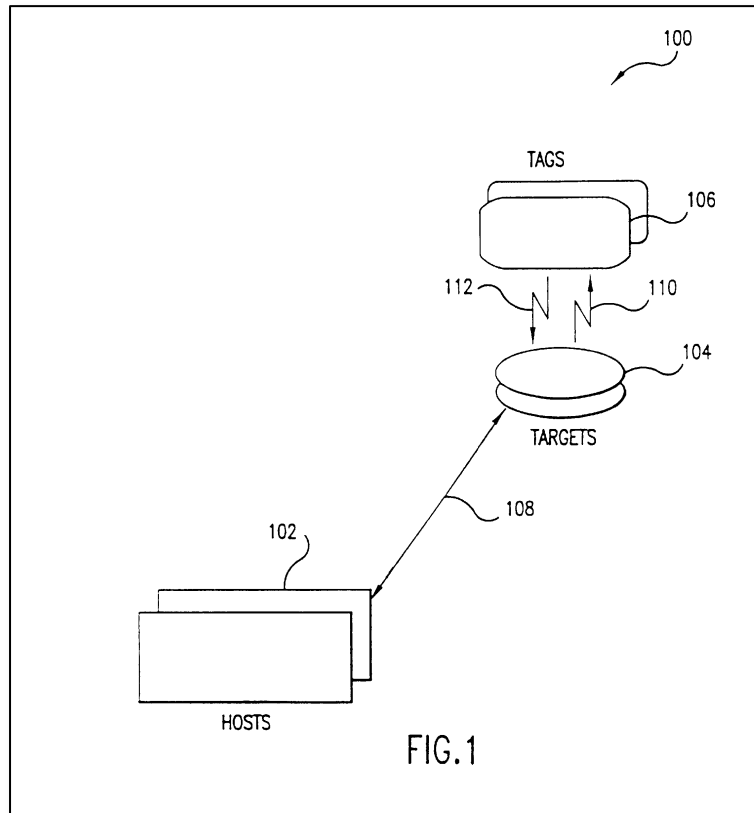
V. OVERVIEW OF THE TECHNOLOGY

A. Portable Electronic Devices for Wireless Data Conveyance

37. Portable electronic devices for wireless data conveyance (*i.e.*, wireless data transmission or wireless data exchange) such as credit cards and smart cards were well known before the priority date of the '333 Patent. In general, smart cards were used for monetary transactions and identification purposes. As part of this process, smart cards are normally used within a data transaction network system that includes an external data exchange device (*e.g.*, card reader/writer device). For example, *Hed* teaches “[a] financial transmission method utilizes smart cards with radiofrequency communication between the central station and the card so that the smart card is periodically or continuously updated as to account details which can be readily seen by a display on the card.” *Hed* (Ex. 1008), Abstract. More specifically, *Hed* teaches a “communicating credit card (CCC) and a wireless communication system within which said card operates.” *Hed*, [0015].

38. *Hed* describes additional examples of smart cards such as those disclosed in *Fidalgo* (Ex. 1009) and *Gloton* (Ex. 1010). These smart cards are “designed as an ‘electronic purse’ to carry on debiting and crediting transactions, for instance in paying for telephone calls, or in lieu of tokens in public transportations systems and even as means of paying for games or other transactions.” *Hed*, [0006]. These cards can be inserted in a terminal, at the point of sale that interfaces with the cards, or can be used in a contactless fashion, wherein “the card is passed over a reader (writer), and the information is transferred between the reader and the card inductively.” *Hed*, [0006]-[0007]; *see also id.*, [0002]-[0011] (discussing numerous prior art examples teaching smart cards).

39. In another example, *Kelly* teaches systems and methods for enhancing performance of contactless proximity automated data collection system which includes a Tag (*i.e.*, smart card), a Target (reader/writer device), and a Host (*i.e.*, controlling computer) wherein RF communication links are established. *Kelly* (Ex. 1011), Abstract, 2:1-55. *Kelly*’s system is depicted in Fig. 1 below:



Kelly, Fig. 1. *Kelly* explains that its system is discussed in the context of an electronic fare collection system for rapid transit or toll applications, but that it would be readily apparent to a POSITA that the invention would have broader applicability to other systems in which contactless proximity information/data/message is exchanged. *Id.*, 4:44-50.

40. In another example of a portable electronic device for wireless conveyances, *Kobayashi* teaches a “portable electronic device including a composite IC [integrated circuit] card having contacting and noncontacting interfaces, capable of being used for various purposes.” *Kobayashi* (Ex. 1012), 1:63-2:11. Some uses include “update (add) data such as prepaid balance and erase unnecessary data[,]”

and “automatic ticket gate, bus fare adjusting machine, or automatic vending machine, it is possible to read out the balance or additionally write the used amount of money as history data[.]” *Id.*, 18:43-53.

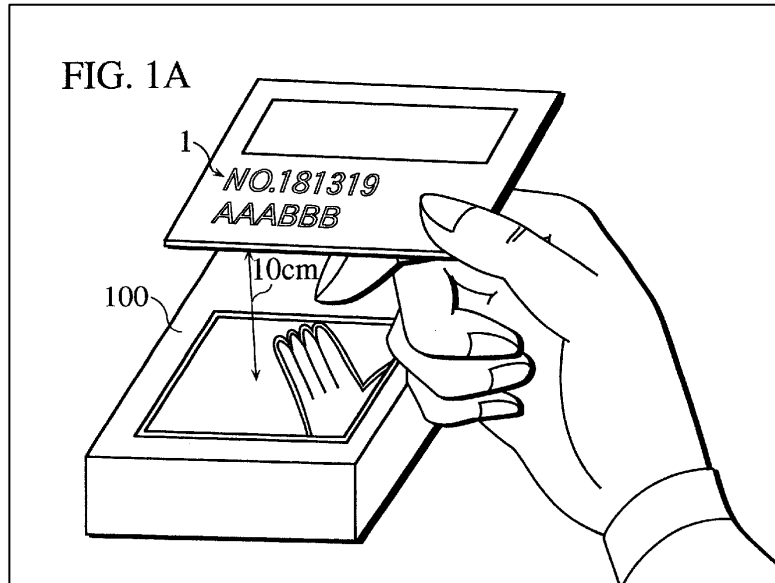
41. In another example of a portable electronic device for wireless transactions, *Daggar* teaches an “electronic wallet is disclosed with provides multiple data media interfaces[.]” *Daggar*, (Ex. 1013), Abstract. *Daggar* explains that its electronic wallet and generic multimedia card provide for the securing of the data and the ability to perform data exchange via a variety of media input and output interfaces, these being:

“... (1) a magnetic reader/writer 220 used to permit interfacing with the existing magnetic reader/writer infrastructure; (2) a smart card reader/writer 210 used to permit interfacing with the emerging smart card infrastructure; (3) a wireless radio frequency transceiver 230 used to allow quick and convenient data exchange, and (4) user interface media 110/120 used to act as backup for the other media and to provide data input/output means. Further media interfaces may optionally be attached via a generic attachment card 500 or a serial port (not shown).”

Daggar, 10:5-22. Some potential uses for *Daggar*’s electronic wallet include “an electronic purse attachment to make payments, a radio frequency key for cars, homes etc, an extended radio frequency range transceiver to make road toll payments, and a long range transceiver to provide paging and personal communications services.” *Daggar*, 18:37-44.

42. In another example of a portable electronic device for wireless conveyances, *Azuma* teaches a “portable card that allows the owner of the card to switch between two purposes of the card, such as payment and passing through a ticket gate.” *Azuma* (Ex. 1014), 3:7-10. *Azuma*’s portable card includes a communicating unit that includes a transmission/reception unit operable to receive a command issued by the terminal apparatus and transmit data to the terminal apparatus using wireless communication. *Azuma*, Claim 6, 5:48-6:3.

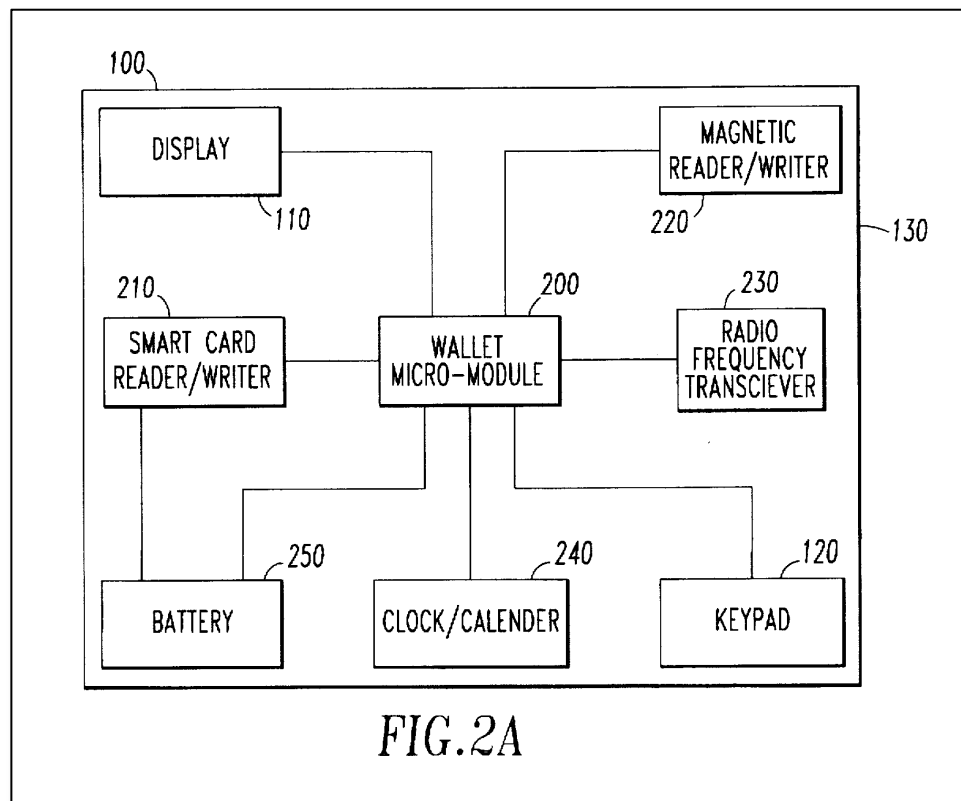
43. *Azuma*’s Figure 1A depicts an exemplary embodiment of an IC card (1) which is a portable electronic device that coordinates with a dedicated card reader/writer (100) when they are a few centimeters away from each other:



Azuma, Fig. 1A. *Azuma* notes that when an IC card approaches the reader/writer device, it transmits and receives radio waves to/from the IC card to output and input data to/from the one-chip IC. *Id.*, 21:3-35.

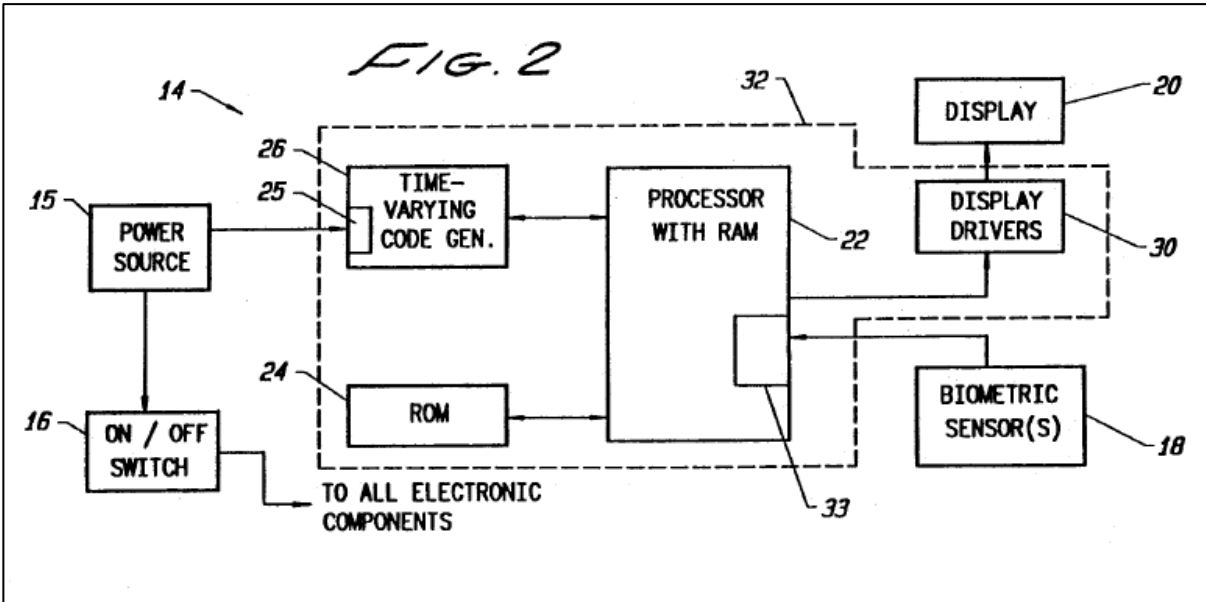
B. Circuitry in Portable Electronic Devices for Wireless Data Conveyances

44. The circuitry used in portable electronic devices for wireless data conveyances was well known in the prior art before the '333 Patent. At a high level, the circuitry used in portable electronic devices for wireless transactions comprised multiple components such as integrated circuits (IC), power means, and user interface devices (*e.g.*, display). The IC comprised multiple components capable of processing and storing data as well as controlling the Input/Output (I/O) of data. For example, *Daggar's* Figure 2A depicts a block diagram showing the electronic components of the electronic wallet including an integrated circuit, power, and display:



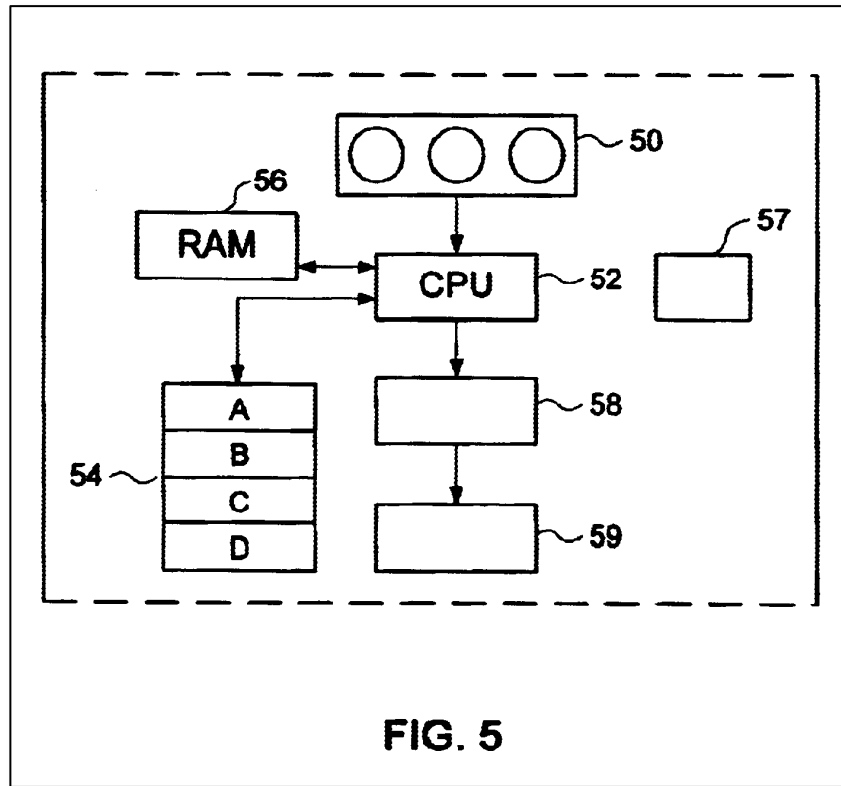
Daggar, Fig. 2A. *Daggar* explains that wallet micro-module 200 provides protected data processing and data storage means, as well as means for controlling other electronic wallet components. *Daggar*, 10:45-11:22. User interface means are exemplified by a keypad 120 and display 110, although more elaborate means such as touch based, or voice recognition interfaces could be implemented. *Id.*, 11:23-28. Power is supplied by a replaceable battery 250, although other power supply means could also be used to augment or replace the battery 250. *Id.*, 12:66-13-3.

45. Another example of circuitry used in portable electronic devices for wireless transactions is shown in *Gullman*'s Figures 2-3. *Gullman* (Ex. 1015). *Gullman* teaches an "integrated circuit card" that serves as a convenient, accessible security device kept in the possession of a person seeking access to the host system 10 (*e.g.*, ATM, bank's computer system, electronic gate for access to a secure area). *Id.*, 2:21-3:2, Figure 3. *Gullman*'s Figure 2 depicts an electronic block diagram showing the components of the integrated circuit card (*i.e.*, security apparatus 14):



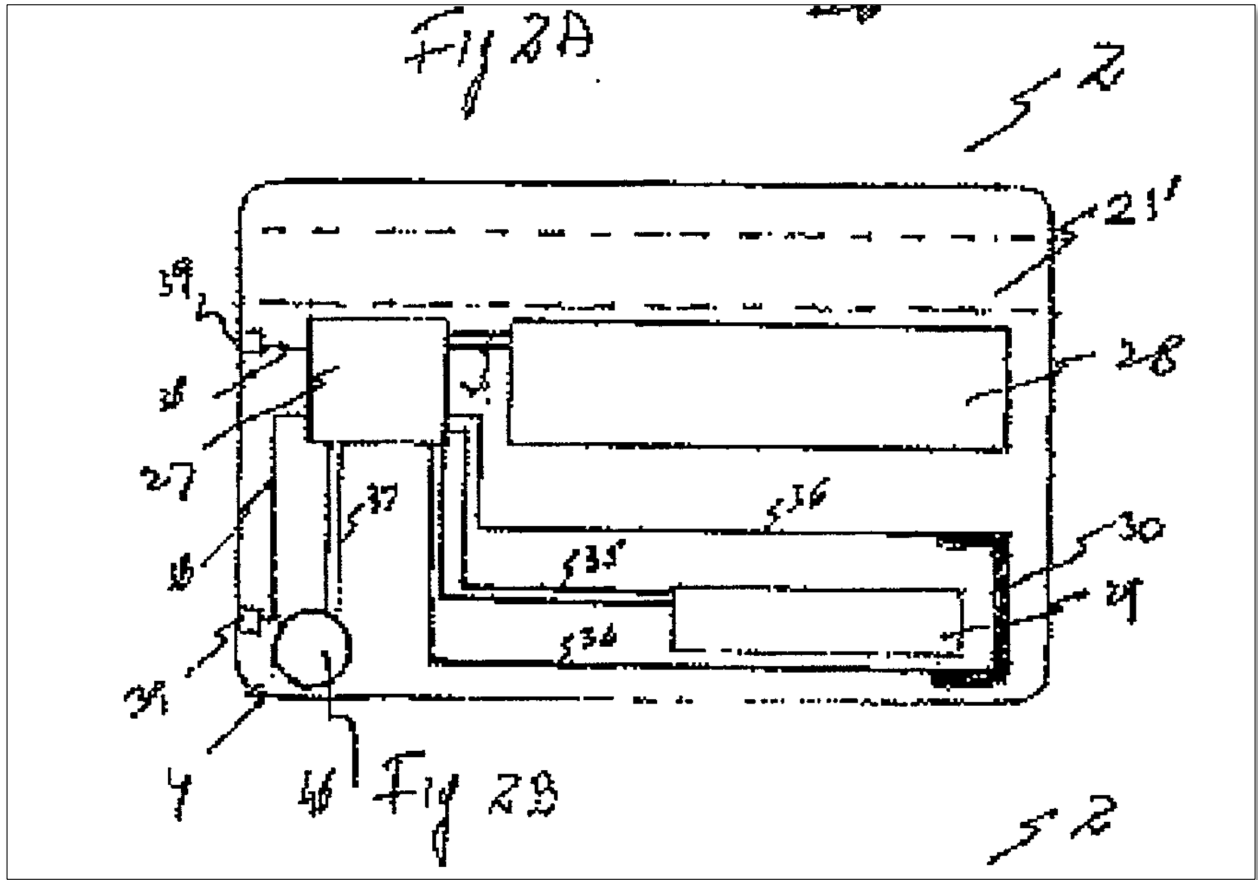
Gullman, Fig. 2. The electronic block diagram includes a power source 15, display 20, a biometric sensor(s) 18, and a multi-chip module 32 comprising a processor with on-chip random access memory and read only memory 24.

46. In another example, *Blossom*'s Figure 5 depicts circuitry used in a smart card:



Blossom (Ex. 1016), Fig. 5. *Blossom*'s smart card depicted in Figure 5 includes a CPU (52), read-only memory (54), dynamic memory (RAM) (56), a power supply system (57), an input control circuit 50, and a display (not shown). *Id.*, 5:47-53. *Blossom* teaches that the power supply may be any of many well-known systems such as, for example, a solar cell connected to a rechargeable battery. *Id.*, 5:53-59. The display may be a thin flexible LEP display covering a portion of the surface of the card or covering the whole surface of at least one side of the card. *Id.*, 6:58-67.

47. In another example, *Hed*'s Figure 2B shows the back laminate of a wireless communicating credit card with the various circuit elements mounted thereon, including the IC (27), the battery (28), and the display (29):



Hed, Fig. 2B. *Hed* discloses a wireless communicating credit card including an integrated circuit comprising a processor interfaced with a clock, 16, memory means 17, and a display driver module 18. *Id.*, [0049]. The IC can be made in a manner similar to IC used in smart cards of the prior art so as to fit the form factor standardized in the marketplace. *Id.*, [0051].

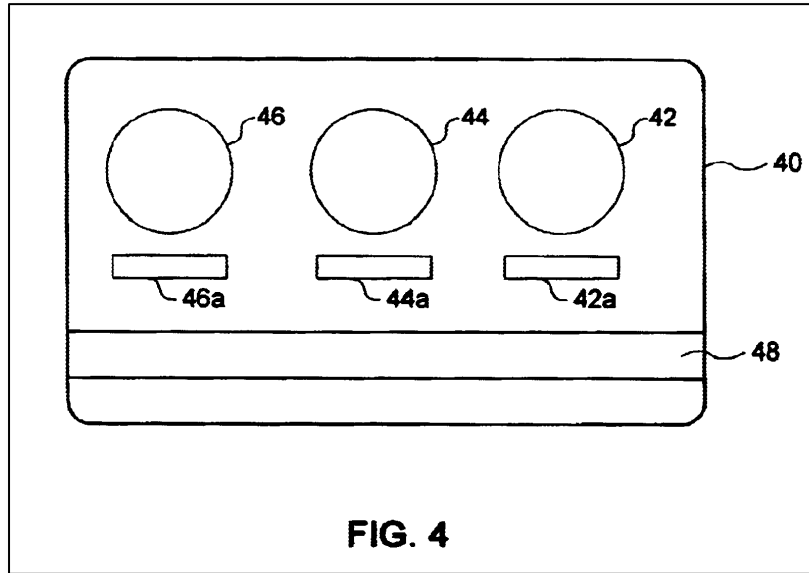
48. *Hed* teaches that the antenna and RF receiver are used to wirelessly communicate with a data service provider. It is disclosed that the data can be accessed “at any time[,]” including in between predetermined times for receiving data from the service providers. *Hed*, [0062]. For example, “[i]f at any time (between

listening periods) the CCC user wishes to review the most recent data received, he can press a small membrane switch on the card . . . thus activating the display function[.]” *Hed*, [0078].

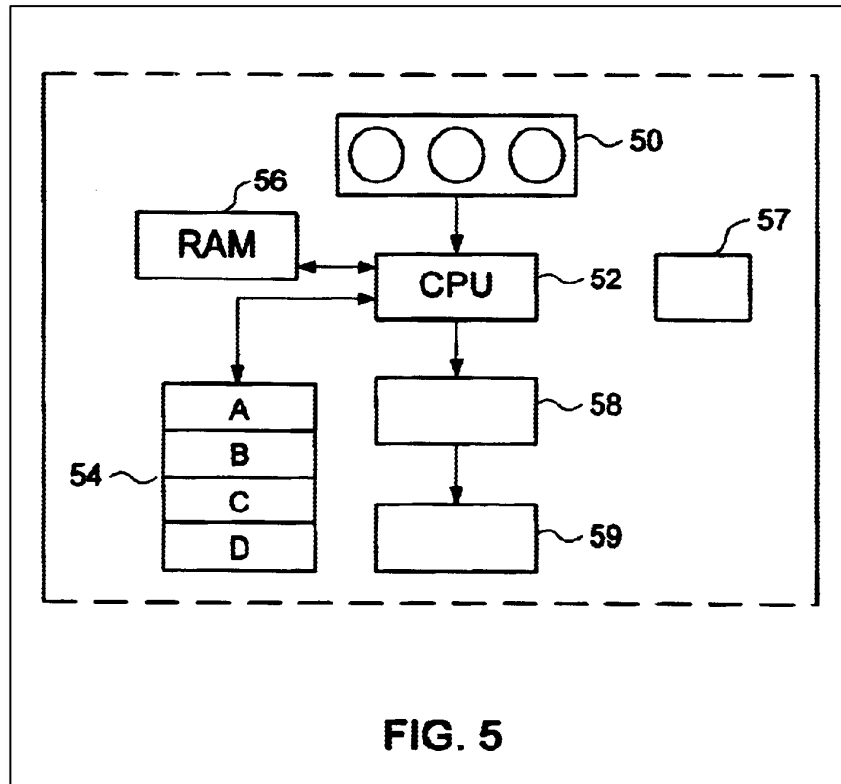
C. Triggering Data Conveyance and User Authentication in Portable Electronic Devices

49. It was known before the priority date of the '333 Patent that portable electronic devices for wireless data conveyance included various methods for triggering said data conveyance. These methods include various forms of user authentication. In general, triggering data conveyance included methods such as manually activating buttons on the portable electronic device, authenticating a user via biometric detectors, or keypads. For example, *Gullman's* integrated circuit card comprises a biometric sensor that detects biometric input from a user (*i.e.*, cardholder) that includes information that is personal and substantially invariant. *Gullman*, 5:41-54. According to various disclosed embodiments, the biometric sensor “may detect a fingerprint, a signature, a voice or other like information.” *Id.*, 5:47-49. The sensor may be “a scanning device which detects a fingerprint or pressure sensing device which detects a signature.” *Id.*, 5:49-54. Once the integrated card user is authenticated, electronic data transmission is allowed. *Id.*, 6:8-61.

50. In another example, *Blossom's* Fig 4 teaches a smart card having a plurality of buttons 42, 44, and 46, each button activating a different card feature:



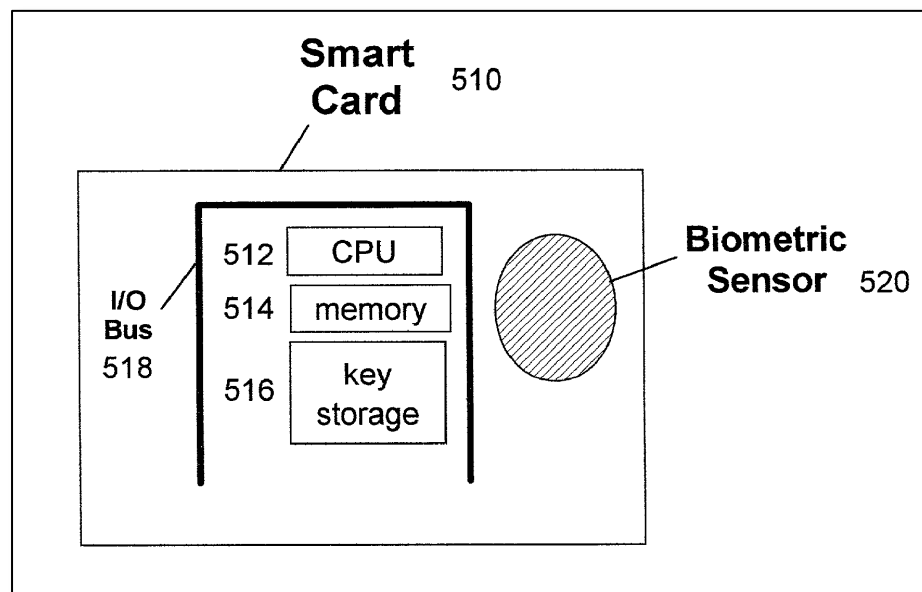
Blossom, Fig. 4. *Blossom* teaches that each button may be depressible or touch sensitive buttons, and the smart card may further include characters 42a, 44a, and 46a denoting the card feature corresponding to each button respectively. *Id.*, 5:34-47. To accomplish this, the smart card may include the systems and circuits illustrated in Figure 5:



Blossom, Fig. 5. In operation, the user of the smart card may select a card feature by depressing one of the buttons 42, 44 or 46, the button controller 50 detects which button is depressed and sends this information to the CPU 52. *Id.*, 6:6-17. The information may then be communicated via a magnetic field output from the processor capable of being read by a card-reading device. *Id.*, 6:18-33. The method further comprises establishing an electronic communication (*e.g.*, wireless connection) between the card and a service institution handling an account corresponding to the selected feature. *Id.*, 7:43-8:7.

51. It was also known before the priority date of the '333 Patent that portable electronic devices for wireless transactions included processes for

transmission to a device through RF fields. Specifically, it was known that a device could be placed within the RF field of a financial transaction reader/writer device to trigger an authentication process that includes (1) authenticating a user's fingerprint, (2) a handshake communication between the device and reader/writer, and (3) a two-way communication between the user device and the reader/writer device furthering a transaction. For example, *Doyle* teaches a "smart card with integrated biometric sensor" that uses a "security handshake" procedure to establish a secure communication with a card reader device to further a transaction. *Doyle* (EX. 1017), [0031]-[0034]. *Doyle*'s smart card is depicted in Figure 5 below:

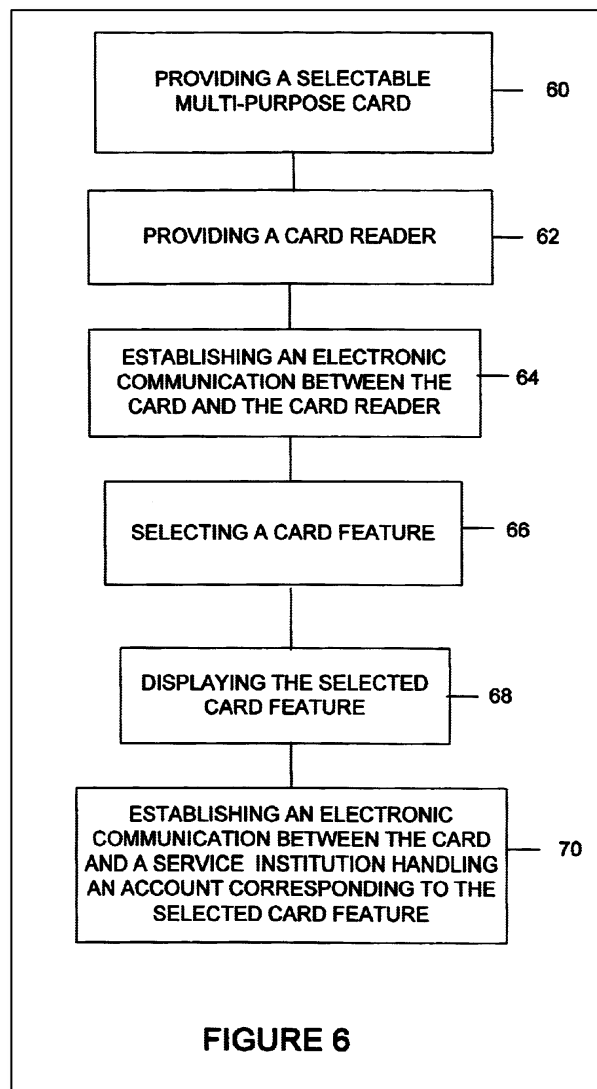


Doyle, Fig. 5. *Doyle* teaches that once the smart card user is authenticated (e.g., using a biometric sensor) a transaction between the smart card and the card reader can begin using a security handshake process. *Id.*, [0085]-[0094], Fig. 7. The security handshake includes a Secure Sockets Layer (SSL)-like encryption in addition to

authentication, in order to provide mutual authentication between the two devices.

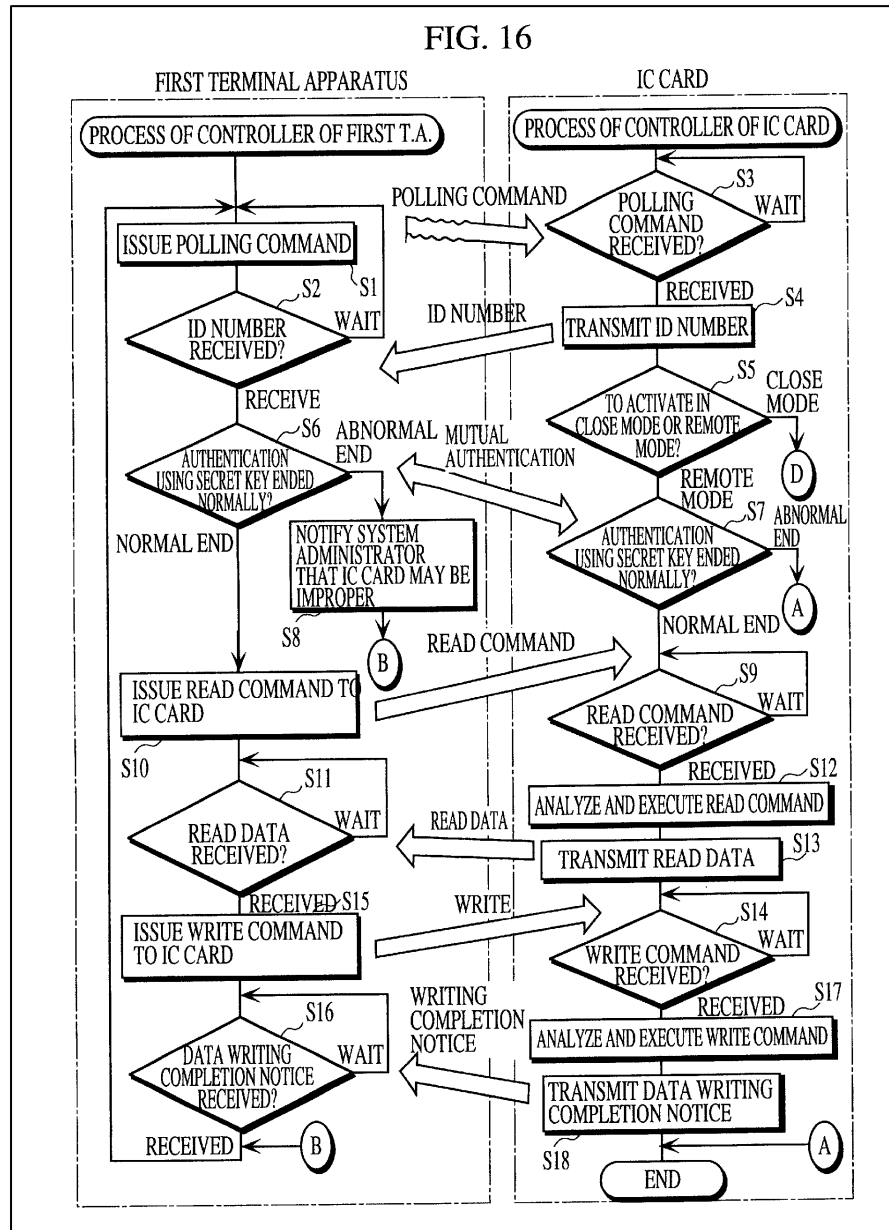
Id., [0051], [0062], Fig. 2.

52. In another example, *Blossom*'s Figure 6 depicts a process where a smart card is placed within the RF field of a card reader, establishing a handshake communication between the card and the card reader (step 64), and a two-way communication occurs between the smart card and the card reader furthering the transaction (steps 66-70):



Blossom, Fig. 6.

53. In another example, *Azuma*'s Figure 16 teaches a process where a smart card is placed in an RF field of a card reader (*i.e.*, first terminal apparatus), establishing a handshake communication between the card and the card reader and a two-way communication between the smart card and the card reader furthering the transaction (steps S3-S18).

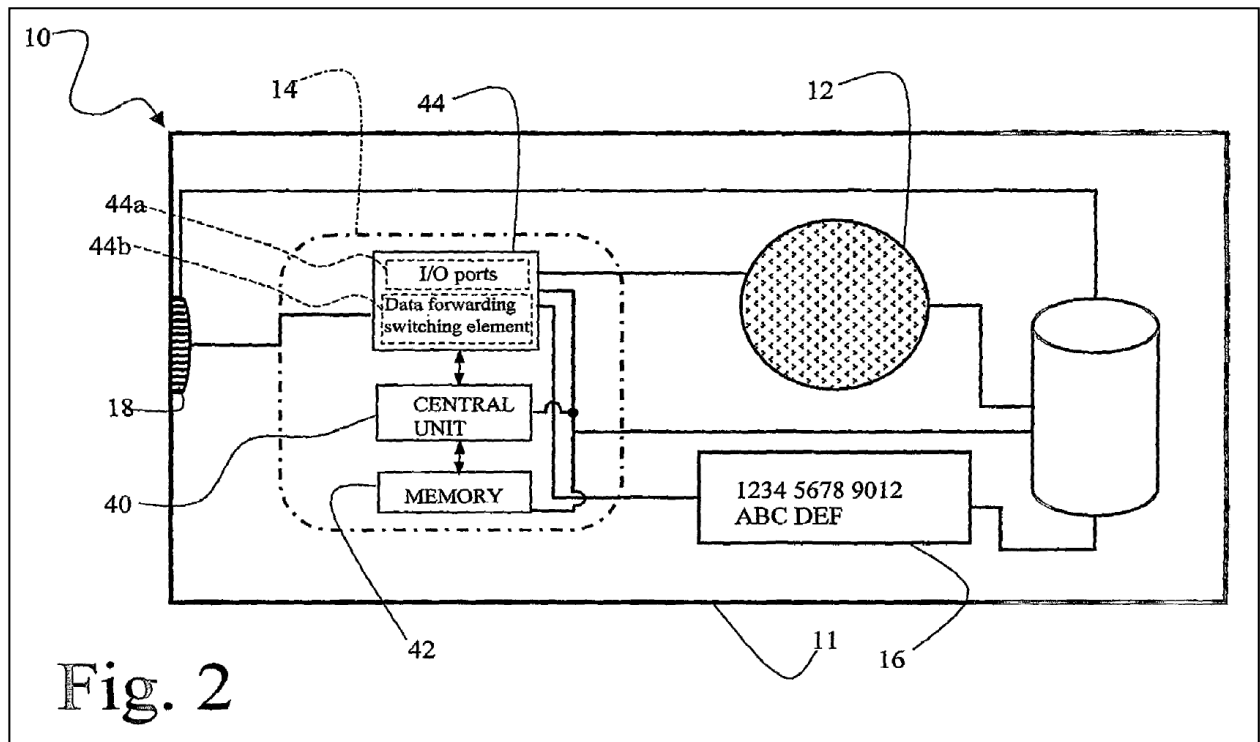


Azuma, Fig. 16.

VI. OVERVIEW OF THE '333 PATENT

54. I have reviewed the '333 Patent (Ex. 1001). Descriptions of the '333 Patent that may be pertinent to my analysis are provided below. This discussion does not represent my entire understanding of the '333 Patent.

55. The '333 Patent is generally directed to “a portable electronic device capable of alternate data conveyance operations responsive to an invariable activation command.” '333 *Patent*, 1:9-11. One such portable electronic device, depicted in Fig. 2, includes a “control device 12, an electronic circuit 14, a display screen 16, a transceiver 18, and power means 20” as well as “switching element 44b.” *Id.*, 4:19-30,, 6:9.



Id., Fig. 2.

56. Switching element 44b can take many forms, including (1) a “series of instructions programmed” on a microchip or (2) “a decisional logical circuit.” *Id.*, 6:4-17 (teaching that switching element can generally “be a physical structure, a virtual program, or both”). Portable electronic device 10 receives an activation cue

from an external device via “transceiver 18[.]” *Id.*, 5:65-67. When an activation cue is received, the switching element 44b changes from a default state (*i.e.*, an inactive state) to an “activated state[.]” *Id.*, 6:18-26.

57. Then, “upon control device 12 being selectively triggered” the portable device initiates a data conveyance operation dependent on the “state of switching element 44b.” *Id.*, 6:42-51. The control device 12 may be “a single manually activated button” or “a biometric parameter detector, for example a fingerprint scanner” that can be selectively triggered to issue an invariable activation command. *Id.*, 5:8, 5:13-14. The invariable activation command, in turn, results in the portable electronic device 10 initiating one of two data exchange operations depending on the state of the “switching element 44b[.]” *Id.*, 6:18-25.

58. If the control device is triggered while the switching element is in an activated state, “a data exchange will be initiated between the portable electronic device 10 and data exchange device 9.” *Id.*, 7:12-14. Alternatively, if the control device is triggered when the switching element is in a default, inactive state, “data will be communicated to the portable electronic device holder by means of user interface device 16” (*e.g.*, a display). *Id.*, 7:9-11.

59. In one example, the portable electronic device 10 acts as a “quick payment means, such as for paying public transportation fares.” *Id.*, 7:57-58. The “portable electronic device 10 would be a payment card with pre-stored electronic

money[.]” *Id.*, 7:59-61. When the user wants to purchase a fare, the user would trigger the control device 12 within the range of “[d]ebit machine 9 . . . emit[ting] an activation cue[.]” *Id.*, 7:64-8:7. Since an activation cue is received the switching element is in an activated state. Subsequently, a wireless data exchange takes place between the portable electronic device and the debit machine 9, consisting of “any type of information required for electronic money transactions[.]” *Id.*, 7:64-8:7. If control device 12 is triggered outside the “emission range of a public transportation service debit machine 9,” no activation cue is received and the switching element remains in an inactive state. *Id.*, 8:24-29, 6:18-25. In this situation, data will be sent to display screen 16, displaying the “total amount of electronic money remaining[.]” instead of exchanging data with the debit machine 9. Data is displayed, rather than transmitted, in this inactive state because the debit machine 9 is presumed to be outside the communication range of the portable electronic device. *Id.*, 8:24-29. In this first example, the displayed data and transmitted data are different (*e.g.*, payment information compared to electronic money remaining).

60. In a second example the portable electronic device 10 is an electronic passport. In the presence of an activation cue, when the switching element is in an activated state, the portable electronic device 10 can “transmit identification data of the electronic passport owner[.]” *Id.*, 8:46-49. Where an activation cue is not received, the switching element is in an inactive state and the device 10 will “simply

display this [identification data] on the display screen[.]” *Id.*, 8:46-49. In this application, the transmitted data and displayed data are the same, identification data of the electronic passport owner. This is advantageous since a user only needs to trigger the control device to cause “the proper data conveyance [to] occur automatically[.]” *Id.*, 8:51-59.

61. The ’333 Patent expressly teaches that the displayed data may be the same as the data transmitted (as in the passport example) or different from the data transmitted (as in the payment example). *Id.*, 8:64-9:3.

VII. THE PROSECUTION HISTORY OF THE ’333 PATENT

62. I have reviewed the prosecution history for the ’333 Patent (Ex. 1002). Pertinent aspects of the prosecution history of the ’333 Patent are described below.

A. Prosecution History of the ’333 Patent

The ’333 Patent issued from U.S. Application Serial No. 10/552,912 (the “’912 Application”), filed on February 27, 2006. The ’912 Application was a U.S. national stage application of PCT Publication No. 2004/090805 filed on April 14, 2003. It is my understanding that in this declaration I should use April 14, 2003, as the priority date for the Challenged Claims.

A Non-Final Office Action issued on June 16, 2009, rejected claim 12 as anticipated. ’333 *File History*, (Ex. 1002), 153. The Examiner identified U.S. Patent No. 5,999,713 to Reiner et al. (“*Reiner*”) as anticipating the “two different

conveyance functions” of the ’912 application by disclosing “contact-based and contactless” based data conveyance modes. *Id.*, 153-154. The Examiner stated that *Reiner* teaches how “[a] cue is received externally, namely a triggering through the contacts, that causes switching into a contact-mode from the default of the contactless mode.” *Id.*, 154.

Within the same Office Action, the Examiner reviewed DE 101 46 804 to Riemschneider et al. (“*Riemschneider*”), which was also cited in the PCT written opinion. The Examiner found that *Riemschneider* did not teach the limitations of original claims 1-11 and 13-15, stating there was “no evidence of all of the limitations being met including the control device being selectively triggered to issue the invariable activation command such that if the switching element is in the activated state, a data exchange will be initiated through the instrumentality of the data transceiver for exchanging data between the electronic circuit and an external data exchange device and if the switching element is in the inactive state, data will be conveyed from the electronic circuit to the user interface device for communicating information to the portable electronic device holder.” *Id.*, 154-155. As such, those claims were placed in a state of allowance.

63. The applicant conducted an Examiner interview on July 10, 2009. Following the interview, the applicant cancelled original claim 12 and made several minor claim amendments via Examiner’s amendment. *Id.*, 198. Original,

independent claims 1 and 11 (issued claim 10) were amended to include “cue receiver” and “data transceiver” as well as to specify the control device being “selectively” triggered. Original, independent claim 11 (issued claim 10) was amended to include an electronic circuit in the portable electronic device. *Id.*, 204-208. A Notice of Allowance was issued on July 21, 2009, in which the Examiner reiterated that *Riemschneider* does not anticipate the claims. *Id.*, 208-209.

VIII. SUMMARY OF UNPATENTABILITY

Proposed Ground of Unpatentability	Exhibits
<u>Ground 1:</u> Claims 1, 2, and 4-10 are obvious under pre-AIA 35 U.S.C. §103 over U.S. Patent Application Publication No. 2002/0180584 to McGregor et al. (“ <i>McGregor</i> ”) in view of U.S. Patent Application Publication No. 2003/0226041A1 to Palmer et al. (“ <i>Palmer</i> ”).	Ex. 1004 Ex. 1005
<u>Ground 2:</u> Claims 3 and 11-13 are obvious under pre-AIA 35 U.S.C. §103 over <i>McGregor</i> in view of <i>Palmer</i> and in further view of U.S. Patent No. 6,078,791 to Tuttle & Lake (“ <i>Tuttle</i> ”).	Ex. 1004 Ex. 1005 Ex. 1006

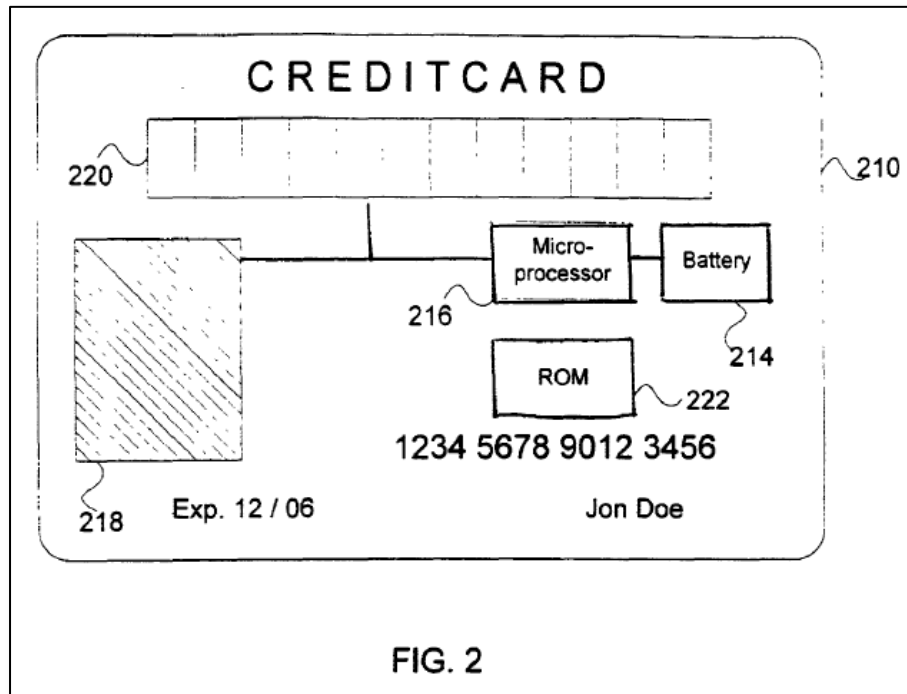
64. Above, I have reproduced the Proposed Grounds of Unpatentability from the Petition for ease of reference.

IX. OVERVIEW OF THE PRIOR ART

A. Overview of *McGregor*

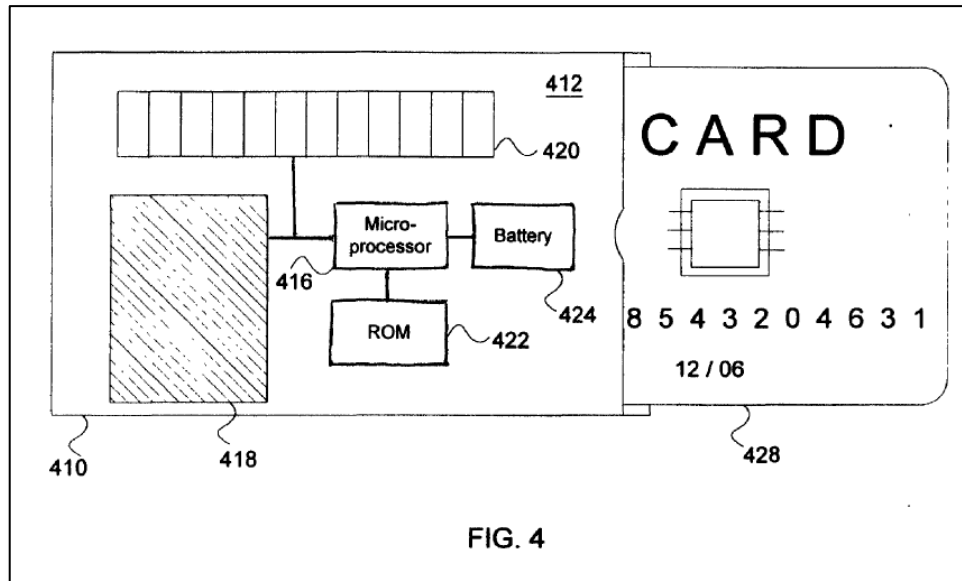
65. *McGregor* provides a “system for increasing transaction security across existing infrastructure[.]” *McGregor*, Abstract. The disclosure is directed to

improving credit card security via a “bio-metric smart card.” *Id.*, [0005]. Fig. 2 below illustrates one embodiment of the subject bio-metric smart card:



Id., Fig. 2. As illustrated, *McGregor's* card includes fingerprint scanner 218 for authenticating a user, microprocessor 216 for generating a security key upon successful authentication, and display 220 for displaying the key such that it can be conveyed to a credit card authorization service and used to approve a transaction. *Id.*, [0037-0042].

66. In a separate embodiment, *McGregor* describes a card reader (or wallet) 410 that has “substantially the same shape and form factor as available plastic credit and debit cards” and may be formed “such that a smart card can be inserted into the reader as shown in Fig. 4.” *Id.*, [0043].



Id., Fig. 4. Wallet 410, like the Fig. 2 bio-metric smart card, includes a “bio-metric reading apparatus such as a fingerprint scanner 418 in electrical communication with a microprocessor 416” and “display 420[.]” *Id.*, [0043]-[0044], Fig. 4. Wallet 410 may also “include an IR or wireless transmitter to automatically transmit the security code to a transaction network.” *Id.*, [0044].

67. Both *McGregor* and the '333 Patent are directed to portable electronic device technology. *Compare McGregor*, [0005], [0043] (disclosing a bio-metric smart card reader to enhance credit card security), *with* '333 Patent, Abstract (describing a portable electronic device), 5:12-19, 7:55-8:31 (describing biometric capabilities and an example embodiment where the device is a payment card for public transportation). Accordingly, *McGregor* is in the same field of endeavor as and is analogous art to the '333 Patent.

68. Further, the '333 Patent is directed to the problem of a supplementary screen on an interface machine being required to view the content of a smart card while *McGregor* discloses a smartcard with display to show information. *Compare* '333 Patent, 1:32-39 (explaining that conventional cards require a card reader interface to access the information on the cards and the interface display is required to view the information) *with McGregor*, [0039]-[0041] (describing how the security key display displays information forwarded by the microprocessor of the smart card). Therefore, *McGregor* is reasonably pertinent to a problem described by the '333 patent. Therefore, *McGregor* is analogous art to the '333 Patent.

B. Overview of *Palmer*

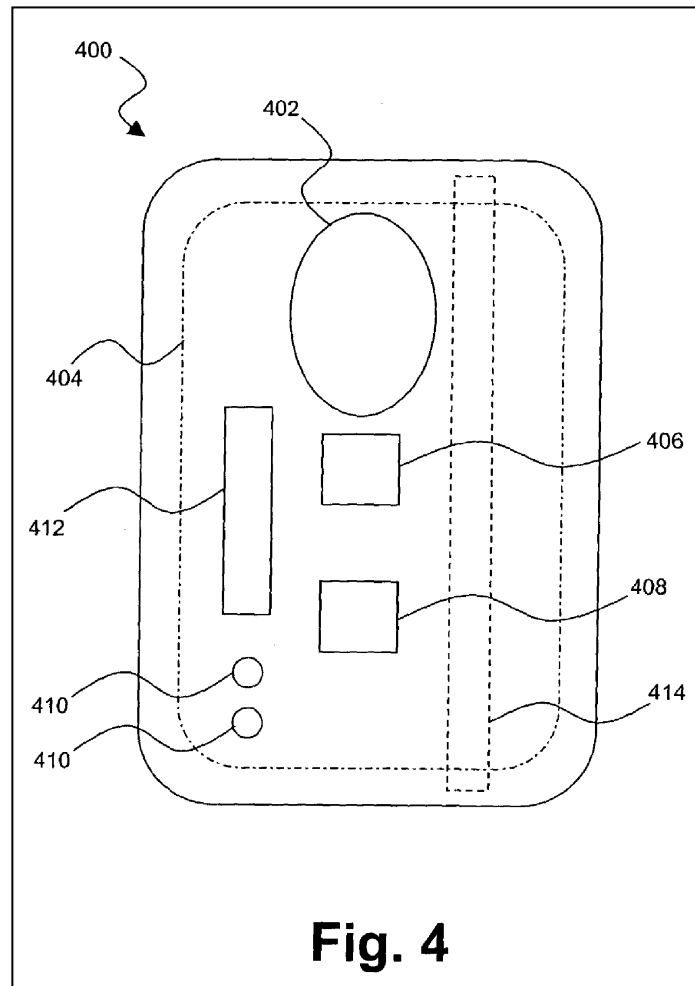
69. *Palmer* provides an apparatus for “effecting secure transactions in a contactless manner using biometric identity validation.” *Palmer*, Abstract. In one embodiment, device 400 has “a form factor similar to that of a credit card[,]” and contains “a fingerprint sensor 402, a [radio frequency] RF antenna 404, a first controller 406, a second controller 408¹, function selector buttons 410,” and “an electro-luminescent display 412[.]” *Id.*, [0030].

70. The first controller 406, which may be implemented as an Application Specific Integrated Circuit (“ASIC”), includes a “Random Access Memory

¹ For clarity the second controller, also called the “408...smart card chip” in *Palmer*, will be called “smartcard chip 408” throughout this declaration.

(“RAM”)” and may include a “non-volatile memory” to store fingerprint templates.

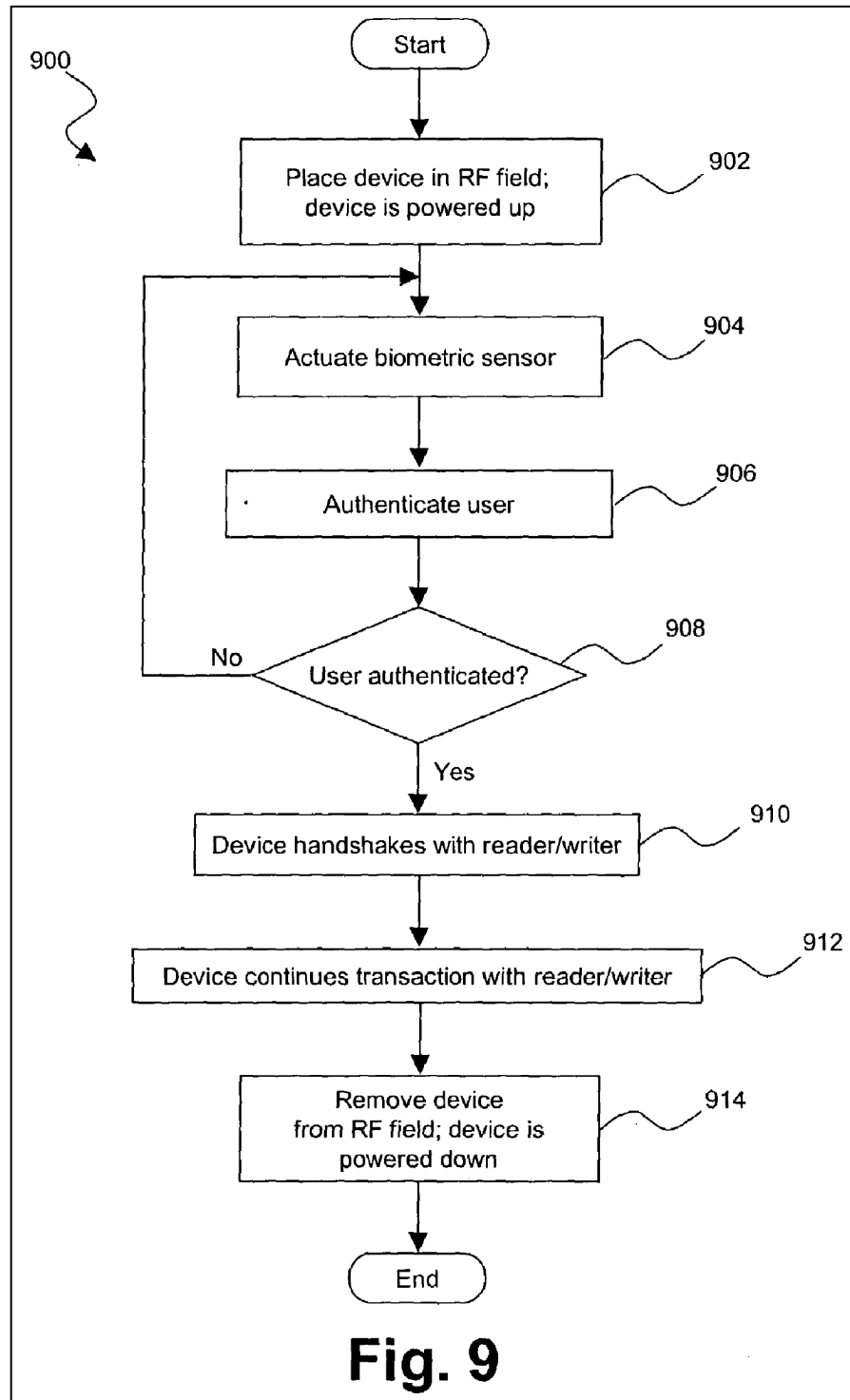
Id., [0031]. “Circuitry contained within the ASIC 406 provides an interface between the ASIC 406 and the fingerprint sensor 402.” *Id.*, [0032]. ASIC 406 also contains a “microprocessor core . . . for executing instructions” and may be “used to drive electroluminescent display 412[.]” *Id.*



Id., Fig. 4.

71. When placed within the RF field of a reader/writer device, RF antenna 404 “may capture RF energy . . . and may also support two-way communication with

an associated reader/writer device[.]” *Id.*, [0043]. Fig. 9 illustrates a process through which a user may verify their identity via this two-way communication link:



Id., Fig. 9. As illustrated, the device is placed in the reader/writer device's RF field at step 902,² a user is authenticated using a fingerprint sensor at steps 904-906, the device performs a "handshake" process with the reader/writer after authenticating the user's fingerprint at step 910, and then the devices exchange data pursuant to the transaction. *Id.*, [0050-51].

72. Both *Palmer* and the '333 Patent are directed to portable electronic devices. *Compare Palmer*, [0030]-[0033] (disclosing an electronic device shaped like a credit card with a smartcard chip to support standard smart card interactions), *with '333 Patent*, 1:15-45 (describing issues with conventional smart cards), 5:12-19, 7:55-8:31 (describing an example embodiment where the device is a payment card for public transportation). Accordingly, *Palmer* is in the same field of endeavor as and is analogous art to the '333 Patent.

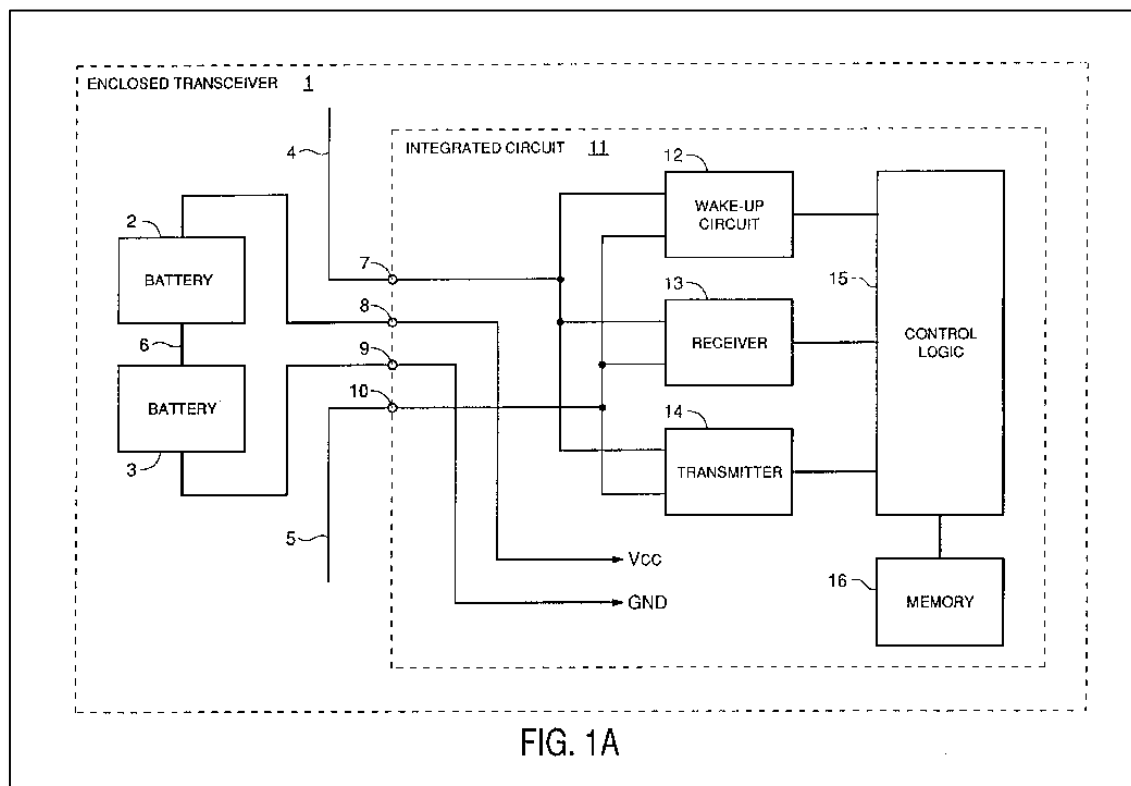
73. Further, the '333 Patent is directed to the problem of a supplementary screen on an interface machine being required to view the content of a smart card while *Palmer* discloses a smartcard with display to show information. *Compare '333 Patent*, 1:32-39 (explaining that conventional cards require a card reader interface

² Although *Palmer* teaches that the RF field powers the device, *Palmer* expressly contemplates battery powered implementations that do not depend on inductive power. *Palmer*, [0043] ("[A] rechargeable battery may power the electronic components when no RF energy field is present.").

to access the information on the cards and the interface display is required to view the information) *with Palmer*, [0025]-[0026] (describing that the dynamic information display controlled by device controller displays information to a user).

C. Overview of *Tuttle*

74. *Tuttle* discloses “a non-contact method of object and person detection and location which can serve as a replacement for metal-to-metal contact in smart card applications.” *Tuttle*, 3:52-57. Specifically, *Tuttle* describes an enclosed transceiver 1 (shown in Fig. 1A) that “includes a pair of batteries 2 and 3, a dipole antenna 4 and 5, and an integrated circuit (IC) 11.” *Tuttle*, 5:67-6:2.



Tuttle, Fig. 1A. “Integrated circuit 11 is a transceiver including wake-up circuit 12, receiver 13, transmitter 14, control logic 15, and memory 16.” *Tuttle*, 6:14-16. Wake-up circuit 12 detects the existence of and processes a wireless signal, enabling receiver 13 to receive and decode data in a signal, and transmitter 14 transmits data in a wireless signal. *Tuttle*, 6:17-30 (teaching that the wake-up circuit detects the energy of a transmitted wireless signal in an appropriate frequency band); *see also id.*, 7:4-16 (teaching that wake-up circuit processes initial “interrogation signals” before receiver 13 and transmitter 15 are able to exchange data with an interrogator device).

75. Both *Tuttle* and the '333 Patent are directed to portable electronic devices. *Compare Tuttle*, 3:52-57 (disclosing a smartcard for entering into a secured area), *with '333 Patent*, 8:42-50 (discussing example embodiment where the device is an electronic passport). Accordingly, *Tuttle* is in the same field of endeavor as and is analogous art to the '333 Patent.

76. Further, the '333 Patent is directed to the problem of conventional credit cards using a magnetic strip that requires use of a suitable transaction interface machine. *Tuttle* addresses this problem as one object of the invention is to serve as a replacement for contact powered electronics in a smart card application. *Compare '333 Patent*, 1:26-29 (“To access the information held by [conventional credit] cards after or during a transaction, a suitable transaction interface machine comprising an

appropriate magnetic card reader is required.”) *with Tuttle*, 3:54-57 (“[The invention] can serve as a replacement for metal-to-metal contact in smart card applications and as a replacement for magnetic strip, bar code, and other types of contact-powered electronics.”) Therefore, *Tuttle* is reasonably pertinent to a problem described by the ’333 patent. Therefore, *Tuttle* is analogous art to the ’333 Patent.

X. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Ground 1: Claims 1, 2, and 4-10 are obvious under pre-AIA 35 U.S.C. § 103 over *McGregor* in view of *Palmer*

77. *McGregor* teaches a bio-metric smart card device that, upon authenticating a user’s biometric data, generates and displays a security code that is used by the transaction network to approve the transaction. *McGregor* expressly teaches that the device can also be equipped with a wireless transceiver for *automatically* communicating the security code to the transaction network. However, *McGregor* doesn’t describe the transmission hardware contemplated or how the system determines when to automatically transmit the security key. The proposed combination establishes that a POSITA would have been motivated to modify *McGregor*’s device pursuant to *Palmer*’s hardware and its process for determining when automatic wireless communications are possible, automatically transmitting a security code when the device detects the existence and availability of an external device. As explained below, the proposed modification would have resulted in a device with improved security.

i. Claim 1

[1(Pre)] A portable electronic device, comprising:

78. To the extent the preamble is limiting, *McGregor* discloses a portable electronic device. As explained below, a POSITA would have understood that *McGregor*'s bio-metric smart card reader (wallet 410) is a portable electronic device, as claimed.

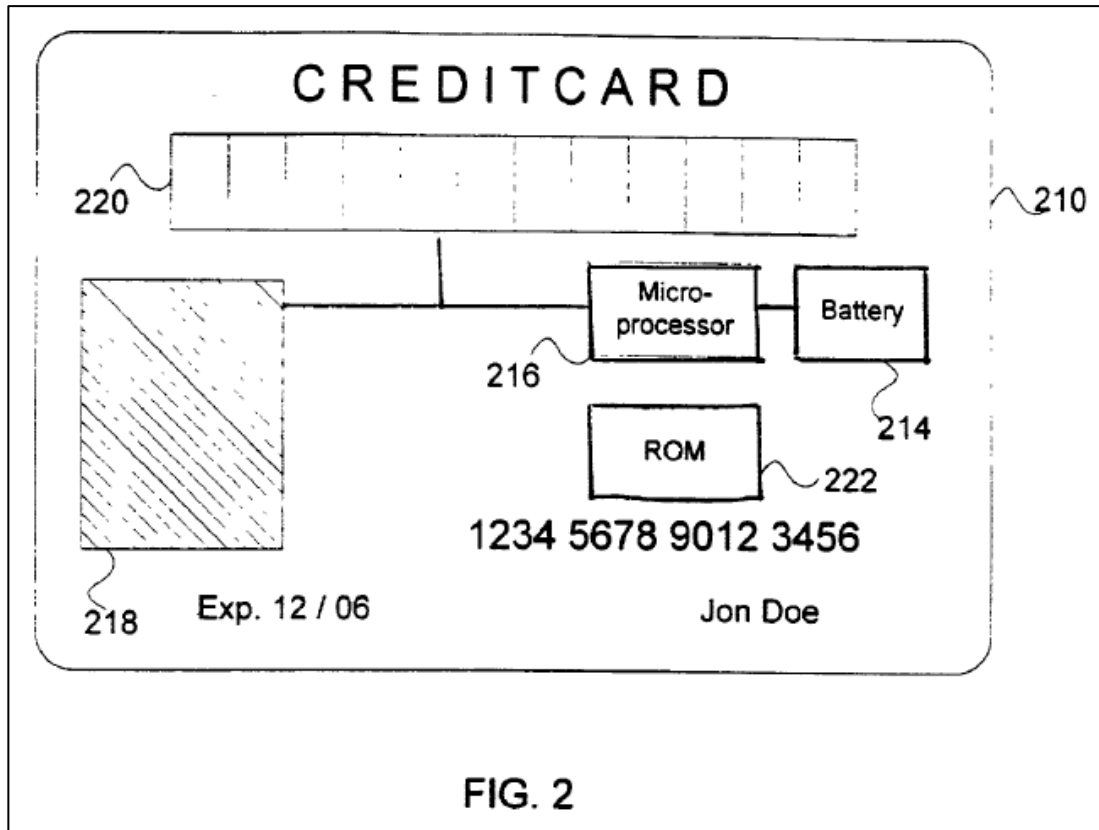
79. The '333 Patent expressly contemplates the portable electronic device having the form factor of a card (*see* '333 Patent, Figs. 1-3) and containing components common to smart cards. '333 Patent, 4:61-62; *see also id.*, 7:55-8:41 (discussing embodiment where the portable electronic device is a payment card). *McGregor* similarly teaches a portable bio-metric smart card reader 410 (referred to as a "wallet") with "substantially the same shape and form factor as available plastic credit and debit cards[.]" *McGregor*, [0043]; *see also id.*, [0037].³ Wallet 410 includes electronic components such as "fingerprint scanner 418 in electrical communication with a microprocessor 416." *Id.*, [0043]; *see also id.*, [0037]. "A battery [424] may also be connected to provide power to microprocessor 416." *Id.*,

³ Both *McGregor*'s bio-metric smart card embodiment as depicted in Fig. 2 and its bio-metric smart card reader (wallet 410) embodiment as depicted in Fig. 4 satisfy the claims and are captured by the Proposed Grounds. To focus the discussion, as the Petition does, I have highlighted the Fig. 4 wallet embodiment, but I've also included parallel citations to the Fig. 2 embodiment.

id., [0037]-[0038]. Wallet 410 is depicted in Fig. 4 below:



Id., [0037] (describing smart card equipped with ROM 222, microprocessor 216, battery 214, and display 220).



Id., Fig. 2.

80. A POSITA would have understood that *McGregor's* bio-metric smart card reader (Wallet 410) embodiment is a portable electronic device. A POSITA would have understood that it was well-known that smart cards and similar devices, such as *McGregor's* wallet, were examples of portable electronic devices. *See Hed*, [0002]-[0011] (teaching smart cards were known in the art); *see generally Doyle*, (teaching a “smart card with integrated biometric sensor”); *see supra* Section V.

[1(a)] an electronic circuit capable of storing data therein, capable of processing data, and capable of data input and output;

81. *McGregor* discloses this limitation. As explained below, a POSITA would have understood that *McGregor's* wallet 410 includes an electronic circuit capable of storing and processing data, and capable of data input and output.

82. *McGregor's* wallet 410 comprises electrical components, including battery 424, ROM 422, and microprocessor 416. *See* Fig. 4, [0043]-[0044]; Claim 1(Pre). Collectively, these components comprise an electronic circuit, as claimed. It was known in the prior art before the '333 Patent that portable electronic devices contained electronic circuits capable of storing, processing, input and output data including components such as a battery, memory, and microprocessor. *See supra* Section V.B; *see also Blossom*, 5:47-53 (teaching a smart card including an electronic circuit having a CPU, memory, power supply system, and input control system); *see Daggar*, 10:45-11:21 (teaching an electronic wallet including an electronic circuit, micromodule 200, capable of processing and storing data, and controlling other electronic wallet components).

83. As part of the electronic circuit, *McGregor's* ROM stores data, including “fingerprint or other bio-metric data, the encryption keys, and a transaction counter.” *McGregor*, [0043]; *see also id.*, [0037].

84. *McGregor's* microprocessor is capable of processing data, accepting data input, and outputting data. For example, the microprocessor accepts a

fingerprint input, processes data to generate a security key, and outputs that security key data (*e.g.*, wirelessly to a transaction network and/or to the display). *See, e.g., McGregor*, [0038]-[0039]⁴ (teaching a security key code is generated in the microprocessor and then displayed on the card), [0044] (“Finger print scanner 418 . . . is connected to the microprocessor 416 to provide an input signal[.] [D]isplay 420 is configured to display dynamic numeric and/or textual data forwarded by microprocessor 416[.] The wallet may include an IR or wireless transmitter to automatically transmit the security code to a transaction network.”), *see also McGregor*, Claim 1 (“a processor device in electrical communication with the user

⁴ Although *McGregor* teaches that the microprocessor in its Fig. 2 embodiment generates a security key code, it does not expressly teach the microprocessor in its Fig. 4 embodiment is similarly responsible for generating a security key code. A POSITA would have understood that the Fig. 4 microprocessor does in fact generate a security key code. Where *McGregor* does describe generating a security key code, it is generated by the microprocessor after receiving a fingerprint input and confirming it matches. *See, e.g., McGregor*, [0013], [0039]-[0041], [0046], [0065]. Because *McGregor* expressly teaches that Fig. 4’s microprocessor *receives* a fingerprint input and *outputs* a generated security key code (*id.*, [0044]), a POSITA would understand that the same microprocessor generated the security key code. Additionally, *McGregor* at [0044] teaches that its Fig. 4 embodiment implements the Fig. 3 flowchart, which expressly describes the microprocessor generating a security key code.

authenticator and counter, the *processor* being programmed to *generate a security key in response to* authentication *data received* via the user authenticator, the security key being derived at least in part from the contents of the counter”).

[1(b)] a control device operatively linked to said electronic circuit, with an invariable activation command being issued when said control device is selectively triggered;

85. *McGregor* in view of *Palmer* teaches this limitation. As explained below, a POSITA would have understood that *McGregor-Palmer* teaches a control device (*e.g.*, *McGregor's* fingerprint scanner 418) that is operatively linked to said electronic circuit (*e.g.*, *McGregor's* wallet 410) with an invariable activation command (*e.g.*, conveying security key code pursuant to *Palmer's* teachings) being issued when said control device is selectively triggered (*e.g.*, a user entering their biometric data).

86. The '333 Patent notes that a “[c]ontrol device 12 can be any suitable device allowing the portable electronic device holder to selectively trigger a data conveyance operation[.]” ’333 *Patent*, 5:5-32. The control device can include “a biometric parameter detector, for example a fingerprint scanner[.]” *Id.*, 5:12-14. Once the control device is selectively triggered, an activation command is issued to convey data within portable electronic device (*e.g.*, display in LCD screen 16), and possibly additionally conveyed to and from the portable electronic device (*e.g.*, data

exchange between portable electronic device and the external data exchange device), depending on the state of the switching element. *Id.* 6:42-58.

87. As discussed above, I have been asked to interpret “invariable activation command” broadly enough to capture a command to transmit data through either a first or second data conveyance operation, where the decision of which operation to use is outside of user control. *McGregor* teaches a control device (*e.g.*, fingerprint scanner 418) that is triggered by a user (*e.g.*, a user entering their biometric data), causing a microprocessor to issue a command to display data (*e.g.*, a security key code) and/or to automatically transmit that same data wirelessly. But *McGregor* does not describe the automatic wireless transmission functionality in detail. For example, it does not explain how the device determines whether to automatically transmit the data in lieu of (or in addition to) displaying the data. It also does not describe the transmission hardware used to accomplish this wireless transmission. The proposed combination relies on *Palmer’s* teachings for these implementation details. Namely, the combination proposes that a POSITA would have been motivated to modify *McGregor* pursuant to *Palmer* such that *McGregor’s* device automatically transmits its security key code when the device confirms the ***existence and availability*** of a reader/writer device able to receive the code. The combination further proposes incorporating *Palmer’s* transmission hardware into *McGregor’s* device.

McGregor's User Authentication and Security Key Conveyance

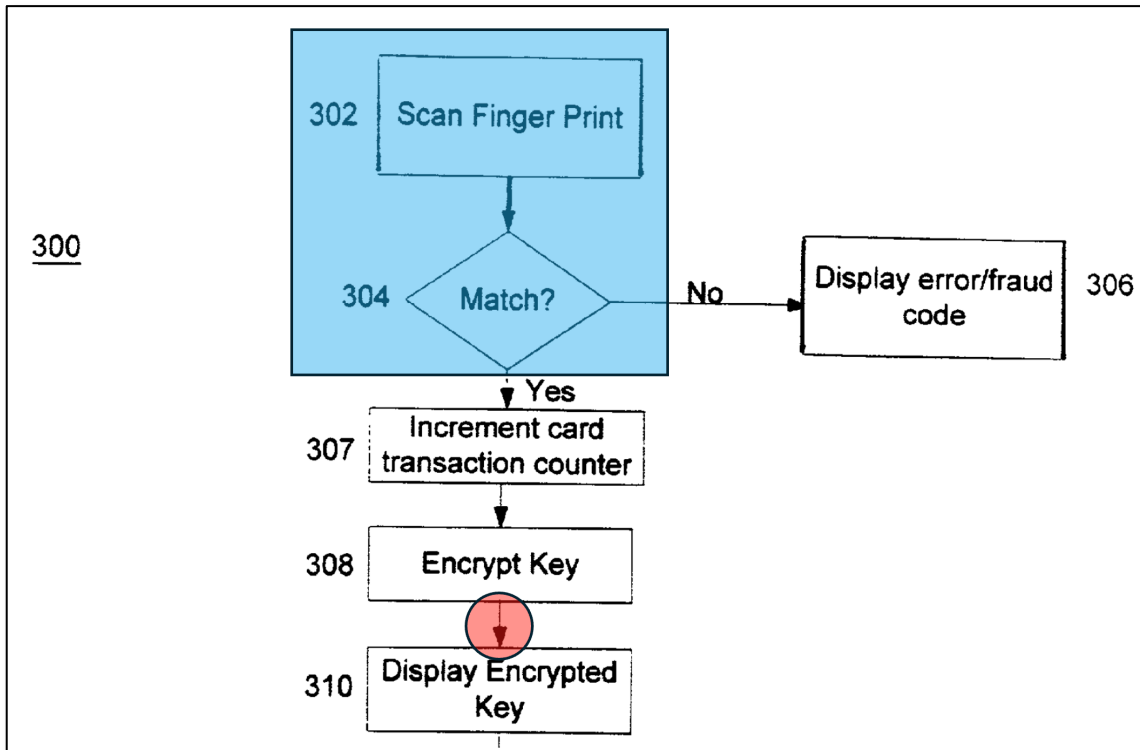
88. *McGregor* discloses a control device operatively linked to said electronic circuit in the form of a “finger print scanner 418 . . . connected to the microprocessor 416[.]” *McGregor*, [0044]; *see also id.*, [0037]; *See* claim 1(a). The fingerprint scanner 418 is selectively triggered when “the user plac[es] a thumb or finger upon the surface of scanner 418[.]” *McGregor*, [0044]; *see also id.*, [0037], [0040] (noting the scan is compared to “a reference file representative of the user’s actual print”). The results of the scan are then compared to a reference file representative of the user’s actual print, which may be stored in memory 222. *Id.*, [0040]. *McGregor* further discloses that its “bio-metric indicator (here, a thumb or finger print) or another user-derived input mechanism triggers in microprocessor 216 the generation of a dynamic security code displayed in the security key display region 220. The display region 220 preferably comprises an LED array, LCD or other similar, low-cost display mechanism.” *McGregor*, [0039].

89. A POSITA would have understood that *McGregor* discloses a control device operatively linked to said electronic circuit in the form of a “[f]inger print scanner 418 . . . connected to the microprocessor 416[.]” *McGregor*, [0044]; *see also id.*, [0037] (“The finger print scanner 218 is accessibly disposed upon surface 212 of card 210 and connected to microprocessor 216 to provide an input signal triggered by the user placing a thumb or finger upon the surface of scanner 218”), *see*

McGregor's Claim 1 (“a ***user authentication device*** configured to provide the user an authentication data input for proving the user is authorized to use the account number”). The fingerprint scanner 418 is selectively triggered when “the user plac[es] a thumb or finger upon the surface of the scanner 418[,]” *McGregor*, [0044]; *see also id.*, [0037], [0040] (noting the scan is compared to “a reference file representative of the user’s actual print”).

90. If the fingerprint scan is a match, “the microprocessor . . . generates [] a numeric or alphanumeric security key.” *McGregor*, [0041]. Once generated, the security key is sent to display 420, allowing the user to input (or otherwise forward) the security key to authorize a transaction. *McGregor*, [0041]. Fig. 3 shows the fingerprint scanner 418 (*i.e.*, control device) being selectively triggered in steps 302-304 (annotated in blue) and the security key being sent to the display prior to step 310, where the key is displayed. *McGregor*, Fig. 3.⁵

⁵ Fig. 3 and its relevant discussion in the specification are focused on and use the numbering of smartcard embodiment 210. These teachings equally apply to the wallet 410 embodiment. *McGregor*, [0044] (“The display 420 is configured to display dynamic numeric and/or textual data forwarded by microprocessor 416, and is intended to accompany the account number for all transactions in the manner outlined above with reference to FIG. 3.”). A POSITA would have understood that Fig. 3’s flowchart and corresponding description apply to both the Fig. 2 card embodiment and Fig. 4 wallet embodiment.



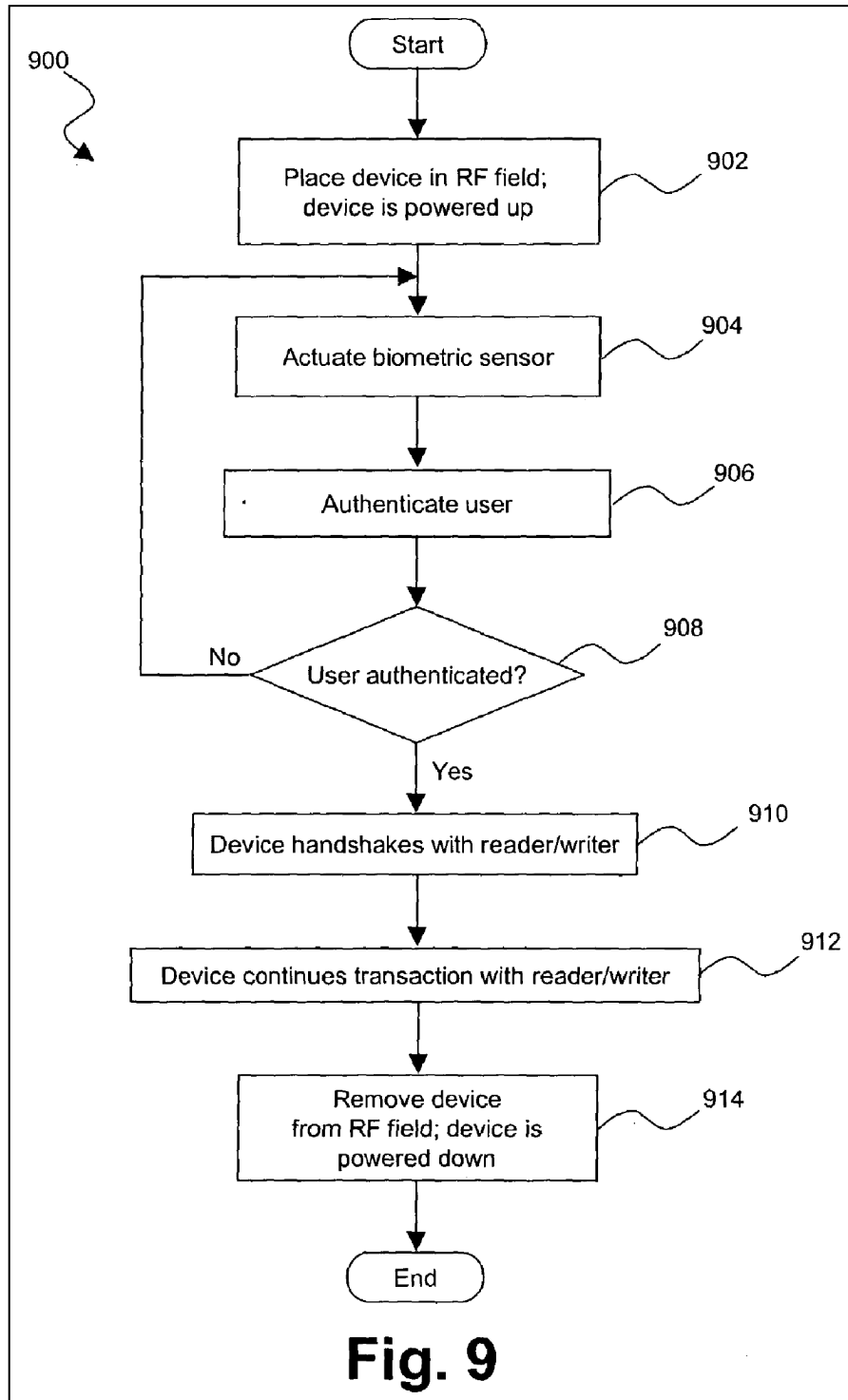
McGregor, Fig. 3, excerpt, annotated.

91. *McGregor* also teaches that the device may be equipped with “an IR or wireless transmitter to automatically transmit the security code to a transaction network.” *McGregor*, [0044]. A POSITA would have understood that *McGregor*’s fingerprint scanner 410 is a control device because it triggers data conveyance within its wallet (e.g., display in LCD screen), and possibly additionally automatically conveys data to a transaction network. *Compare* ’333 *Patent*, 6:42-58; *see* Claim [1(a)]. However, *McGregor* does not elaborate on how or when such automatic transmission would occur. Given *McGregor*’s silence on how this feature would be implemented, a POSITA would have looked to teachings in the art to guide its implementation. For a number of reasons discussed below, a POSITA would have

been motivated to implement *McGregor's* device pursuant to *Palmer* such that the security code would be automatically transmitted when the device detects the existence and availability of an external reader/writer device available to receive the security code.

Palmer's RF Field Detection, Handshake Process, and Wireless Transmission

92. Like *McGregor*, *Palmer* teaches a device takes the “form factor similar to that of a credit card[,]” containing a fingerprint sensor, RF antenna, and a display. *Palmer*, [0030]. Also, like *McGregor*, *Palmer's* device is used to authenticate its user via biometrics (*e.g.*, a fingerprint) to facilitate and secure a financial transaction. *Palmer* describes a process through which its device is placed within the RF field of a financial transaction reader/writer device, triggering the authentication process that includes (1) authenticating a user's fingerprint, (2) a handshake communication between the device and reader/writer, and (3) a two-way communication between the user device and the reader/writer device furthering a transaction. Fig. 9 illustrates this process:



Id., Fig. 9. As illustrated, the device is placed in the reader/writer's RF field at step 902,⁶ a user is authenticated using a fingerprint sensor at steps 904-906, the device performs a handshake process with the reader/writer at step 910 after authenticating the user's fingerprint, and then the device wirelessly exchanges data with the reader/writer device to "continue[] the transaction[.]" *Id.*, [0050]-[0051]. *Palmer* explains that its portable electronic device conducts a "communications handshake process with the reader/writer device via a contactless two-way communication link." *Id.*, [0051], Fig. 9.

93. A POSITA would have known that handshakes were well-established in computer science as a back-and-forth communication between two devices, often used to establish a set of encryption keys used to secure subsequent communications between the devices. It was well known in the prior art before the '333 Patent that wireless communication devices such as smart cards established handshake communication link with reader/writer devices to perform a subsequent transmission of data. For example, *Doyle* teaches a "smart card with integrated biometric sensor" that uses a "security handshake" procedure to establish a secure communication link

⁶ Although *Palmer* teaches that the RF field powers the device, *Palmer* expressly contemplates battery powered implementations that do not depend on inductive power. *Palmer*, [0043] ("[A] rechargeable battery may power the electronic components when no RF energy field is present.").

with a card reader device. *Doyle*, [0031]. *Doyle* teaches that the security handshake includes a Secure Sockets Layer (SSL)-like encryption in addition to authentication, to provide mutual authentication between the two devices. *Id.*, [0051], [0062], Fig. 2; *see also* Section V (discussing *Kelly*'s teachings for establishing RF communication links between a smart card and a reader/writer device to wirelessly communicate data).

94. Although *Palmer* does not go into detail about the specific signals exchanged in its contemplated handshake, consistent with the common purpose of a handshake, it teaches that communications “between the device [] and the reader/writer device . . . may be secured using mechanisms such as data encryption.” *Palmer*, [0023], [0033] (noting the device “may perform various encryption functions to support secure communications”). It was known in the art that handshake communications employed various encryption methods (in addition to any other security methods such as user authentication using biometrics). For example, *Doyle* explains that:

“When the buses are wireless links, the *security handshake* described below should include *Secure Sockets Layer (SSL)—like encryption* in addition to authentication, in order to provide mutual authentication of both endpoints, negotiation of a time limited key agreement with secure passage of a selected encryption key, and periodic renegotiation of the key agreement with a new encryption key. (Alternatives to use of SSL

include *Bluetooth link layer encryption, IPSec—which is also known as ‘ISAKMP-Oakley’—and perhaps others).*”

Doyle, [0051]. Accordingly, a POSITA would have understood that well-known encryption methods for handshake processes included Secure Socket Layer (SSL), Bluetooth link layer encryption, IPSec (ISAKMP-Oakley), and others.

Proposed Combination of *McGregor* and *Palmer* and Motivation to Combine *McGregor* and *Palmer*

95. In my opinion, a POSITA would have been motivated to implement *Palmer’s* (1) RF field detection and handshake processes and (2) *Palmer’s* transceiver hardware in *McGregor’s* device. Specifically, *Palmer’s* process of identifying an RF field generated by a reader/writer device and establishing a two-way communication link with that device would be implemented to dictate when *McGregor’s* wallet device should “automatically transmit the security code to a transaction network.” When no RF field is detected and no two-way communication link is established, *McGregor’s* device exclusively displays the security key code on the device’s display for the user to manually enter/forward. A POSITA would have been motivated to make this modification for a number of reasons.

96. First, the proposed combination applies *Palmer’s* known technique to implement *McGregor’s* device, which is ready for improvement, yielding predictable results. Namely, a POSITA would have recognized that *Palmer’s* process of detecting an RF field and handshaking with the reader to determine

whether short-range wireless communications are possible was a well-established practice. *Palmer*, [0065] (teaching that to “authorize a payment transaction where invoice information is displayed by the POS device, the user ... may hold the device 110 at an approximate six inch distance from the RF reader”); *see also Doyle*, (teaching a “smart card with integrated biometric sensor” that detects an RF field and uses a “security handshake” procedure to establish a secure communication with a card reader device); *Kelly* (teaching systems and methods for enhancing performance of contactless proximity automated data collection system which include a tag (*i.e.*, smart card) and a Target (reader/writer device) wherein RF communication links are established); Section V.

97. A POSITA would also have recognized that, by failing to describe how its wallet device “automatically transmit[s] the security code to a transaction network[,]” *McGregor* is ready for improvement, *i.e.*, guidance from the art as to how this automatic transmission would be implemented. Detecting the existence of an RF field and handshaking as a threshold for establishing a two-way communication link over which to communicate a security code would have yielded obvious results. It is well-accepted practice in the field of communications that a communication link should be setup and confirmed operable before transmitting data. This well-accepted practice is rooted in the need for reliability, efficiency and security. By confirming the communication link is functional, the sender increases

the probability that the data will reach its intended destination without being lost or corrupted, and ensuring operability indicates that the communication channel is ready for data transmission, allowing for efficient use of available energy.

98. As I discuss in the state of the art section above, it was well established before the priority date of '333 Patent that a communication link should be set up and confirmed operable before transmitting data. For example, *Kelly* teaches a system and method for improving wireless data transmission comprising a Target (*i.e.*, reader/writer device), a Tag (*i.e.*, smart card), and establishing an “RF communication link” between devices before transmitting data. *Kelly*, 2:29-36. Some of the advantages of the invention included authenticating both parties in the transaction, resolving communication collision with other devices, rapidly and robustly relaying information through the link, ensuring the integrity and incorruptibility of the transaction, and reducing power consumption. *Id.* A POSITA would have understood that the RF communication link disclosed in *Kelly*, consistent with the prior art at the time, should be set up and confirmed operable before transmitting data. *See* Section V (discussing *Doyle*, *Blossom*, and *Azuma*, which are references that disclose inventions where communication links are established before transmitting data). A POSITA would have understood that the proposed *McGregor-Palmer* combination would have provided similar benefits and improvements.

99. Further, the practice of handshaking to ensure secure communications would have similarly yielded predictable results, given the prevalence of handshaking in secure data communications at the time. A POSITA would have recognized that the practice of handshaking was a well-known concept in the field of smart card devices used for wireless communication. *See* Section V (discussing *Doyle, Kelly, and Azuma*).

100. Second, a POSITA would have recognized that implementing *Palmer's* process into *McGregor's* wallet would improve *McGregor's* similar device in the same way it benefits *Palmer*. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007) (“[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious[.]”). In both systems, detecting an RF field as a precursor to setting up a two-way communication link to exchange transaction-related data ensures the external reader-writer device is in-range, operable, and available to receive the data before the data transmission is attempted. As explained above, *Palmer* teaches that its device 400 (*e.g.*, smart card) is placed into an RF field emanated by a reader/writer device as a precursor of setting up a handshake process with the reader/writer device. *Palmer*, [0050]-[0051]. Detecting the RF field establishes the *existence* of a reader/writer and performing a handshake process establishes the *availability* of the reader/writer. *McGregor* teaches that its device

may be equipped with “an IR or wireless transmitter to automatically transmit the security code to a transaction network.” *McGregor*, [0044]. A POSITA would have recognized that, before automatically transmitting a security code, *McGregor*’s device would benefit from ensuring both the existence and availability of a reader device. The proposed combination would have resulted in an improved *McGregor*’s wallet to provide increased transaction speed, ensured data integrity and security, reduced cost, and reduced power consumption in the device.

101. A POSITA would have expected these benefits to apply to *McGregor*’s system in the same way they apply to *Palmer*’s given their similarities in structure and function. Indeed, both systems utilize portable electronic devices, sized similarly to credit cards, which utilize biometric user validation to perform financial transactions. *McGregor* teaches a portable bio-metric smart card reader 410 (referred to as a “wallet”) with “substantially the same shape and form factor as available plastic credit and debit cards[.]” *McGregor*, [0043]. Wallet 410 includes electronic components such as fingerprint scanner 418, microprocessor 416, battery 424, memory 422, and a display 420. *Id.*, [0043]-[0044]. Similarly, *Palmer* teaches a device 400 that has “a form factor similar to that of a credit card[.]” and contains “a fingerprint sensor 402, a RF antenna 404, a first controller 406, a second controller 408, function selector buttons 410,” and “an electro-luminescent display 412[.]” *Id.*, [0030]. Compare *McGregor*, [0012], [0037], with *Palmer*, [0002], [0061], [0030].

102. Further, the reader of *McGregor* and reader/writer of *Palmer* are both external devices used to process financial transactions. *See McGregor*, [0005] (“The present invention relates generally to the *field of credit card security*, and more particularly to a bio-metric smart card, a *bio-metric smart card reader* and a method of use for the card and reader.”); *compare with Palmer*, [0023] (“The communications envisioned include . . . *financial transactions* . . . and other interactions between the device 100 and the *reader/writer device*.”). *Compare McGregor*, [0012], [0039], *with Palmer*, [0029], [0051].

103. It was well known that in the field of wireless communication devices financial transactions required robust security methods. *See Palmer*, [0002]-[0005] (describing the importance of methods for providing secure transactions in the use of credit cards for remote transactions). *Palmer’s* handshake process enables improved security in financial transactions and is part of its disclosed method for improving security in commercial transactions in a contactless manner using biometric indemnity validation. *Palmer*, [0021], Fig. 9.

104. Finally, such modifications would have been well within a POSITA’s skill, supporting a reasonable expectation of success. First, as discussed above, *McGregor* and *Palmer* describe starkly similar systems, both of which use card-based devices to communicate wirelessly with transaction network reader/writer devices. Regarding *Palmer’s* hardware, given the similar form factors and

functionalities, a POSITA would have expected to easily incorporate *Palmer's* transceiver hardware in *McGregor's* device. Both *McGregor* and *Palmer* teach similar smartcard hardware. Each describe using a portable electronic device to transmit/exchange data with an external device. *See* Section IX.A-B. Each describe portable electronic devices comprising an electronic circuit, power means, and a user interface device (*e.g.*, display screen). *Id.* *McGregor* teaches that its smartcard (*e.g.*, wallet) has “substantially the same shape and form factor as available plastic credit and debit cards[.]” *McGregor*, [0043]; *see also id.*, [0037]. *Palmer* teaches that its device and method implementation can be achieved using a form factor similar to that of a credit card, or a variety of other physical structures. *Palmer*, [0030], [0067]. The modified device uses *McGregor's* device circuitry, which has wireless communication capability with a reader device. Thus, A POSITA would understand *McGregor's* device includes wireless communication components that can be modified per *Palmer's* teachings.

105. It would also have been a straightforward implementation of *Palmer's* teachings in *McGregor's* system to first detect an RF field and establish a two-way communication link via a handshake process before “automatically transmit[ing] the security code to a transaction network.” *McGregor* already contemplated implementing hardware system variations, consistent with the state of the art, to accommodate alternative smart card designs:

The present invention may be incorporated into a new smart card design, including a bio-metric sensor and a display, or may be incorporated as a portable ‘wallet’ that can also be used with standard credit cards.

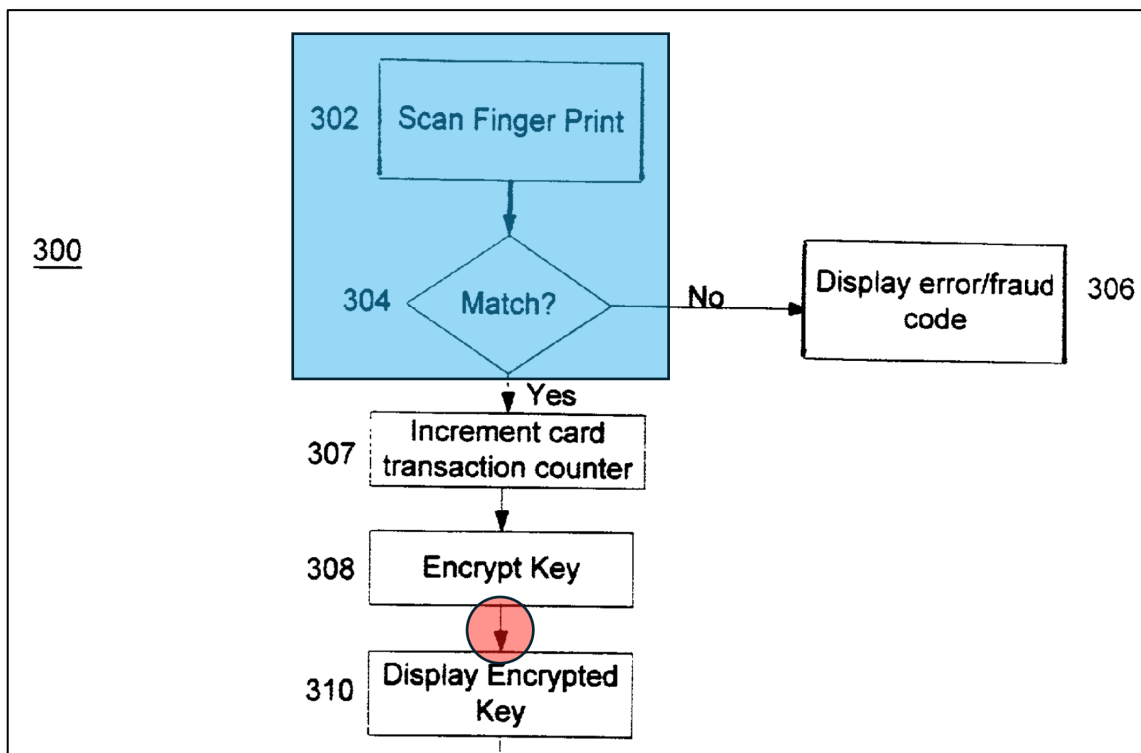
McGregor, [0047]. *McGregor* contemplated modifications to existing data transmission infrastructure such as reprogramming a smart card to accommodate alternative procedures for data transmission. *McGregor*, [0077]. A POSITA would have understood and been capable of programming *McGregor*’s microprocessor to perform the functionality taught by *Palmer*.

McGregor’s Microprocessor Issues an Invariable Activation Command in the Proposed Combination

106. As discussed above, in this declaration I assume that “invariable activation command” can be construed broadly enough to capture a command to transmit data through either a first or second data conveyance operation, where the decision of which operation to use is outside of user control. In the Proposed Combination, after a user enters their fingerprint and a security key code is generated, *McGregor*’s microprocessor causes the security key code to be displayed on the card and transmitted through a wireless network, if an RF field is detected and a two-way communication link established. Because these distinct data paths are determined by the RF field detection process, rather than by user choice, the data transmission command issued by *McGregor*’s microprocessor is invariable, as claimed. In other words, the user has no ability to prevent the automatic wireless

transmission if the device has established a communication link with the reader/writer device. This is consistent with the teachings of *Palmer* in which the communication with the reader/writer automatically occurs once the RF field is detected and authentication takes place. *Palmer*, Fig. 3, Fig. 9.

107. *McGregor* teaches that the transition from step 308 to step 310 within *McGregor's* Fig. 3 demonstrates that when the security key is created, it is automatically displayed without any additional user input.



McGregor, Fig. 3 (annotated). *McGregor* teaches that at step 302 the user attempting to use the account number found on the smart card, places his or her thumb or finger upon fingerprint scanner, or any other form of bio-metric authentication. *Id.*, [0040]. The results of scan step 302 are then compared at step 304 to a reference file

representative of the user's actual print. *Id.* If no match is found, an error message or fraud code is displayed at step 306. *Id.* If a match is found, the microprocessor increments an activation/transaction counter to generate and display an encrypted security key (steps 307-310). *Id.*, [0041].

108. In the modified device pursuant to the proposed *McGregor-Palmer* combination, once *McGregor's* device receives an activation cue the invariable activation command generated by *McGregor's* microprocessor would cause the security key code to be wirelessly transmitted instead of displaying *or* in addition to displaying. As shown in *McGregor's* Figure 3 above, when a user device has been successfully authenticated (steps 302-307), the encrypted security key code is displayed (step 310). *McGregor* also teaches that the code can be automatically transmitted. *McGregor*, [0044]. *McGregor* is not entirely clear whether automatically transmitting the code is performed in lieu of or in addition to displaying the code, but there is some suggestion that the wireless transmission is an alternative to displaying. *Id.*, [0053] (teaching the code is communicated "via the display on the front of the card, *or* the data is directly sent via IR or other wireless technology"). Whether the code is also displayed or not is not pertinent to the Challenged Claims, however. While the '333 Patent Claims do require transmitting data when an activation cue has been received (*e.g.*, when handshake signals are exchanged), they do not exclude a device that both displays and transmits its data

when an activation cue has been received. The mapping of *McGregor-Palmer's* device under this scenario is further discussed in Claim [1(g)] below. Accordingly, whether *McGregor's* device automatically transmits the security key code instead of or in addition to displaying that data does not impact the Proposed Grounds.

[1(c)] a user interface device operatively linked to said electronic circuit;

109. *McGregor* discloses this limitation. As explained below, a POSITA would have understood that *McGregor's* display 420 is a user interface device operatively linked to the electronic circuit of the portable electronic device (*i.e.*, wallet).

110. *McGregor* discloses a display 420 that is “configured to display dynamic numeric and/or textual data forwarded by microprocessor 416[.]” *McGregor*, [0044], [0038], [0039] (“The display region 220 preferably comprises an LED array, LCD, or other similar, low-cost display mechanism.”). Specifically, display 420 displays the security key after a user has been authenticated via the fingerprint scanner. *McGregor*, [0040], [0041]. The display also notifies a user when a user other than the authorized user attempts to use the device by displaying an error message. *Id.*, [0040]. Thus, a POSITA would have understood that *McGregor's* display 420 is a user interface device, as claimed, at least because it communicates data to the user.

111. *McGregor's* display 420 is operatively linked to the said electronic circuit, as claimed, because it displays data received from microprocessor 416, which is part of the electronic circuit. *See* Claim [1(a)]; *see also McGregor*, [0016] (“[A]n electronic display in electrical communication with the key generator, for displaying the security key in a manner visible upon the structure[.]”), *see McGregor*, Claim 25 (“A smart card, comprising, . . . a processing device coupled to the display device and configured to receive said signal . . . and display the encrypted key on the display mechanism[.]”).

[1(d)] a data transceiver operatively linked to said electronic circuit, said data transceiver being for exchanging data between said electronic circuit and an external data exchange device, and for receiving a selectively emitted activation cue from a source external to said portable electronic device;

112. As set forth above with reference to limitation [1(b)], the Proposed Combination relies on *McGregor's* modified wallet device exchanging data (*e.g.*, security key code) with an external data exchange device (*e.g.*, reader/writer device) when a selectively emitted activation cue (*e.g.*, one or more handshake signals received from the reader/writer device) is received from a source external to the portable electronic device (*e.g.*, the reader/writer device).

A data transceiver operatively linked to said electronic circuit.

113. *McGregor* in view of *Palmer* teaches this limitation. As explained below, a POSITA would have understood that *McGregor-Palmer* teaches a data transceiver (*e.g.*, *Palmer's* smart card chip 408) operatively linked to the portable

electronic device (e.g., battery 424, ROM 422, and microprocessor 416 in *McGregor's* wallet 410—see Claim [1(a)]), as claimed.

114. *McGregor* discloses that wallet 410 can send the security key “directly [] via IR or other wireless technology” via an “IR or wireless transmitter[.]” *McGregor*, [0053], [0044]. The proposed *McGregor-Palmer* combination implements *Palmer's* hardware and techniques to achieve the wireless transmission contemplated by *McGregor*. As explained above in Claim [1(b)], a POSITA would have been motivated to implement *Palmer's* (1) RF field detection and handshake processes and (2) *Palmer's* transceiver hardware in *McGregor's* wallet 410. See Claim [1(b)]. *Palmer's* device 400 includes an RF antenna 404 and smart card chip 408 that “support two-way communication” with external devices. *Palmer*, [0030], [0033] (“[T]he smart card chip 408 may support two-way communication data transfers and may perform various encryption functions to support secure communications.”), [0043] (“[T]he RF antenna 404 . . . may also support two-way communication with an associated reader/writer device[.]”). The smartcard chip 408 “may support standard smart card interactions such as identification validation, credit card transactions, and others.” *Id.*, [0033] Thus, a POSITA would have understood that *Palmer's* smartcard chip 408 receives and sends data through the RF antenna 404 to facilitate two-way communication with an external device.

Accordingly, a POSITA would have understood that *Palmer's* smartcard chip 408 is a data transceiver, as claimed.

115. Under the proposed combination, *Palmer's* RF antenna 404 and smartcard chip 408 would be operatively connected to *McGregor's* electronic circuit to function as intended. Namely, these components from *Palmer* allow the modified *McGregor* device to transmit the security key generated by the microprocessor 416 (part of the “electronic circuit”) via RF—functionality expressly taught by *McGregor*, but not described in detail. Thus, *Palmer's* smartcard chip 408 is a data transceiver operatively linked to *McGregor's* electronic circuit, as claimed.

Said data transceiver being for exchanging data between said electronic circuit and an external data exchange device

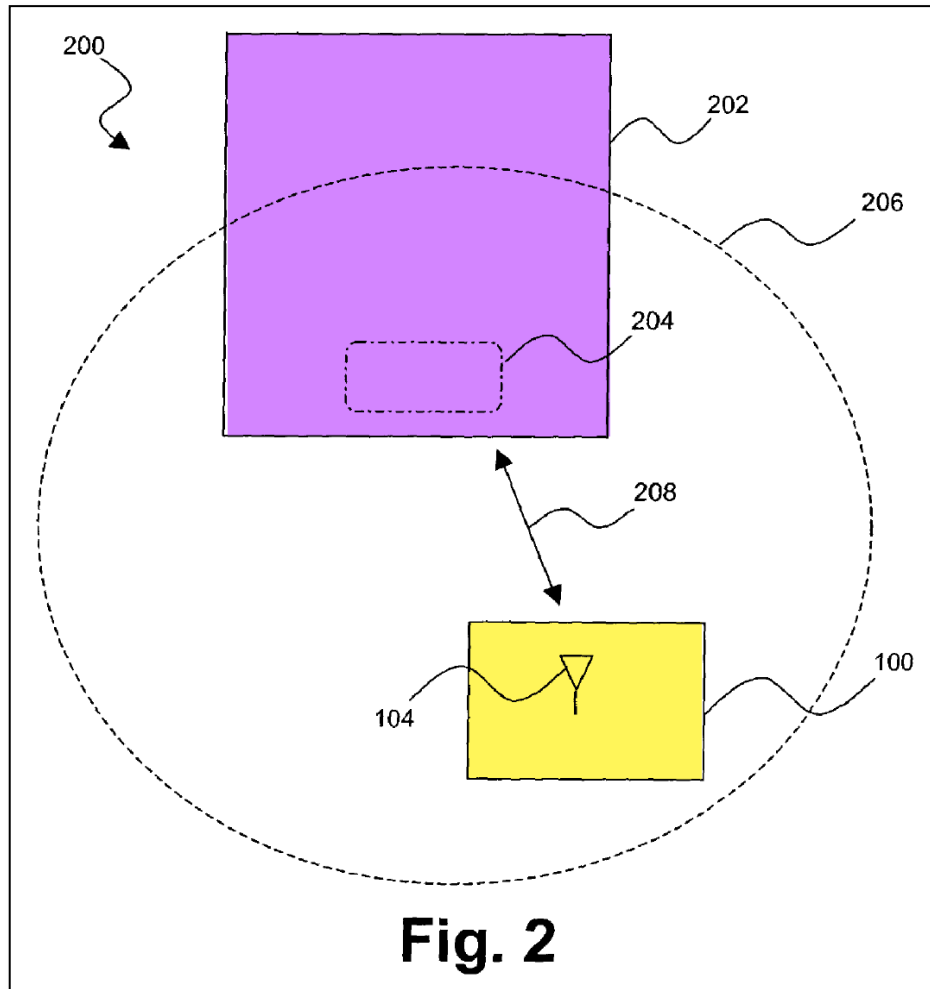
116. *McGregor* teaches that the wallet “may include an IR or wireless transmitter to automatically transmit the security code to a transaction network.” *McGregor*, [0044], [0053]. A POSITA would understand that an IR transmitter or other similar wireless transmitters would be limited in range and, therefore, must communicate with a nearby short-range base station to transmit the security code to the transaction network. For example, *Palmer* teaches that to “authorize a payment transaction where invoice information is displayed by the POS device, the user of the device 100 holds the device 100 within an RF field generated by an RF reader connected to the POS device in step 1302. For example, the user may hold the device 110 at an *approximate six inch distance from the RF reader.*” *Palmer*, [0065].

117. A POSITA would have understood *McGregor's* automatic transmission is similarly accomplished via short-range communication technology. *McGregor*, [0085] (“Included in the programming (software) of the general/specialized computer or microprocessor are software modules for implementing the teachings of the present invention, including, but not limited to, ... *transmitting and receiving any of IR, RF, or other electronic or optical signals*”). Though many RF technologies may support long-range communications, a POSITA would have understood that *McGregor's* suggestion of IR, as well as the context of a portable device communicating with a smart card reader, suggests short range communications are the preferred implementation. A POSITA would also understand for security reasons, wireless transmissions of financial data would be limited to short range technologies. Additionally, a POSITA would understand that devices with limited power (*e.g.*, from a small battery) would typically have shorter range than long-range devices such as cell phones.

118. *McGregor* teaches retailer-based readers connected to the transaction network to facilitate short-range communications with the portable device. *McGregor*, [0039] (“The displayed security key is [] communicated or transmitted to the credit card authorization service [] through a reader[.]”), [0044] (teaching that the wallet “may include an IR or wireless transmitter to automatically transmit the security code to a transaction network”). *McGregor* explains that its wallet may be

used with existing smart cards, which lack an incorporated microprocessor and/or display, and that existing smart cards utilize retailer-based readers. A POSITA would have understood that a reader or other merchant device capable of short-range communication wirelessly receives the security key code from *McGregor's* wallet device. A POSITA would have understood that the reader discussed in *McGregor* [0039] is a point-of-sale card reader (called a retailer-based reader throughout this petition) operated by a retailer to perform in-person retail transactions. Further, a POSITA would understand that, in both the wallet embodiment of Fig. 4 and the smart card embodiment of Fig. 2, the devices communicate data with a retailer-based reader to perform in-person financial transactions.

119. *Palmer* teaches a reader device consistent with that described by *McGregor*. Namely, *Palmer's* reader/writer device 202 is an example of a short-range communication capable reader device designed to (1) communicate wirelessly with a smart card and (2) to communicate transaction data with the transaction network. *Palmer*, [0027-28] (teaching that reader/writer device 202 communicates wirelessly with smart card devices and is also connected to a network). Fig. 2 of *Palmer* shows the relationship between reader/writer device 202 and a portable electronic device 100:



Palmer, Fig. 2 (annotated). As illustrated, “exemplary environment 200” “enables contactless interaction” between reader/writer device 202 (annotated in purple) and device 100 (annotated in yellow) via “a two-way communication link 208[.]” *Palmer*, [0027]. This contactless interaction includes a “communications handshake process” and continuing “the desired transaction” (each a data exchange) between device 100 and the external reader/writer 202 “via a contactless two-way communication link.” *Palmer*, [0051].

120. To the extent Patent Owner disputes that *McGregor* teaches an external data exchange device for wirelessly communicating with its wallet device, a POSITA would have been motivated and found it obvious to implement *McGregor*'s system with the reader/writer 202 described in *Palmer*. As discussed above, *McGregor* teaches a system for wireless transactions that includes a portable electronic device (e.g., wallet, smartcard) and a device reader in a transaction network. *Palmer* teaches a similar system for wireless transactions that includes a portable electronic device (smartcard) and a reader/writer in a transaction network.

121. Indeed, a POSITA would have recognized that *Palmer*'s reader/writer device 202 is a reader device that serves the same purpose as the reader contemplated by *McGregor*—wirelessly communicating with a smart card device and exchanging data with the transaction network. The motivations to make this additional modification to *McGregor* are the same as those set forth with reference to limitation [1(b)]. A POSITA would have recognized that the motivations for modifying *McGregor*'s system pursuant to *Palmer*'s RF field detection and handshake processes and transmission hardware also motivate implementing *Palmer*'s reader/writer device as an exemplary device through which *McGregor*'s wireless communications would occur. *See* Claim [1(b)].

For receiving a selectively emitted activation cue from a source external to said portable electronic device.

122. The '333 Patent does not define “selectively emitted[.]” The term is not used outside the claims and summary of the invention, which simply restates the claim language. The patent’s use of “selectively” in other contexts, however, provides insight into the meaning of “selectively emitted[.]” For example, the patent repeatedly describes a user “selectively” triggering a data conveyance. *See '333 Patent*, 5:5-7, 6:42-65. In this context, “selectively” appears to mean that some specific action occurs to cause the event, *e.g.*, the user engages the device to trigger a data conveyance.

123. Applying the same logic to a “selectively emitted activation cue[.]” this phrase should require some intervening action that causes the activation cue to be transmitted. Even under this interpretation, the Proposed Combination satisfies the limitation. Namely, as set forth with reference to limitation [1(b)], *Palmer’s* process first detects an RF field and then engages in a handshake process in which data is exchanged between the smart card device and reader/writer device. At least because the activation cue (*e.g.*, the one or more handshake signals that establish a communication link) are sent in response to the user bringing the smart card device within the RF field and in response to the smart card device initiating the handshake process, *Palmer’s* process satisfies the Claims’ “selectively emitted activation cue” language. That is, there are intervening acts that cause the reader/writer device to

emit its activation cue (*e.g.*, handshake signals). Accordingly, a POSITA would have understood that *McGregor-Palmer* teaches a data transceiver for receiving a selectively emitted activation cue from a source external to the portable electronic device.

124. In sum, *McGregor-Palmer* teaches a data transceiver (*e.g.*, *Palmer's* smartcard chip 408) operatively linked to the portable electronic device (*e.g.*, the components in *McGregor's* wallet, including the microprocessor) wherein the data transceiver exchanges data with an external data exchange device (*e.g.*, reader) and receives a selectively emitted activation cue (*e.g.*, handshake signal) from a source external to the portable electronic device (*e.g.*, reader).

[1(e)] a data conveyance switching element operatively linked to said electronic circuit, said switching element being in an activated state upon an activation cue having been received by said data transceiver, and being in an inactive state when no activation cue was received by said data transceiver; and;

125. *McGregor* in view of *Palmer* teaches this limitation. As explained below, a POSITA would have understood that *McGregor-Palmer* teaches a data conveyance switching element (*e.g.*, *McGregor's* microprocessor modified pursuant to *Palmer's* teachings), as claimed.

126. Limitation [1(e)] requires a switching element that is either an activated state or inactivated state, depending on whether an activation cue is received. '333 *Patent*, 6:4-25. The '333 Patent states that "switching element 44b can be a physical

structure, a virtual program, or both.” *Id.*, 6:16-17; *see id.*, 6:11-12 (teaching that the element can be “a series of instructions programmed onto the microchip”).

127. *McGregor’s* device modified pursuant to *Palmer’s* processes satisfies this limitation. Namely, as discussed above with reference to limitation [1(b)], *McGregor’s* microprocessor is responsible for transmitting a security key code to the device’s display and/or automatically transmitting the code in the event a wireless reader/writer device has been detected and a handshake operation has been performed (pursuant to *Palmer’s* teachings). A POSITA would have understood that a series of instructions would be programmed into *McGregor’s* microprocessor to function as a switching element (pursuant to *Palmer’s* teachings), and as described in the ’333 Patent. *See* Claim [1(b)]; *see* ’333 Patent, 6:9-14. Accordingly, *McGregor’s* microprocessor is a switching element (1) that is placed into an activated state after receiving a handshake signal (an activation cue) that establishes a communication during the handshake process and (2) that remains in an inactivated state if no reader/writer device is detected (no activation cue). As explained above, in Claim [1(d)], the activation cue can be an RF signal (*e.g.*, a handshake signal) emanating from the reader/writer device. *See* Claim [1(d)].

[1(f)] power means for providing power to said portable electronic device;

128. *McGregor* discloses this limitation. As explained below, a POSITA would have understood that *McGregor* teaches power means for providing power (e.g., battery) to its portable electronic device (i.e., wallet).

129. *McGregor* discloses “[a] battery [] connected to provide power to microprocessor 416.” *McGregor*, [0043]; *see also id.*, [0037]. Alternatively, *McGregor* contemplates other forms of power: “movement of card reader 410 (as with an automatic watch) or contact of the card or by a solar panel.” *McGregor*, [0043]; *see also id.*, [0037]. The battery 424 or alternative source of power is connected to the microprocessor 416, which is a part of the electronic circuit of the wallet 410. *See* Claim 1(pre); *McGregor*, [0043]; *see also id.*, [0037].

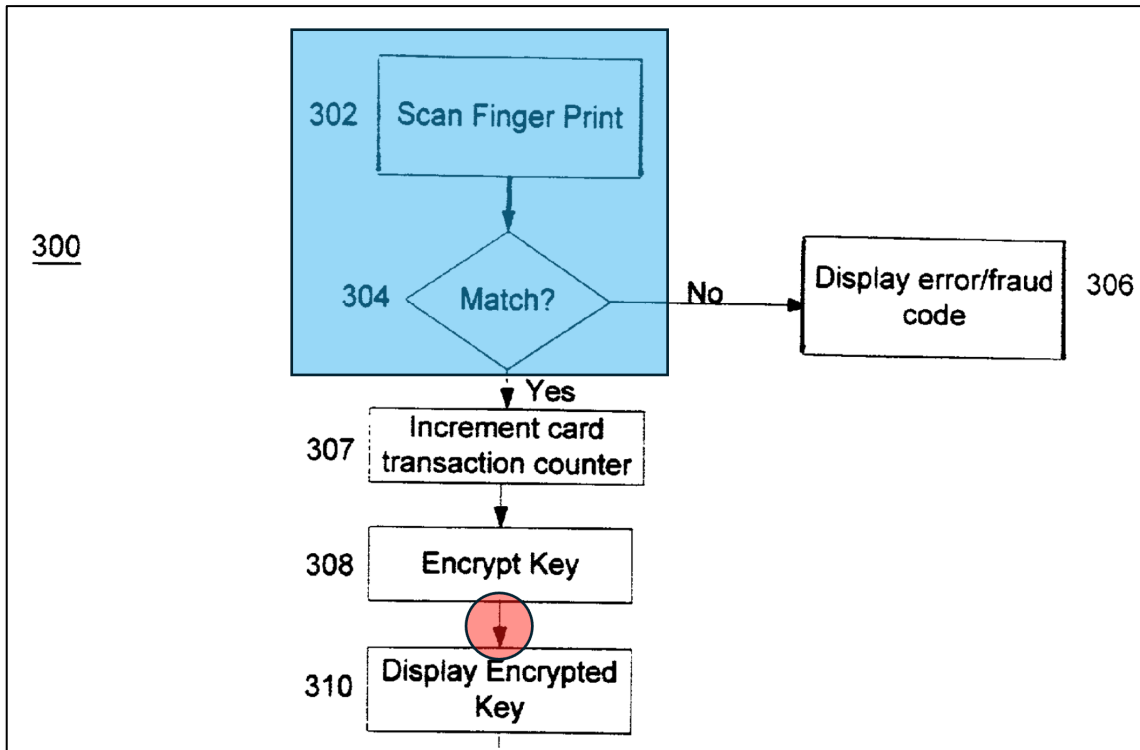
[1(g)] wherein upon said control device being selectively triggered to issue an[] invariable activation command: if said switching element is in said activated state, a data exchange will be initiated through the instrumentality of said data transceiver for exchanging data between said electronic circuit and an external data exchange device;

130. The combination of *McGregor* and *Palmer* teaches this limitation. As set forth in the preceding limitations, *McGregor*’s wallet device modified based on the teachings of *Palmer* automatically transmits a security key code to an external reader device after an RF field of the wireless reader/writer device has been detected, a user enters their fingerprint for authorization (i.e., selectively triggers the device to send data), and a handshake operation is completed between *McGregor*’s device

and the reader/writer device. When the RF signal is detected and a handshake signal is received (cue signal) establishing a communication link, *McGregor's* microprocessor (*i.e.*, switching element) is placed in an activated state. As discussed with reference to limitation [1(b)], the command issued by *McGregor's* microprocessor to convey the security key code is “invariable” in that the microprocessor being in an activated state dictates how the data is conveyed, rather than providing any user control over the conveyance. *See also* Claim [1(e)]. As discussed above with reference to limitation [1(b)], the invariable activation command generated by *McGregor's* microprocessor would cause the security key code to be wirelessly transmitted instead of displaying *or* in addition to displaying. While the claims do require transmitting data via the transceiver when an activation cue has been received (*e.g.*, when the handshake signals are exchanged), they do not exclude a device that both displays and transmits its data when an activation cue has been received. *See* Claim [1(h)]. Accordingly, whether *McGregor's* device automatically transmits the security key code *instead of* or *in addition to* displaying that data, when it receives an activation cue, is of no moment to the Proposed Grounds.

[1(h)] wherein upon said control device being selectively triggered to issue an[] invariable activation command: . . . if said switching element is in said inactive state, data will be conveyed from said electronic circuit to said user interface device for communicating information to the portable electronic device holder.

131. The combination of *McGregor* and *Palmer* teaches this limitation. As set forth in the preceding limitations, *McGregor*'s wallet device modified based on the teachings of *Palmer*, when a user enters their fingerprint for authorization (*i.e.*, selectively triggers the device to send data), automatically displays a security key code (*i.e.*, data) to the wallet device's display (*i.e.*, user interface device for communicating information to the portable electronic device holder) when no RF field of a wireless reader/writer device has been detected (and no handshake has occurred). *McGregor*'s Figure 3 shows that when a user device has been successfully authenticated (steps 302-307), the encrypted security key code is displayed (step 310):



McGregor, Fig. 3 (annotated).

132. Absent detecting an RF field of a reader/writer device and performing a handshake process, the wallet's microprocessor (*i.e.*, switching element) remains in an inactivated state. As discussed with reference to limitation [1(b)], the command issued by *McGregor's* microprocessor to convey the security key code is "invariable" in that the microprocessor being in an inactivated state dictates how the data is conveyed, rather than providing any user control over the conveyance.

ii. Claim 2

A portable electronic device as defined in claim 1, wherein said user interface device is a display screen.

133. *McGregor* discloses this limitation. For example, *McGregor* discloses a display 420 (a user interface device). *See* claim 1(c). “The display region [420] preferably comprises an LED array, LCD, or other similar, low-cost display mechanism.” *McGregor*, [0039], [0043]. A POSITA would have understood an LED array or LCD constitute a display screen. Indeed, the ’333 Patent describes that its display screen 16 “can be a LCD (liquid crystal display) screen embedded into main body” of the portable electronic device. ’333 *Patent*, 4:65-67. Accordingly, a POSITA would have understood that *McGregor*’s display 420 is a display screen, as claimed.

iii. Claim 4

A portable electronic device as defined in claim 1, wherein said control device is a biometric parameter detector.

134. *McGregor* discloses this limitation. As explained below, a POSITA would have understood that *McGregor* teaches a control device that is a biometric parameter detector (*i.e.*, fingerprint scanner 418). *See also* Claim [1(b)].

135. *McGregor* discloses that its wallet 410 includes a “bio-metric reading apparatus such as fingerprint scanner 418[.]” *McGregor*, [0043]. The “[f]inger print scanner 418 ... is connected to the microprocessor 416 to provide an input signal

triggered by the user placing a thumb or finger upon the surface of the scanner 418.”

Id., [0044]. The results of the scan are then compared to a reference file representative of the user’s actual print, which may be stored in memory 222. *Id.*, [0040]. *McGregor* further discloses that its “bio-metric indicator (here, a thumb or finger print) or another user-derived input mechanism triggers in microprocessor 216 the generation of a dynamic security key code displayed in the security key display region 220. The display region 220 preferably comprises an LED array, LCD or other similar, low-cost display mechanism.” *McGregor*, [0039]. A POSITA would have understood that *McGregor*’s fingerprint scanner 410 is a control device that is a biometric parameter detector because it receives as input a user’s biometric fingerprint data. Indeed, the title of *McGregor* is a “bio-metric smart card, bio-metric smart card reader, and method of use[.]” *McGregor*, Title.

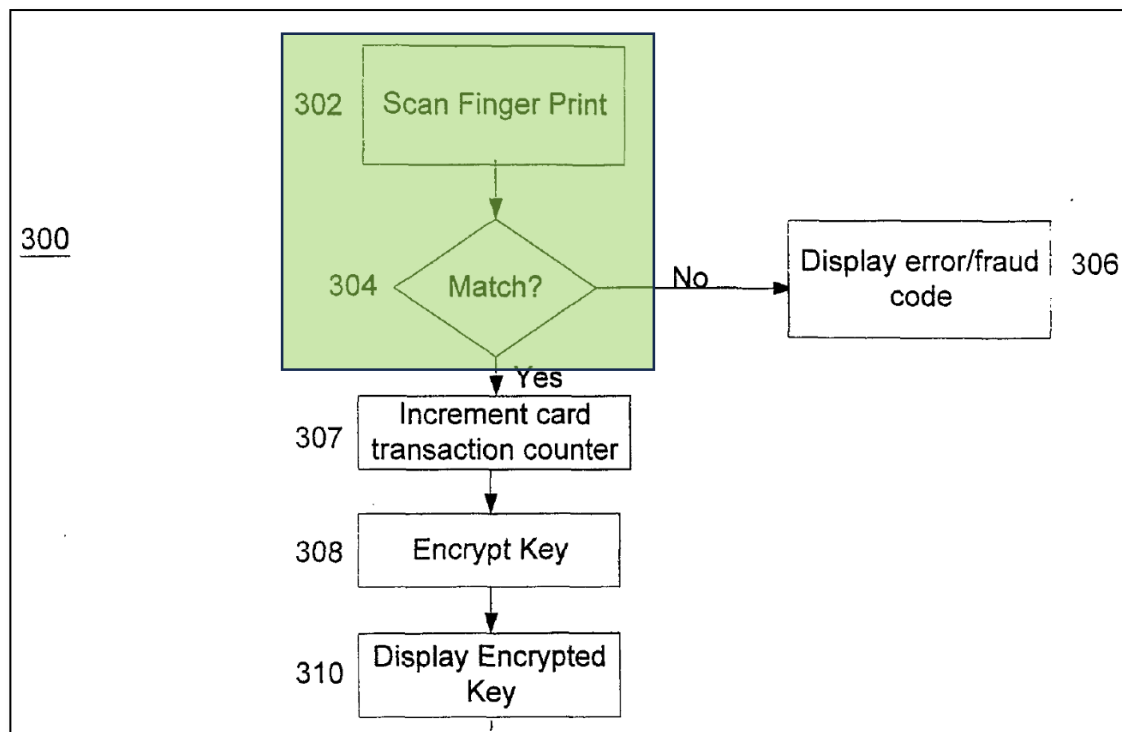
iv. Claim 5

A portable electronic device as defined in claim 4, wherein said biometric parameter detector is a fingerprint scanner capable of obtaining a fingerprint scan, and whereby said control device is triggered when the fingerprint scan matches a fingerprint image pre-saved in said electronic circuit.

136. As explained above in Claim 4, *McGregor* teaches a fingerprint scanner that is a control device that is a biometric parameter detector. With the data obtained from the fingerprint scanner, *McGregor* teaches matching a fingerprint to a pre-saved fingerprint in the electronic circuit:

[T]he user places his or her thumb or finger upon fingerprint scanner [418]. In the alternative, step 302 might be replaced with any other form of bio-metric authentication that provides positive identification that an authorized user is, in fact, attempting to use the account number found on the card. The results of scan step 302 are then compared (either by scanner [418] alone or in cooperation with microprocessor [416]) at step 304 to a reference file representative of the user's actual print. The reference file might be stored in scanner [418], in microprocessor [416], or in a separate memory unit (ROM [422]).

McGregor, [0040]. The microprocessor 416 and ROM 422 are parts of the electronic circuit. See Claim [1(a)].



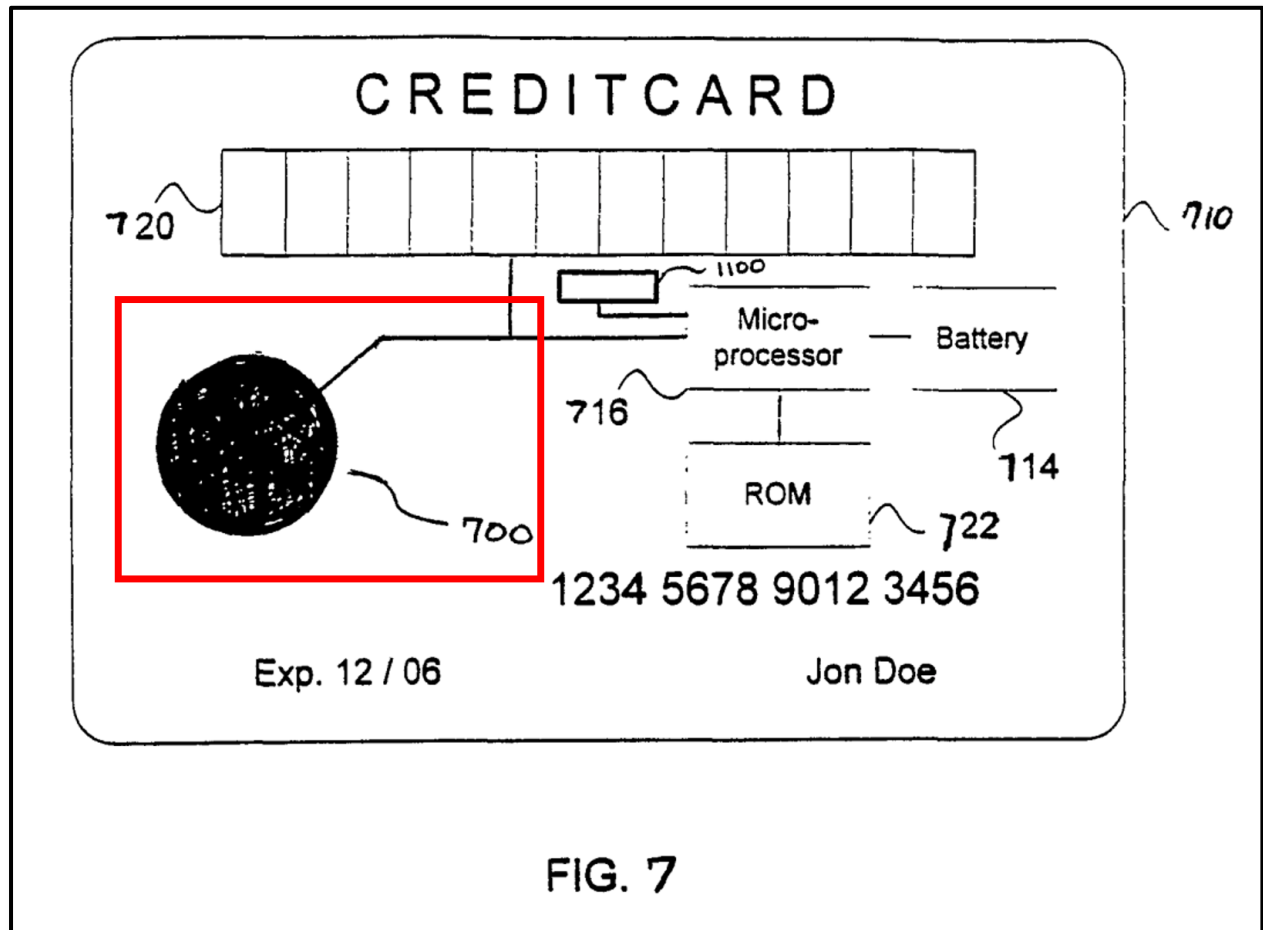
McGregor, Fig. 3, excerpt, annotated.

137. Scanning a fingerprint that matches a stored fingerprint constitutes selectively triggering the fingerprint scanner 418. *McGregor*, Fig. 3. As shown in *McGregor's* Fig. 3, Step 304 (annotated in green above), “[i]f a match is found . . . the microprocessor [416] increments an activation/transaction counter at step 307 and generates therewith a numeric or alphanumeric security key.” *McGregor*, [0041]. In the context of this limitation, triggering the control device does not imply initiating or triggering the fingerprint scanner to turn on, but rather that the user is entering a fingerprint to initiate a data conveyance (*e.g.*, as part of a financial transaction).

v. Claim 6

A portable electronic device as defined in claim 1, wherein said control device is a manually activated button, and whereby said control device is triggered when the button is pressed.

138. *McGregor* discloses this limitation. For example, *McGregor* discloses an embodiment of a smartcard 710 where “a button or other activation device 700” has the functionality of fingerprint scanner 218. *McGregor*, [0058]. Fig. 7 shows the button or other activation device 700 (*i.e.*, control device) on smartcard 710, as shown in the red box below.



McGregor, Fig. 7 (annotated).

139. *McGregor* further discloses that the button “provides a signal that initiates production of an encrypted key that is displayed on display 720.” *McGregor*, [0059]. The button 700 may be a physical button having contacts, a pressure sensitive or light sensitive switch, a heat sensitive button, or another activation device. *Id.* As such, the button is the claimed control device. *See also* Claim [1(b)]. A POSITA would have understood that the button must be manually activated (*i.e.*, pressed).

140. A POSITA would have recognized that the button in smart card 710 would be simply implemented in the wallet 410 embodiment, replacing its biometric sensor. For example, *McGregor* explains, consistent with the state of the art at the time, that other arrangements of components, including the activation device (*e.g.*, biometric sensor, button, etc.), in smart cards may be implemented:

“In this embodiment, a button or other activation device 700 is placed on a smart card 710. The smart card 710 contains components similar to the biometric smart card 210, including a microprocessor, 716, battery 714, ROM 722, and display 720. Also ***similar to the bio-metric smart card, other arrangements of these components may also be utilized.***”

McGregor, [0058].

141. A POSITA would have recognized that implementing a button in *McGregor*'s wallet represents a straightforward tradeoff between cost and security. Namely, the biometric sensor equipped in the wallet 410 provides an additional layer of security, allowing the user to be authenticated using unique fingerprint data before a transaction may proceed. The button actuator in Fig. 7 would not permit this additional layer of security to be realized, but a POSITA would have recognized that biometric sensors are more expensive than simple buttons. Accordingly, whether to implement *McGregor*'s wallet with a biometric sensor (*e.g.*, the Fig. 4 embodiment) or with a simple button (*e.g.*, the Fig. 7 embodiment) is just a tradeoff between cost and security. A POSITA would have understood that manufacturers would have been interested in capitalizing on using buttons or other manually pressed features

instead of biometric sensors to reduce complexity, cost, and power requirements. A POSITA would have recognized that for certain applications, a button might be sufficient, especially if high-level security (like biometrics) is not necessary, cost effectiveness is a priority, or simplicity is desired. For example, public transportation systems might incentivize speed over security to avoid delays. Further, a button might provide a more user-friendly and accessible interface compared to a biometric sensor, especially in scenarios where biometric data cannot be easily used (*e.g.*, wet fingers or privacy concerns).

142. A POSITA would have expected success in making this simple substitution between a biometric sensor and simple button. *McGregor* already contemplated this type of substitution as evidenced by its disclosed exemplary embodiments of its invention in Figure 7 (*e.g.*, smart card with a button).

vi. Claim 7

A portable electronic device as defined in claim 1, wherein said electronic circuit comprises said switching element.

143. *McGregor* in view of *Palmer* teaches this limitation. *See* Claim [1(e)]. For example, *McGregor* and *Palmer* teach a portable electronic device with an electronic circuit. *See* Claims [1(a)] and [1(d)]. Further, *McGregor* in view of *Palmer* teaches a switching element programmed as software onto microprocessor 416, which is part of the electronic circuit. *See McGregor*, [0085]; *see* Claim [1(e)]. A POSITA would have understood that since the switching element is part of the

microprocessor 416, it is part of the electronic circuit. *See* Claims [1(a)], [1(d)], [1(e)].

vii. Claim 8

A portable electronic device as defined in claim 7, wherein said electronic circuit comprises a microchip, and wherein said switching element is a series of instructions programmed onto said microchip.

144. *McGregor* in view of *Palmer* teaches this limitation. *See* Claims [1(e)], 7.

viii. Claim 9

A portable electronic device as defined in claim 1, wherein said switching element comprises a logical circuit.

145. The '333 Patent provides little detail regarding the claimed “logical circuit.” At best, it suggests that implementing switching element as a “decisional logical circuit” is an alternative to implementing switching element as “instructions programmed onto [a] microchip[.]” ’294 *Patent*, 6:9-17. To the extent Patent Owner contends that Claim 9 captures software-driven switching (e.g., software switching that relies on logical circuits), despite the patent distinguishing software implementations from logical circuit implementations, *McGregor* in view of *Palmer* teaches this limitation. *See* Claim [1(e)]. A POSITA would have understood that a microprocessor such as *McGregor*’s microprocessor 416 consists of multiple logical circuits to run logical operations. Software, a set of logical operations, run on a microprocessor causes logical circuits contained on the microprocessor to be

triggered. As such, any software switching element that is implemented on a microprocessor must utilize at least one logical circuit. Therefore, a POSITA would understand that a software switch executed by a microprocessor comprises a logical circuit.

ix. Claim 10

[10(Pre)] A data exchange system comprising:

146. To the extent the preamble is limiting, *McGregor* in view of *Palmer* teaches this limitation. For example, *McGregor* in view of *Palmer* teaches a device that has two-way communication (*i.e.*, data exchange) with a reader/writer device. *See* Claim [1(d)]. A POSITA would understand that together, a portable electronic device and a reader/writer device constitutes a data exchange system. Accordingly, a POSITA would have understood that *McGregor-Palmer* teaches a data exchange system comprising a portable electronic device (*e.g.*, *McGregor's* wallet) and a data exchange device (*e.g.*, *Palmer's* reader/writer device). *See* Claim [1(d)].

[10(a)] a data exchange device comprising a first electronic circuit, a first data transceiver and a cue emitter; and

147. *McGregor* in view of *Palmer* teaches this limitation. As discussed below, a POSITA would have understood that *McGregor-Palmer* teaches a data exchange device (*i.e.*, *Palmer's* reader/writer) comprising a first electronic circuit, a first data transceiver and a cue emitter (*e.g.*, for performing a handshake with wallet 410).

148. As discussed with reference to limitation [1(d)], *McGregor* teaches retailer-based readers connected to the transaction network that facilitate short-range communications with wallet 410. *McGregor*, [0039] (“The displayed security key is [] communicated or transmitted to the credit card authorization service [] through a reader[.]”). A POSITA would have understood that a reader or other merchant device capable of short-range communication wirelessly receives the security key code from *McGregor*’s wallet device. As also explained in this mapping, *Palmer* teaches a reader device consistent with that described by *McGregor*, and a POSITA would have been motivated to implement *Palmer*’s reader/writer device 202 in *McGregor*’s system to (1) communicate wirelessly with a smart card and (2) to communicate transaction data with the transaction network. Indeed, a POSITA would have recognized that *Palmer*’s reader/writer device 202 is a reader device that serves the same purpose as the reader contemplated by *McGregor*—wirelessly communicating with a smart card device and exchanging data with the transaction network. See Claim [1(d)]. The motivations to make this modification to *McGregor*’s system are the same as those set forth with reference to limitations [1(b)], [1(d)].

149. For both *McGregor*’s retailer-based readers and *Palmer*’s reader/writer 202, a POSITA would understand that they include a cue emitter (*e.g.*, for performing a handshake with wallet 410) and a first data transceiver (*e.g.*, for exchanging handshake data and transaction data wirelessly with wallet 410).

150. A POSITA would have further understood that each reader (*McGregor*'s retailer-based reader and *Palmer*'s reader/writer 202) includes a first electronic circuit for controlling the communications and processing the software that governs at least the communications processes implemented by these readers.

151. To the extent Patent Owner argues the first data transceiver and cue emitter must be a singular element, *McGregor* in view of *Palmer* discloses it. Namely, *Palmer* teaches that its communications may be conducted using "one or more antennae 204[.]" *Palmer*, [0027], [0043]. A POSITA would understand this means that the first data transceiver and cue emitter utilize a single antenna. *Palmer* teaches that an RF antenna may (1) capture RF energy from an RF field emanated by an RF power source and (2) may also support two-way communication with an associated reader/writer device. *Palmer*, [0023], [0027], [0043].

[10(b)] a portable electronic device, comprising:

152. *McGregor* discloses this limitation. See Claim [1(Pre)].

[10(c)] a second electronic circuit capable of storing data therein, capable of processing data, and capable of data input and output;

153. *McGregor* in view of *Palmer* teaches this limitation. See Claim [1(a)]. As explained above, *McGregor* teaches a portable electronic device (*i.e.*, *McGregor*'s wallet) comprising an electronic circuit (*i.e.*, wallet's electronic circuit) capable of storing and processing data, and capable of data input and output. See Claim [1(Pre)-(a)]. The electronic circuit described in Claim [1(a)] and the claimed

second electronic circuit are both the circuit of the portable smartcard device. Thus, a POSITA would have understood that *McGregor-Palmer* teaches a data exchange device (*i.e.*, *Palmer's* reader/writer) comprising a first electronic circuit, and a portable electronic device (*i.e.*, *McGregor's* wallet) comprising a second electronic circuit, as claimed. *See* Claim [10(a)-(b)].

[10(d)] a control device operatively linked to said second electronic circuit, with an invariable activation command being issued when said control device is selectively triggered;

154. *McGregor* in view of *Palmer* teaches this limitation. *See* Claims [1(b)] and [10(c)].

[10(e)] a user interface device operatively linked to said second electronic circuit;

155. *McGregor* discloses this limitation. *See* Claims [1(c)] and [10(c)].

[10(f)] a second data transceiver operatively linked to said second electronic circuit;

156. *McGregor* in view of *Palmer* teaches this limitation. *See* Claims [1(d)] and [10(c)]. The data transceiver described in Claim [1(d)] and the second data transceiver of this claim both refer to the transceiver of the portable electronic device.

[10(g)] a data conveyance switching element operatively linked to said second electronic circuit, and

157. *McGregor* in view of *Palmer* teaches this limitation. *See* Claims [1(e)] and [10(c)].

[10(g)(i)] switching element being in an activated state upon an activation cue having been received by said second data transceiver, and being in an inactive state when no activation cue was received by said second data transceiver; and

158. *McGregor* in view of *Palmer* discloses this limitation. See Claims [1(e)], [10(f)-(g)].

[10(h)] power means for providing power to said portable electronic device;

159. *McGregor* discloses this limitation. See Claims [1(f)] and [10(b)].

[10(i)] wherein upon said control device being selectively triggered to issue said invariable activation command: if said switching element is in its activated state, a data exchange will occur between said first data transceiver and said second data transceiver, thereby exchanging data between said data exchange device and said portable electronic device;

160. *McGregor* in view of *Palmer* teaches this limitation. See Claim [1(g)].

[10(j)] wherein upon said control device being selectively triggered to issue said invariable activation command: . . . if said switching element is in its inactive state, data is forwarded to said user interface device for communicating information to the portable electronic device holder.

161. *McGregor* in view of *Palmer* teaches this limitation. See Claim [1(h)].

B. Ground 2: Claims 3 and 11-13 are obvious under pre-AIA 35 U.S.C. § 103 over *McGregor* in view of *Palmer* and in further view of *Tuttle*

162. Claim 3 is dependent on Claim 1, additionally requiring that the portable electronic device utilize a distinct data transmitter, data receiver, and cue receiver. Claims 11-13 similarly require multiple communication ports. As set forth below, a POSITA would have been motivated to implement the combination of

McGregor and *Palmer* with distinct data transmitter, data receiver, and cue receiver ports pursuant to the teachings of *Tuttle*.

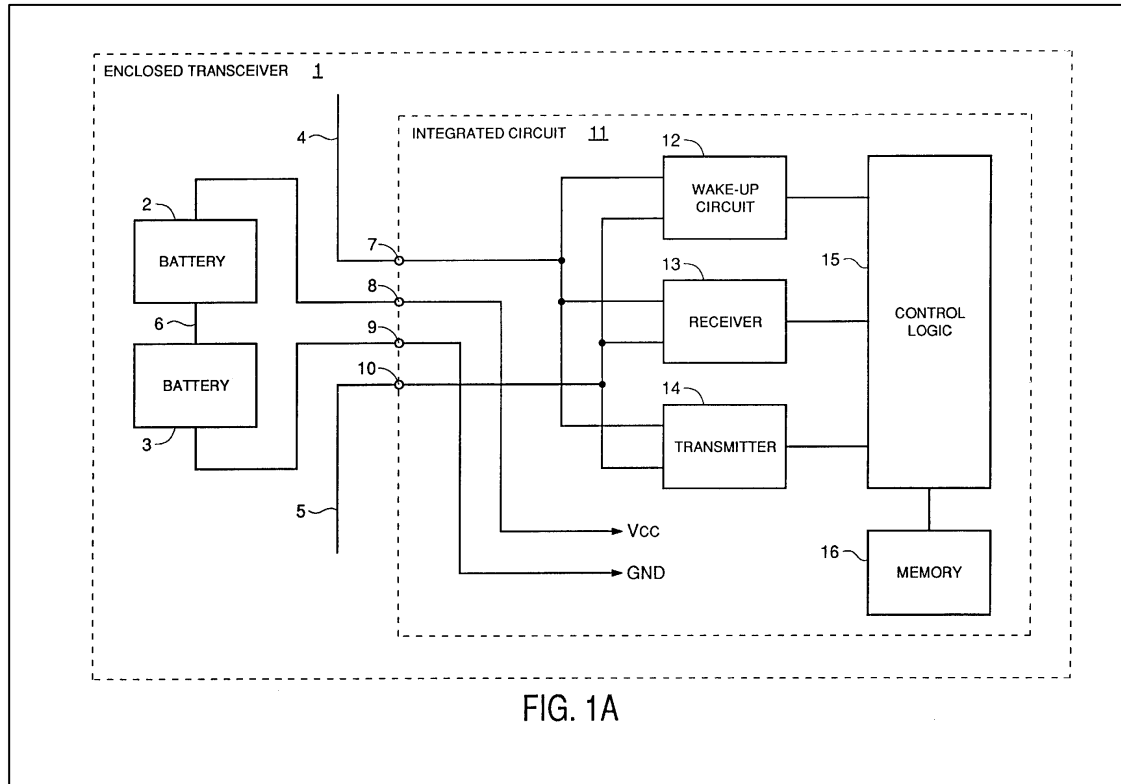
i. Claim 3

A portable electronic device as defined in claim 1, wherein said data transceiver comprises a data transmitter, a data receiver distinct from said data transmitter, and a cue receiver distinct from said data receiver.

163. *McGregor* in view of *Palmer* and *Tuttle* teaches this limitation. As discussed in Ground 1, *McGregor* in view of *Palmer* teaches a portable electronic device with a data transceiver capable of two-way communication and receiving an activation cue via RF antenna 404 and smartcard chip 408. *See* Claim 1. *Palmer* teaches that its communications may be conducted using “one or more antennae,” which suggests that certain transmission and reception functionality may be dedicated to separate antennae. But *Palmer* does not elaborate beyond suggesting multiple antennae. In my opinion, a POSITA would have looked to chip designs in the prior art, such as *Tuttle*’s integrated circuit 11, to guide separating receiving and transmitting functionalities to distinct antennae. A POSITA would have understood that separating receiving and transmitting functionalities using separate components in a portable electronic device was a well-known practice in wireless communication devices before the priority date of the ’333 Patent. Some of the benefits of this practice included minimization of interference, improved signal quality, energy efficiency and system reliability. Separating transmitting and receiving

functionalities helps avoid self-interference caused by a device transmitting and receiving signals on overlapping frequencies. Separate components allow for optimized power usage. For instance, the transmitter may require higher power to broadcast, while the receiver is designed to operate with minimal power for detecting signals. *See e.g., Kelly*, 21:3-8 (describing a schematic of the circuitry in a Tag device (*e.g.*, smart card)) in Figure 13, with separate transmitter 1340 and receiver 1350 components).

164. *Tuttle* discloses an integrated circuit 11, “a four terminal device operating as communicating means for transmitting and receiving radio signals.” *Tuttle*, 6:7-9. Further, integrated circuit 11 “is a transceiver including wake-up circuit 12, receiver 13, transmitter 14, control logic 15, and memory 16.” *Tuttle*, 6:14-16. A POSITA would have understood that a chip such as *Palmer*’s smartcard chip 408 would include one or more integrated circuits. A POSITA would have understood that “chip” refers to a silicon substrate computer chip containing an integrated circuit, and that the terms are often used interchangeably. Fig. 1A depicts the integrated circuit 11.



Tuttle, Fig. 1A.

165. *Tuttle* provides detail on an integrated circuit that would allow smartcard chip 408 to achieve the functions outlined in *Palmer*. For example, *Palmer* discloses detecting the presence of an RF field via RF antenna 404 emitted from the external reader/writer device 202, “device 400 captures power, energizing its electronics.” *Palmer*, [0050]. However, in embodiments where the device is powered by a battery, a POSITA would have understood that energizing the electronics initiates device software on the smartcard chip to “support two-way communication with an associated reader/writer device” instead of solely powering the device 400. *Palmer*, [0043]; see Claims [1(b)], [1(d)]. In the combination of

McGregor, Palmer, and Tuttle, the RF antenna 404 picks up signals from the external reader/writer device and provides them to the smartcard chip 408 of *Palmer*, allowing the smartcard chip to detect the existence of (*e.g.*, detecting an RF field) and availability of (*e.g.*, exchanging handshake signals) a reader/writer device before initiating data exchange with the reader/writer device. *Tuttle* similarly discloses that initial RF signals are detected and processed before data is sent to and received from an external device. Namely, *Tuttle* teaches “interrogation signals . . . [are] first processed by [the] sleep/wake up circuit 12[,] . . . bring[ing] integrated circuit 11 out of a ‘sleep’ mode into a ‘waked’ mode[.]” *Tuttle*, 7:4-10. After the device is placed into a waked mode, data is received via receiver 13 and transmitted via transmitter 15. *Tuttle*, 7:11-16. A POSITA would understand that the interrogation signals of *Tuttle* are functionally similar to the handshake signals disclosed by *Palmer*. In both cases, initial signaling is processed to establish a communication channel over which data communication can occur. *Tuttle* also teaches that the integrated circuit 11 includes a receiver and a transmitter:

Received data is provided by receiver 13 to control logic 15. Control logic 15 writes received data into memory 16. . . . If a response is appropriate, control logic 15 reads transmit data from memory 16 and ***enables transmitter 14 for sending the transmit data*** as a second radio signal on antenna 4 and 5.

Tuttle, 6:20-29. In the *McGregor-Palmer-Tuttle* combination, data transmission to and from the reader/writer device will be done through *Tuttle*'s transmitter 14 and receiver 13, respectively. *Tuttle* discloses the integrated circuitry 11 (a transceiver) includes wake-up circuit 12, receiver 13, and transmitter 14 that are separate from one another. See *Tuttle* 6:14-17, Fig. 1A. Therefore, the combination of *McGregor*, *Palmer*, and *Tuttle* discloses a data transmitter, a data receiver distinct from said data transmitter, and a cue receiver distinct from said data receiver.

166. A POSITA would be motivated to incorporate *Tuttle* into the *Palmer-McGregor* combination. Namely, a POSITA would have understood that the *Palmer-McGregor* combination requires implementation details beyond those disclosed in *Palmer*, such as how to detect readers and exchange data, and would have looked for guidance from known wireless systems, specifically focusing on those with chips capable of automatic wireless data transmission. *KSR Int'l Co.*, 550 U.S. 398 at 421 (“When there is a design need . . . and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.”); see also *In re Translogic Technology, Inc.*, 504 F.3d 1249, 1262 (Fed. Cir. 2007) (“[I]n looking for a multiplexer circuit for the individual 2:1 multiplexers disclosed in *Gorai*, a person of ordinary skill in the art would have solved this design

need by ‘pursu[ing] known options within his or her technical grasp.’”). One such system is *Tuttle*’s integrated circuit 11 comprising wake-up circuit 12, receiver 13, transmitter 14, control logic 15, and memory 16. For example, *Tuttle* teaches that the wake-up circuit 12 “senses in band energy [(an interrogation signal)] and switches from a sleep mode to an operating (waked) mode.” *Tuttle*, 4:27-29. When in an operating mode, the receiver 13 and transmitter 14 receive and send data in conjunction with the control logic 15 and memory 16. *See Section IX.C.* A POSITA would understand that chips used for detecting, receiving, and transmitting RF signals can have components that are more or less integrated into the chip, and that implementing a chip with separate wake-up circuit, receiver, and transmitter components is a simple design choice. Indeed, designing chips or integrated circuits to have a varied arrangement of components (*e.g.*, wake-up circuit, receiver and transmitter) was a well-known concept in wireless communication devices, electrical engineering, integrated circuits, and similar fields. *See Section V.*

167. Finally, a POSITA would have expected success in implementing *Tuttle*’s design into the *Palmer-McGregor* combination. The hardware and software at issue is straightforward in nature and would have been well within the capabilities of a POSITA. Namely, such a modification would have merely required straightforward changes to the design of the circuitry arrangement of the *Palmer-McGregor* device, and software/programming instructions which would have been

well within the capabilities of a POSITA. As detailed above in my Background of the Technology section, smart card circuitry architectures which incorporated wake up circuit, receiver and transmitter functionalities were well known in the art before the priority date of the '333 Patent. *See* Section V (discussing *Daggar*, *Gullman*, *Blossom*, *Hed*, and *Kelly*). Notably, smart cards using separate receivers, and transmitters were known in the art as well. *Id.*, (discussing *Kelly*). Additionally, a POSITA would have understood that *McGregor-Palmer's* device would have maintained its functions and overall architecture after integration of *Tuttle's* wake-up circuit 12, receiver 13, transmitter 14 onto its integrated circuit. As noted above, *McGregor* already generally contemplates incorporating additional components and/or smart card designs. *See* Claim 6.

i. Claim 11

[11(Pre)] A method for data exchange with a portable electronic device of the type comprising; an electronic circuit capable of storing data therein, capable of processing data, and capable of data input and output, a control device operatively linked to said circuit, a user interface device operatively linked to said circuit, communication ports operatively linked to said circuit, a switching element operatively linked to said electronic circuit and being in a default inactive state, and power means for providing power to said portable electronic device, said method comprising the steps of:

168. To the extent the preamble is limiting, *McGregor* in view of *Palmer* and *Tuttle* teaches this limitation. For example, *McGregor* in view of *Palmer* discloses each of the portable electronic devices, electronic circuit capable of storing and processing data, and data input and output, control device operatively linked to

said circuit, user interface linked to said circuit, switching element linked to said circuit, default inactive state, and power means. *See* Ground 1, Claim [1(Pre)-(h)].

169. *Tuttle* discloses communication ports operatively linked to a circuit for data exchange. Specifically, *Tuttle* describes an integrated circuit 11 that “is a transceiver including wake-up circuit 12, receiver 13, transmitter 14, control logic 15, and memory 16.” *Tuttle*, 6:14-16. The wake-up circuit 12, receiver 13, and transmitter 14 would be understood to be communication ports since they correspond with the communication ports described by the ’333 Patent, “namely a data transmitter 18a, a data receiver 18b, and a cue receiver 19.” ’333 *Patent*, 9:30-33.

170. The *McGregor-Palmer-Tuttle* combination teaches communication ports operatively linked to said circuit. A POSITA would have understood that *Tuttle*’s communication ports (*e.g.*, wake up circuit, receiver, transmitter) would be operatively linked to said circuit (*e.g.*, *McGregor*’s wallet modified pursuant to *Palmer*’s teachings). As explained above in Claim 3, a POSITA would have been motivated to incorporate *Tuttle*’s communication ports (*e.g.*, wake-up circuit 12, receiver 13, and transmitter 14) into the *Palmer-McGregor* combination (*e.g.*, smartcard chip 408). *See* Claim 3. Because the smartcard chip 408 in the *Palmer-McGregor* combination is part of the portable electronic device’s electronic circuit, a POSITA would have recognized that *McGregor-Palmer-Tuttle* teaches

communication ports operatively linked to said circuit. *See* Claim 3; Ground 1, Claim [1(d)].

[11(a)] awaiting for an activation cue to be received at a predetermined one of said communication ports;

171. *McGregor* in view of *Palmer* and *Tuttle* teaches this limitation. As explained above, a POSITA would have understood that an activation cue can be an RF handshake signal (or interrogation signal) emanating from a reader/writer device. *See* Ground 1, Claim [1(d)].

172. One of *Tuttle*'s communication ports (*see* claim 11(Pre)) is a wake-up circuit 12 that "senses in-band energy [(an interrogation signal)] and switches from a sleep mode to an operating (waked) mode." *Tuttle*, 4:27-29; *see also id.*, 7:4-10. *Tuttle* explains that when the transceiver's integrated circuit 11 receives an interrogation signal that has "substantial in-band energy as detected by wake-up circuit 12, control logic 15 enables receiver 13 for receiving and decoding a radio signal on antenna 4 and 5." *Id.*, 6:14-20. *Tuttle* notes that a goal of its invention is to provide an RFID system and method that "utilizes RF transmitting and receiving sections on a single IC." *Id.*, 3:10-15.

173. A POSITA would have understood that "in-band" energy refers to RF interrogation/handshake signals which constitute an activation cue. *See* Claim 1(d). Accordingly, the *McGregor-Palmer-Tuttle* combination teaches a device that awaits

for an activation cue (e.g., interrogation/handshake signal) to be received at a predetermined one of said communication ports (e.g., *Tuttle*'s wake-up circuit 12).

[11(b)] if an activation cue is received at one of said communication ports, changing the state of said switching element from its default inactive state to an activated state; and

174. *McGregor* in view of *Palmer* and *Tuttle* teaches this limitation. See Claims [1(e)] and [11(a)]. As explained above, *McGregor-Palmer-Tuttle* teaches a portable electronic device that receives an activation cue. See Claim [11(a)]. The *McGregor-Palmer-Tuttle* portable electronic device comprises a wake-up circuit 12 that detects the RF handshake signal and causes the modified smartcard chip 408 to be placed in an active state (or operational mode). See Claims 3, [1(e)], and [11(a)]. As explained above, when the smartcard chip 408 is in an active state it allows the exchange of data with an external data exchange device (e.g., reader/writer device). See Ground 1, Claim [1(e), (f)-(g)]. Further, a POSITA would have recognized that the smartcard chip 408 would be by default in an inactive state (or sleep mode) in the absence of an activation cue (i.e., RF handshake signal) to conserve battery power. See *Tuttle*, 4:26-31 (“The wake-up circuit senses in-band energy [(an interrogation signal)] and switches from a sleep mode to an operating (waked) mode. The sleep mode being useful during transit and storage of the RFID device to conserve battery power.”).

[11(c)] selectively triggering said control device to issue an invariable activation command, whereby said method will further comprise one of the two following steps: if said switching element is in its activated state, initiating a data exchange with an external data exchange device through at least one of said communication ports; and

175. *McGregor* in view of *Palmer* teaches this limitation. See Claims [1(b), 1(g)], and [11(a)].

[11(d)] selectively triggering said control device to issue an invariable activation command, whereby said method will further comprise one of the two following steps: . . . if said switching element is in its inactive state, conveying data from said electronic circuit to said user interface device for communicating information to the portable electronic device holder.

176. *McGregor* in view of *Palmer* teaches this limitation. See Claims [1(b), 1(h)], and [11(a)].

ii. Claim 12

A method as defined in claim 11, wherein said activation cue is received at one of said communication ports distinct from another one of said communication ports used for data exchange with the external data exchange device.

177. *McGregor* in view of *Palmer* and *Tuttle* teaches this limitation. As explained above *McGregor-Palmer-Tuttle* teaches a method for data exchange with a portable electronic device comprising multiple communication ports, one of which (*i.e.*, wake-up circuit 12) receives and processes an activation cue (*i.e.*, RF interrogation signal). See Claim [11(Pre)-(a)]. The *McGregor-Palmer-Tuttle* combination further teaches that this communication port can be distinct from other communication ports (*e.g.*, receiver, transmitter) that are used for data exchange with an external data exchange device (*e.g.*, reader/writer device). For example, *Tuttle*

discloses an integrated circuit 11 that “is a transceiver including wake-up circuit 12, receiver 13, transmitter 14, control logic 15, and memory 16.” *Tuttle*, 6:14-16. *Tuttle* explains that interrogation signals are “received by antenna 4 and 5 and first processed by sleep/wake up circuit 12.” *Id.*, 7:4-10. The wake-up circuit 12 receives an activation cue while the receiver 13 and transmitter 14 are used for data exchange. *See* Claim 3. In the combination, the data exchange occurs between the external data device and the smartcard chip 408, which includes the features of *Tuttle* discussed. *See* Claim 11; Section IX.C.

iii. Claim 13

A method as defined in claim 11, wherein the additional following step occurs after selectively triggering said control device if said switching element is in said activated state: conveying data from said electronic circuit to said user interface device for communicating information to the portable electronic device holder.

178. *McGregor* in view of *Palmer* teaches this limitation. As explained above *McGregor-Palmer* teaches a method for data exchange using a portable electronic device consisting of a first step of conveying data with an external data exchange device through at least one communication port, if the switching element of the portable electronic device is in an activated state. *See* Claims 11, and [1(b), 1(h)].

179. *McGregor* in view of *Palmer* discloses selectively triggering a control device when the switching element is in the activated state. *See* Claims [1(g)], and [11(c)]. *McGregor*’s modified device discloses both displaying and wirelessly

transmitting data. *See* Claims [1(g), 1(h)], and [11(c)-(d)]. As explained below, *McGregor-Palmer* teaches a second following step consisting of conveying data to the user interface device (*e.g.*, display) for communicating information to the user of the portable electronic device, as claimed.

180. *Palmer* discloses that its electro-luminescent display 412 can display information to the user including a “credit card number to support ‘card not present’ transactions, a residual balance of an ‘electronic purse,’ air travel flight and seat assignment information[.]” *Palmer*, [0044]. Accordingly, a POSITA would have understood that *Palmer* taught that its device, for example, informed the user through its display 412 of the remaining balance in the “electronic purse,” after a payment was made.

181. A POSITA would have been motivated to apply this functionality to *McGregor’s* modified device, displaying data when the switching element is in the active state *after* a data conveyance with an external data exchange device. A POSITA would have understood that such modification would have improved *McGregor’s* device for numerous reasons. For example, during a wireless transaction, when *McGregor’s* security key is automatically wirelessly transmitted, it would be obvious to display a confirmation message via display 420. Providing confirmation of a successful data transaction would be desired by manufactures and users of the device, especially in commercial transactions. Such a modification

would improve trust, reliability, error prevention in wireless transactions. Manufacturers and users want assurance that a transaction has been completed successfully to main trust and satisfaction in the system. A confirmation prevents disputes or misunderstandings about whether a transaction was successful. Without confirmation, users may repeat the transaction unnecessarily, leading to potential errors, duplicate payments, accounting errors, etc. In another example, it would be obvious to a POSITA that if a wireless transaction is ongoing (*i.e.*, when the switching element is in an active state) but a user has insufficient funds, the user would be notified of such insufficient funds via the user interface. Additionally, in the event that a wireless transaction fails, information displayed on the screen would be used to complete the transaction. *see* Claim [1(g)]. Such modifications would improve *McGregor's* device for the reasons explained above. In addition, for financial transactions in particular, the proposed modification would improve fraud prevention and operational efficiency. With this additional functionality, a user can immediately recognize if something goes wrong or if an unauthorized transaction was attempted. Further, merchants would be able to quickly proceed to the next customer without worrying about unresolved payments.

182. It was well known in the art before the priority date of the '333 Patent, that portable electronic devices (*e.g.*, smart card) were capable to convey

information to the user following the conveyance of data to an external data exchange device (e.g., card reader/writer device).

183. For example, *Hed* teaches a financial data transmission method that utilizes smart cards with RF communication between “the central station and the card so that the smart card is periodically or continuously updated as to account details which can be readily seen by a display on the card.” *Hed*, Abstract. The smart card (*i.e.*, CCC) comprises an LCD display 29, and if at any time the smart card user wishes to review the most recent data received, the user can press a small membrane switch on the card thus activating the display function that fetches information from the card’s memory and displays these data in a sequential manner on the smart card display 29. *Id.*, [0078], Fig. 2B, [0100].

184. In another example, *Sung et al.* (“*Sung*”) (Ex. 1018), published on March 28, 2002, discloses an internet interface system that displays usage time and fees on an LCD screen and “[a]t the same time . . . transmits usage time information [and] usage fee information” to a central management server. *Sung*, [0037]. The transmission of the usage time and fee information occurs wirelessly as contemplated by *Sung*. *See Sung*, [0025], Fig. 1, Fig. 2 (describing that the second communication unit 23 within the interface unit 1, connects to the internet and subsequently the central management server by wireless means).

185. The proposed modification would be well within the skill of a POSITA because it would be a simple modification using technology taught by both *McGregor* and *Palmer*. Both *McGregor* and *Palmer* teach similar devices and systems. Each describe using a portable electronic device to transmit/exchange data with an external device. *See* Section IX.A-B. Each describe portable electronic devices comprising an electronic circuit, power means, and a user interface device (*e.g.*, display screen). *Id.* Such a modification would have utilized *McGregor*'s user interface device (*e.g.*, display screen), and electronic circuit which already have the capability to communicate information to the user regarding data conveyance (*e.g.*, security key code).

186. A POSITA would have had a reasonable expectation of success for implementing the proposed *McGregor-Palmer* modification for the same reasons discussed above. *See* Ground 1, Claim [1(b)].

CONCLUSION

I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Date: December 2, 2024

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Education

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August 1993	The University of Toledo, Department of Electrical Engineering and Computer Science, M.S.
June 1991	The University of Toledo, Department of Electrical Engineering and Computer Science, B.S. <i>cum laude</i> .

Employment

Aug. 2012 - Present	Professor, Virginia Polytechnic Institute and State University, Bradley Department of Electrical and Computer Engineering, Director of <i>Wireless @ Virginia Tech</i>
Aug. 2006 – Aug. 2012	Associate Professor, Virginia Polytechnic Institute and State University, Bradley Department of Electrical and Computer Engineering, Mobile and Portable Radio Research Group.
Aug. 2009 – Dec. 2009	Visiting Researcher at the Laboratory for Telecommunication Sciences (LTS) a federal research lab which focuses on telecommunication challenges for national defense.
Aug. 2001 – Aug. 2006	Assistant Professor, Virginia Polytechnic Institute and State University, Bradley Department of Electrical and Computer Engineering, Mobile and Portable Radio Research Group.
Aug. 2001 – Present	Independent Consultant, self-employed.
Aug. 1996 – Aug. 2001	Member Technical Staff, Bell Laboratories, Lucent Technologies, promoted to Distinguished Member of Technical Staff in September 2000.
Sep. 1993 – Jun. 1996	Graduate Research Assistant, Virginia Polytechnic Institute and State University, Bradley Department of Electrical and Computer Engineering, Mobile and Portable Radio Research Group.
May 1994 – Aug. 1994	Senior Engineer, Stanford Telecommunications, Advanced Programs.
Sep. 1991 – Aug. 1993	Graduate Research Assistant, The University of Toledo, Department of Electrical Engineering and Computer Science, Communications Research Group.

Honors and Recognitions

- Fellow of the IEEE (So named “for contributions to wideband signal processing in communications and geolocation”)
- Ellersick Best Paper Award in the Unclassified Technical Program, *IEEE Military Communications Conference (MILCOM)* 2010.
- SDR Forum Best Paper Award, 2007.
- Outstanding Paper Award, SDR Forum, 2008.
- Dean’s Award for Teaching Excellence - April 2014.
- Dean’s Award for Outstanding New Assistant Professor, College of Engineering, 2003.
- Dean’s List for Teaching Effectiveness (teaching evaluation greater than 3.6) 16 out of 18 semesters.
- Nominated for Teaching Certificate, College of Engineering, Spring 2004 and Spring 2005.
- Bell Labs President’s Silver Award for outstanding research contributions.
- 1999 Best Paper Award for *Bell Labs Technical Journal*.

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- R. D. Benning, R. M. Buehrer, Mark H Kramlm, and P. A. Polakos, “Space-Time Spreading and Phase Sweep Transmit Diversity”, *US Patent No. 7,042,955 B2*, May 9, 2006.
- R.D. Benning, R.M. Buehrer, and R.A. Soni, “Biased Phase Sweep Transmit Diversity”, *US Patent No. 7,035,599 B2*, April 25, 2006.
- R. D. Benning, R. M. Buehrer, P. A. Polakos, and R. A. Soni, “Split Shift Phase Sweep Transmit Diversity,” *US Patent No. 6,980,778 B2*, December 27, 2005.
- R.D. Benning, R.M. Buehrer, and R.A. Soni, “Symmetric Sweep Phase Sweep Transmit Diversity”, *US Patent No. 6,920,314*, July 19, 2005.
- R.M. Buehrer, S.P. Nicoloso, R.A. Soni, and D. Uptegrove, “Cellular Communications System And Related Methods”, *US Patent No. 6,801,791*, October 5, 2004.
- R.M. Buehrer, S.-C. Liu, S.P. Nicoloso, and D. Uptegrove, “Method of channel estimation and compensation based thereon,” *U.S. Patent No. 6,542,560*, April 1, 2003.

- R.M. Buehrer and S.-C. Liu, “Code division multiple access system and method of operation with improved signal acquisition and processing,” *U.S. Patent No. 6,549,565*, April 15, 2003.
- R.D. Benning, R.M. Buehrer, and R.A. Soni, “Apparatus and method of enhancing transmit diversity,” *U.S. Patent No. 6,594,226*, July 15, 2003.
- R.M. Buehrer, S.-C. Liu, S.P. Nicoloso, and D. Uptegrove, “Iterative channel estimation and compensation based thereon,” *U.S. Patent No. 6,614,857*, September 2, 2003.
- R.M. Buehrer and R.A. Soni, “Methods And Apparatus For Downlink Diversity In CDMA Using Walsh Codes”, *U.S. Patent No. 6,515,978*, February 4, 2003.
- R.M. Buehrer, S. Gollamudi, and S.P. Nicoloso, “Multistage interference cancellation for CDMA applications using M-ary orthogonal modulation,” *US Patent No. 6,363,103*, March 26, 2002.
- S.A. Allpress, R.M. Buehrer, and R.A. Soni, “Receiver Architecture Employing Space Time Spreading and Orthogonal Transmit Diversity Techniques,” *US Patent No. 6,317,410 B1*, November 13, 2001.
- S.A. Allpress, R.M. Buehrer, Quinn Li, Ramesh Nallepilli, and R.A. Soni, “Transmitter Architecture Employing Space Time Spreading and Orthogonal Transmit Diversity Techniques,” *US Patent No. 6,392,988*, May 21, 2001.
- R.M. Buehrer, M.D. Hahm, S.C. Liu, and S.P. Nicoloso, “Base Station System Including Parallel Interference Cancellation Processor,” *US Patent No. 6,157,847*, December 5, 2000.

Teaching

Undergraduate Courses

- Engineering Exploration
- Electric Circuits
- Signals and Systems
- Introduction to Communications
- Digital Communications
- Analog and Digital Communication Laboratory – *developed this course with \$70k grant from the State of Virginia.*

Graduate Courses

- Spread Spectrum Communications – *developed this course for the ECE department. It is now a permanent offering.*
- Advanced Digital Communications
- Multi-Channel Communications (Course covers the fundamentals of OFDM and MIMO techniques the underlying technologies for 4G cellular communications) – *developed this course for the ECE dept.*
- Information Theory
- Machine Learning for Communication Systems

Teaching Evaluations (through Spring 2011)

- Average student evaluation – 3.8/4.0 (17 courses, 450 students)
- Dean's List (student evaluation > 3.6) in 16 of 18 semesters of teaching

Short Courses Given

- Position Location
- Position Location using Ultra-Wideband Signals
- Radio Resource Management in CDMA Systems
- WiFi – An introduction to WLANs
- OFDM – Multicarrier transmission for high data rate systems; Application to 4G (LTE) cellular and Wi-Fi
- Ultra Wideband Communications
- Multi-Input Multi-Output (MIMO) Communication Systems; Application to 4G (LTE/LTE-Advanced) cellular and Wi-Fi

Advising

Current

- Jianyuan Yu, "The Application of Machine Learning to Dynamic Spectrum Access," Ph.D. candidate, expected graduation, May 2020.
- Yue Xu, "Deep Learning in Wireless Communication Systems," Ph.D. candidate, expected graduation, May 2020.
- Charlie Thornton, "Distributed Cognitive Radar," Ph.D. candidate, expected graduation May 2023.
- William Howard, "Distributed Learning Approached for Cognitive Radar and Radio," Ph.D. candidate, expected graduation May 2023.
- Don-Roberts Emenonye, "Machine Learning Approaches to Remote Rehabilitation," Ph.D. candidate, expected graduation May 2023.
- Sam Shebert, "Automatically Classifying Modern Communication Waveforms," Ph.D. candidate, expected graduation May 2024.
- C. Tanner Fredieu, "Classification Approaches for Electronic Warfare," M.S. candidate, expected graduation May 2022.
- Sebastian Rodriguez, "Advanced Signal Processing for Cognitive Radar," M.S. candidate, expected graduation May 2022.

Former

- Chris O’Lone, “Statistical Analysis of Geolocation Fundamentals Using Stochastic Geometry,” Ph.D. December 2020.
- Jeff Poston, “ILoViT: Indoor Localization via Vibration Tracking,” Ph.D. March 2018.
- Mahi Abdelbar, “Applications of Sensor Fusion in Classification, Localization and Mapping,” Ph.D. February 2018.
- Mico Woolward, “SUPPLEMENTING LOCALIZATION ALGORITHMS FOR INDOOR FOOTSTEPS,” Ph.D., July 2017.
- Daniel Jakubisin, “Advances in Iterative Probabilistic Processing for Communication Receivers,” Ph.D., April, 2016, *currently employed by McGuire-Woods.*
- Jeannette Nounagnon “Using Kullback-Leibler Divergence to Analyze the Performance of Collaborative Positioning,” Ph.D., April, 2016, *currently employed by ComSat.*
- SaiDhiraj Amuru, “Intelligent Approaches for Communication Denial,” Ph.D., September, 2015, *currently employed by Samsung.*
- Javier Schloemann, “Fundamental Analyses of Collaborative and Noncollaborative Positioning,” Ph.D., August, 2015, *currently employed by Northrup-Grumman.*
- Reza Vaghefi, “Cooperative Positioning in Wireless Sensor Networks Using Semidefinite Programming,” Ph.D., December 2014, *currently employed by Blue Danube Labs.*
- Jeong-heon Lee, “Physical Layer Security for Wireless Position Location in the Presence of Location Spoofing,” Ph.D., March 2011, *currently employed by Samsung.*
- Haris I. Volos, “Cognitive Radio Engine Design For Link Adaptation,” Ph.D., September 2010, *currently employed by the University of Arizona.*
- Tao Jia, “Collaborative Position Location for Wireless Networks in Harsh Environments,” Ph.D., March 2010, *currently employed by Qualcomm, Inc.*
- Heba Shaban, “A Novel Highly Accurate Wireless Wearable Human Locomotion,” Ph.D., April 2010, *currently employed by Arab Academy of Science and Technology.*
- Haesoo Kim, “Cooperative Communications,” Ph.D., August 2008, *currently employed by LG Electronics.*
- Rekha Menon, - “Interference Avoidance based Underlay Techniques for Dynamic Spectrum Sharing,” Ph.D., April 2007, *currently employed by Tyco Electronics.*
- Swaroop Ventkatesh, “The Design and Modeling of Ultra-Wideband Position-Location Networks,” Ph.D., February 2007, *currently employed by Marvel Semiconductor.*
- Jihad Ibrahim, “Algorithms and Architectures for UWB Receiver Design,” Ph.D. January 2007, *currently employed by MathWorks.*
- Chris Anderson, “A Software Defined Ultra Wideband Transceiver Testbed for Communications, Ranging, or Imaging,” Ph.D., September 2006, *currently an Associate Professor at the US Naval Academy.*
- Samir Al-Ghadhban - “ Multi-layered Space Frequency Time Codes,” Ph.D. October, 2005, *currently an associate professor at King Fahd University.*
- Jing Jiang – “Increasing the Capacity of Wireless Data Systems - A Cross Layer Perspective,” Ph.D., July 2004, *currently employed by Texas Instruments.*
- Jiann-An Tsai – “Overloaded Array Processing Using Interference Cancellation,” Ph.D., May 2002. *Currently employed by Samsung.*

- Daniel Tait, “Electromagnetic Vector-Sensor Direction-of-Arrival Estimation in the Presence of Interference,” M.S. August 2020.
- Don-Roberts Emenonye, “Application of Machine Learning to Multi-Antenna Transmission and Machine Type Resource Allocation,” M.S. July 2020.
- Charlie Thornton, “Learning Schemes for Adaptive Spectrum Sharing Radar,” M.S. May 2020.
- Mark Kozy, “Creation of a Cognitive Radar with Machine Learning: Simulation and Implementation,” M.S., May 2019.
- Bryse Flowers, “Adversarial RFML: Evading Deep Learning Enabled Signal Classification,” M.S., June 2019.
- Parker White, “Constrained Clustering for Frequency Hopping Spread Spectrum Signal Separation,” M.S., August 2019.
- Ersin Selvi, “Cognitive Radar Applied To Target Tracking Using Markov Decision Processes,” M.S. December 2017, *currently employed by Raytheon.*
- Ali Gaber Mohamed, “Navigating via Discrete Astronomical Radio Sources: Geolocation Using Fringe Rates,” M.S. April 2017, *currently employed by Alexandria University.*
- Eric Sollenberger, “Iterative Leakage-Based Precoding for Multiuser-MIMO Systems,” M.S., May, 2016, *currently employed by Qualcomm, Inc..*
- Kevin McDermott, “On the Improvement of Positioning in LTE with Collaboration and Pressure Sensors,” M.S., May, 2015, *currently employed by Northrup Grumman*
- Tori Jewell, “Use of GIS in Radio Frequency and Positioning Applications,” M.S. June 2014.
- Jacob Overfield, “The Impact of MIMO on Signal Localization,” MS, May 2013, *currently employed by n-ask, inc.*
- Zachary Biskaduros, “Collaborative GPS,” MS, June 2013, *currently employed by n-ask, inc.*
- Hunter DeJarnette, “Measuring Noise in the VHF Band and Its Effect On Low SNR Signal Detection,” MS Thesis, September 26, 2012, *currently employed by Johns Hopkins Applied Physics Lab.*
- Benton Thompson, “Characterization and Improvement of the Collaborative and Non-Collaborative Position Location Problems,” MS, August 2011, *currently employed by G3, Inc.*
- Corey Cooke, “Attenuation Field Estimation using Radio Tomography,” MS, August 2011, *currently a Ph.D. student at Georgia Tech.*
- Harpreet Dhillon, “The Optimal Sum-Rate of Multi-Band MIMO Interference Channel,” MS, July 2010, *currently an Assistant Professor at Virginia Tech.*
- Justin Kelly, “The Value of Collaboration in Dynamic Spectrum Access,” MS, July 2009, *currently employed by the Department of Energy.*
- Matthew Roney, “Dual-Channel Direction Finding in Multipath Channels,” M.S. candidate, *currently employed by DRS Signal Solutions.*
- Jesse Reed, “Approaches to Multiple-source Localization and Signal Classification,” MS, May, 2009, *currently employed by Arinc, Inc.*
- Chang Li, “Non-contact Estimation of Respiration and Heartbeat Rate using Ultra Wideband,” MS, August 20, 2008, *currently employed by Qualcomm, Inc.*
- Arjun Bhupathi Raju, “Characterization of Uplink Transmit Power and Talk-Time in WCDMA Networks,” MS, July 15, 2008, *currently employed by Qualcomm, Inc.*

- Rajaraman Parameswaran – “Effects of user and spatial diversity on high data rate wireless systems,” M.S., August 2005, *currently employed by Qualcomm Inc.*
- Nathan Harter, “Single Channel Direction Finding in Multipath Channels,” M.S., April 2007, *currently employed by IO-Max.*
- John Keaveny – “The Implementation of Single-Channel Direction Finding,” M.S., February 2005. *Currently employed by Boeing.*
- Brian Donlan, “Ultra-wideband Narrowband Interference Cancellation and Channel Modeling for Communications,” M.S., January 2005, *currently employed by IOMAX USA.*
- Vivek Baradwaj, “Ultra-Wideband for Communications: Spatial Characteristics and Interference Suppression,” M.S., April 2005. *Currently employed by Qualcomm, Inc.*
- Liu Yang, “On the Applicability of the Tap-delay Line Model to UWB Channel Modeling,” M.S., August 2004, *currently employed by Microsoft.*
- Dan Hibbard, “The Impact of Bandwidth on Indoor Communication System Performance,” M.S., May 2004. *Currently employed by Raytheon.*
- Nishant Kumar – “MAC and Physical Layer Design for Ultra-Wideband Communications,” M.S., May 2004. *Currently employed by Staccato Communicaitons.*
- Samir Ginde – “A Game-theoretic Analysis of Link Adaptation in Cellular Radio Networks,” M.S., May 2003. *Currently employed by Qualcomm, Inc.*
- Rahul Mahajan – “Cross Layer Optimization: System Design and Simulation Methodologies,” M.S., December, 2003. *Currently employed by Qualcomm, Inc.*
- Aaron Orndorf, “Transceiver Design for Ultra Wideband Communications,” M.S., completed May 2004.
- David McKinstry – “Channel Models and Receivers for Ultra Wideband Communications,” M.S., May 2003. *Currently employed by Johns Hopkins Applied Physics Lab.*
- Venkatasubramanian Ramasamy – “MC-CDMA/OFDM and Adaptive Antennas,” M.S., June 2002. *Currently employed by Apple.*
- Ray Chan – “Link Adaptation for Public Safety Wireless Information Networks,” M.S., June 2003. *Currently employed by Northrup Grummond Corp.*
- Payal Jain – “Software Radio Implementation of Adjustable High Data Rate Receivers,” M.S., November 2002. *Currently employed by Digital Receiver Technology, Germantown, MD.*

Funded Research

1. Title: “SWIFT: SMALL: Interference Canceling for Improved Coexistence for Passive and Active Radio Systems,”
Sponsor: National Science Foundation,
Funding: \$499,999,
Period of Performance January 2021 January 2024.
Percent: 50%.
2. Title: “SCH:INT: Collaborative Research: Semi-Automated Rehabilitation in the Home,”
Sponsor: National Science Foundation,
Funding: \$1.1M
Period of Performance: August 2020 July 2024,
Percent: 10%

3. Title: "Vector Sensor Processing in the Presence of Multipath"
Sponsor: Applied Signals Intelligence
Funding: \$170,000
Period of Performance: April 2020 - April 2021.
Percent: 90%
4. Title: "Machine Learning Approaches to Optimize Army Radar, Communication and EW Systems"
Sponsor: Army Research Lab
Funding: \$975,000
Period of Performance: May 11, 2020 - May 10, 2024.
Percent: 100%
5. Title: "Vector Sensor Processing in the Presence of Interference"
Sponsor: Applied Signals Intelligence
Funding: \$232,193
Period of Performance: December 20, 2018 - April 30, 2019.
Percent: 60%
6. Title: "Digital Beamforming and Interference Mitigation for MIMO Systems "
Sponsor: GIRD Systems
Funding: \$1,575,398
Period of Performance: October 17, 2018 - October 16, 2021.
Percent: 50%
7. Title: "Cognitive Radar for C-SCoRE: Enhancing Radar Functionality though Interference Analysis and Avoid-
ance,"
Sponsor: Georgia Tech Research Institute (AFRL)
Funding: \$121,758
Period of Performance: December 15, 2018 June 30, 2020
Percent: 100%
8. Title: "Collaborative Learning for Harmonious Coexistence of Heterogeneous Wireless Networks"
Sponsor: Defense Advanced Research Agency
Funding: \$1,999,994
Period of Performance: January 1, 2017 - December 30, 2019.
Percent: 25%
9. Title: "MU-MIMO Channel Characterization"
Sponsor: GIRD Systems
Funding: \$117,712
Period of Performance: April 1, 2017 - March 31, 2019.
Percent: 100%
10. Title: "Cognitive Radio Approaches to Optimize Army Radar Systems"
Sponsor: Army Research Lab
Funding: \$250,000
Period of Performance: January 1, 2018 - December 30, 2020.
Percent: 100%
11. Title: "Cognitive Radio Approaches to Optimize Army Radar and Communication Systems"
Sponsor: Army Research Lab
Funding: \$190,282
Period of Performance: January 1, 2017 - December 30, 2017.
Percent: 50%
12. Title: "Hyper-wideband Communications"
Sponsor: Defense Advanced Research Projects Agency

- Funding: \$182,451
Period of Performance: May 1, 2015 - April 30, 2016.
Percent: 50%
13. Title: "IUSE: Gamification of Wireless Communication Testbeds for Authentic STEM Learning"
Sponsor: National Science Foundation
Funding: \$626,665
Period of Performance: Sept. 1, 2014 - Aug. 31, 2017.
Percent: 20%
14. Title: "Advanced Cognitive Radio Design using SDRs"
Sponsor: Lockheed Martin Advanced Technologies
Funding: \$494,600
Period of Performance: April 1, 2014 – Sept. 30, 2015
Percent: 100%
15. Title: "SDR Technology Development Support"
Sponsor: DoD
Funding: \$375,000
Period of Performance: 5/1/14 – 4/30/14
P.I.: J.H. Reed
Percent: 30%
16. Title: "Improving Cellular Positioning through Collaboration"
Sponsor: Polaris Wireless
Funding: \$82,813
Period of Performance: 11/01/2013 - 10/31/2014
Percent: 100%
17. Title: "Advanced Wireless Systems and Technologies"
Sponsor: DoD
Funding: \$3,883,320
Period of Performance: 07/01/2012 - 06/30/2014
P.I. R.W. McGwier
Percent: 10%
18. Title: "Cognitive Radio Development"
Sponsor: Lockheed Martin – Advanced Technologies Lab
Funding: \$325,000
Period of Performance: 7/1/2012 – 12/31/2013
P.I. R.M. Buehrer
Percent: 50%
19. Title: "Next Generation Secure, Scalable Communication Network for the Smart Grid"
Sponsor: Oak Ridge National Labs
Funding: \$626,671
Period of Performance: 1/1/2011-10/31/2012
PI – R.M. Buehrer
Co-PI: J.H. Reed
Percent: 50%
20. Title: "Software Defined Radio Waveform and Device Development And Component Deployment Using Ossie"
Sponsor – DoD (Maryland Procurement Office)
PI – RM Buehrer
Period of Performance: Aug. 1, 2010 – July 31, 2013
Funding: \$299,227
Percent: 100%

21. Title: “SDR Technology Development Support”
Sponsor: DoD (Maryland Procurement Office)
PI: R.M. Buehrer and J.H. Reed
Funding: \$638,653
Period of Performance: 9/30/2010 4/30/2014
Percent: 75%
22. Title: “Signal Processing Research”
Sponsor: Aerospace Corp.
PI: T.C. Clancy
Co-PI: R.M. Buehrer
Period of Performance: 1/1/2011 10/31/2011
Funding: \$130k
Percent: 50%
23. Title: “IHCS: Proactive Cross-Layer Adversary Localization for Hostile or Harsh Wireless Environments”
Sponsor: NSF
Funding: \$494,788
Period of Performance: 5/1/08 4/30/11
PI: Y. Yang
Co-PIs: R.M. Buehrer and J.M. Park
Percent: 33%
24. Title: “A Fundamental Analysis of Spectrum Sharing”
Sponsor: Qualcomm, Inc.
Funding: \$120,000
Period of Performance: 5/1/08 4/30/10
PI: Buehrer
Co-PIs: Y. Yang
Percent: 85%
25. Title: “Reasoning and Learning in Adaptive Wireless Networks”
Sponsor: BBN/DARPA
Funding: \$605,000
Period of Performance: 10/1/07 3/31/10
PI: L. DaSilva
Co-PIs: R.M. Buehrer, C. Bostian, A. MacKenzie, and J.H. Reed
Percent: 25%
26. Title: DRS Graduate Fellowship
Sponsor: DRS Signal Solutions
Funding: \$76,000
Period of Performance: 9/01/07 8/30/09
PI: R.M. Buehrer
Percent: 100%
27. Title: U-PoLo Nets Position Location in Harsh Environments
Sponsor: National Science Foundation
Funding: \$175k
Period of Performance: 8/1/05 7/30/08
PI: R.M. Buehrer
Percent: 100%
28. Title: NeTS ProWiN: An Open Systems Approach for Rapid Prototyping Waveforms for Software Defined Radio
Sponsor: National Science Foundation
Funding: \$1M

Period of Performance: 8/1/05 7/30/09
PI: J.H. Reed (lead), R.M. Buehrer, and W.H. Tranter
Percent: 33%

29. Title: Node and Network Benefits of Improved RF Characteristics in CDMA Cellular Networks
Sponsor: ParkerVision
Funding: \$131,474
Period of Performance: 11/1/07 10/31/08
PI: R. M. Buehrer
Percent: 100%
30. Title: UWB Propagation in Office Environments
Sponsor: Freescale Semiconductor
Funding: \$35,000
Period of Performance: 5/1/05 4/30/06
PI: R. M. Buehrer
Percent: 100%
31. Title: Networking Issues for Peer-to-Peer VoIP Link for Radio Interoperability, Fire Management and Security
Sponsor: Catalyst Communications
Funding: \$67,500
Period of Performance: 1/1/05 5/15/05
PI: S.M. Midkiff (lead) and R.M. Buehrer
Percent: 33%
32. Title: AWINN: Advanced Wireless Networking for the Navy
Sponsor: ONR
Funding: \$3M
Period of Performance: 12/20/04 6/19/06
PI: Warren Stutzman
Co-PIs: J.H. Reed, Scott Midkiff, R. M. Buehrer, W.H. Tranter, Peter Athanas, Tom Hou, Binoy Ravindran, Rick Habayeb
Percent: 10%
33. Title: Ultra Wideband Communications Systems
Sponsor: ASPIRES
Funding: \$118,360
Period of Performance: 7/1/03 6/30/04
PI: R. M. Buehrer
Percent: 100%
34. Title: UWB Communications
Sponsor: Motorola
Period of Performance: 12/15/03 12/14/04
Funding: \$35,000
PI: Buehrer
Percentage: 100%
35. Title: Simulation of Ultra Wideband Communications
Sponsor: ITRI
Funding: \$10,000
Period of Performance: 9/1/03 12/31/03
PI: R.M. Buehrer
Percent: 100%
36. Title: Receiver Design for Ultra Wideband Communications
Sponsor: ITRI

- Funding: \$15,000
Period of Performance: 9/1/03 12/31/03
PI: R.M. Buehrer
Percent: 100%
37. Title: Indoor Propagation
Sponsor: Qualcomm, Inc.
Funding: \$14,000
Period of Performance: 12/1/03 5/15/04
PI: R.M. Buehrer
Percent: 100%
38. Title: Single Channel Direction Finding
Sponsor: DRS Technologies
Funding: \$91,000
Period of Performance: 10/18/02 10/17/05
PI: R. M. Buehrer
Percent: 100%
39. Title: Flexible High Data Rate Transmission for Wireless Data Applications
Sponsor: BAE Systems
Funding: \$29,000
Period of Performance: 10/18/01 10/17/02
PI: R. M. Buehrer
Percent: 100%
40. Title: UWB Propagation Measurements, Modeling, and Communication System Enhancements
Sponsor: DARPA
Funding: \$688,620
Period of Performance: 5/13/02-5/12/03
PI: R.M. Buehrer
Co-PI: A.S. Safaai-Jazi, W. Davis, D. Sweeney
Percentage: 35%
41. Title: Modeling and Simulation for the FCS Development Environment
Sponsor: Boeing
Funding: \$127,022
Period of Performance: 5/1/02 - 4/1/03
PI: W. H. Tranter
Co-PI: R. M. Buehrer, A. Annamalai
Percentage: 33%
42. Title: The Benefits of Multiple Antennas at the Handset for Cellular CDMA
Sponsor: e-Tenna Corporation
Funding: \$15,000
Period of Performance: 5/15/02 8/14/02
PI: R. M. Buehrer
Percent: 100%
43. Title: MPRG Affiliates Program
Sponsor: Analog Devices, ARO, Cingular, DRS Technologies, General Motors, General Dynamics, Huawei Technologies, Hughes, Lucent Technologies, Motorola, Qualcomm, Raytheon, Samsung, SW Bell, Texas Instruments, et. al.
Funding: \$2M
Period of Performance: 8/25/01 5/15/11
PI: J.H. Reed

Co-PIs: R.M. Buehrer, W.H. Tranter, S.W. Ellingson, others
Percent: 20%

Book Publications

S. Zekavat and R.M. Buehrer, editors, Position Location - Theory, Practice and Advances, Second Ed., Wiley-IEEE, 2019.

S. Zekavat and R.M. Buehrer, editors, Position Location - Theory, Practice and Advances, Wiley-IEEE, 2011.

J.H. Lee and R.M. Buehrer, "Security Issues in Position Location," Chapter 3 in Position Location - Theory, Practice and Advances, Wiley-IEEE, 2011.

R. M. Buehrer and S. Venkatesh, "Fundamentals of Time-of-Arrival-based Position Location," Chapter 6 in Position Location - Theory, Practice and Advances, Wiley-IEEE, 2011.

J.H. Lee and R.M. Buehrer, "Fundamentals of Received Signal Strength Based Position Location," Chapter 11 in Position Location - Theory, Practice and Advances, Wiley-IEEE, 2011.

T. Jia and R.M. Buehrer, "Collaborative Position Location," Chapter 23 in Position Location - Theory, Practice and Advances, Wiley-IEEE, 2011.

R.M. Buehrer, An Introduction to Code Division Multiple Access (CDMA), Morgan-Claypool Publishers, 2007.

R.A. Soni and R.M. Buehrer, "Multiple Antenna Techniques in 3G Wireless Systems," Chapter 25 in Space-Time Wireless Systems: From Array Processing to MIMO Communications, H. Bolecskei, D. Gesbert, C. Papadias, and A.J. vander Veen, editors, Cambridge University Press, 2005.

R.M. Buehrer, "Channel Modeling," Chapter 3 in An Introduction to Ultra Wideband Communication Systems, Jeff Reed, editor, pp. 73-158, Prentice-Hall, 2005.

A.F. Molisch, J. Kunisch, R. Qiu, D. Cassioli, M. Buehrer, M. Pendergrass, I.Z. Kvac, G.F. Pedersen, P.C.F. Eggers, S. Roy and I. Ramachandran, "UWB Propagation Channels," Chapter 2 in UWB Communication Systems – A Comprehensive Overview, M.-G. Di Benedetto, T. Kaiser, A.F. Molisch, I. Oppermann, C. Politano, and D. Porcino, editors, pp.21-142, Hindawi Publishing Company, 2006.

M. Dohler, J. Liu, S. Venkatesh, R.M. Buehrer and B. Allen, "Large- and Medium-Scale Propagation Modelling," Chapter 14 in Ultra-wideband Antennas and Propagation for Communications, Radar and Imaging, B. Allen, et. al., editors, pp. 283-308, John Wiley and Sons, 2006.

S. Venkatesh, R.M. Buehrer, J. Liu, and M. Dohler, "Small-Scale Ultra-wideband Propagation Modelling," Chapter 15 in Ultra-wideband Antennas and Propagation for Communications, Radar and Imaging, B. Allen, et. al., editors, pp. 309-330, John Wiley and Sons, 2006.

R. Muhamed, R.M. Buehrer, A. Doradla, and T.S. Rappaport, "Mobile and Portable Radio Communications," Chapter 139 in The Engineering Handbook, Second Ed., R.C. Dorf, Editor, pp. 139-1 - 139-19, CRC Press, 2004.

T.S. Rappaport, R. Muhamed, M. Buehrer, and A. Doradla, "Mobile and Cellular Radio Systems," The Engineering Handbook, R. C. Dorf Editor, CRC Press, 1996.

R.M. Buehrer and B.D. Woerner, "Spread Spectrum for Wireless Communications," Wireless Personal Communications: Research Developments, B.D. Woerner, T.S. Rappaport, and J.H. Reed editors, Kluwer Academic Press, 1995.

H. Shaban, M. A. El-Nasr, and R. M. Buehrer, "A Full-Body Wireless Wearable UWB-Based Human Motion Capture

and Gait Analysis System,” Chapter 20 in *E-Healthcare Systems and Wireless Communications: Current and Future Challenges*, pp. 434-459, Prof. Mohamed K. Watfa, Editor.

Journal Publications

S. R. Zekavat, R. M. Buehrer, G. D. Durgin, L. Lovisolo, Z. Wang, S.T. Goh, and A. Ghasem, An Overview of Position Location: Past, Present, Future, *accepted for publication in International Journal of Wireless Information Networks*, January 2021.

C.E. Thornton, M. Kozy, A. F. Martone, K. Sherbondy, and R.M. Buehrer, “Deep Reinforcement Learning Control for Radar Detection and Tracking in Congested Spectral Environments,” *IEEE Transactions on Cognitive Communications and Networking*, Vol. 6, No. 4, pp. 1335-1349, December 2020, Digital Object Identifier: 10.1109/TCCN.2020.3019605.

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- P. Jain and R.M. Buehrer, "Implementation of Adaptive Modulation on Sunrise Software Radios," *45th IEEE Midwest Symposium on Circuits and Systems*, Tulsa, OK, pp. 405-408, August 4-7, 2002.
- R. Venkatasubramanian, J. Tsai, and R. M. Buehrer, "Beamforming for MC-CDMA," *45th IEEE Midwest Symposium on Circuits and Systems*, Tulsa, OK, pp. 441-444, August 4-7, 2002.
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- R.M. Buehrer, R.A. Soni, and Q. Li, "Transmit Diversity with More than Two Transmit Antennas," *10th Virginia Tech Symposium on Wireless Personal Communications*, Blacksburg, VA, pp. 131-143, June 2000.
- R.M. Buehrer, "Generalized Equations for Spatial Correlation for Low to Moderate Angle Spread," *10th Virginia Tech Symposium on Wireless Personal Communications*, Blacksburg, VA, pp. 101-108, June 2000.
- S.P. Nicoloso, M. Metke, and R.M. Buehrer, "Frame-Quality-Based vs. Eb/No-Based Forward Power Control Methods for cdma2000," *10th Virginia Tech Symposium on Wireless Personal Communications*, Blacksburg, VA, pp. 239-248,

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R.M. Buehrer, "On the Convergence of Multistage Interference Cancellation," *33rd IEEE Conference on Signals, Systems and Computers - Asilomar*, Pacific Grove, CA, vol. 1, pp. 634-638, October 1999.

R.A. Soni, R.M. Buehrer, and J. Tsai, "Open-Loop Transmit Diversity in IS-2000 Systems," *33rd IEEE Conference on Signals, Systems and Computers - Asilomar*, Pacific Grove, CA, vol. 1, pp. 654-658, October 1999.

J.-A. Tsai, R.M. Buehrer, and D. Uptegrove, "Performance Comparisons of Adaptive Antenna Arrays with Fixed Multibeam Systems for TDMA Systems," *49th IEEE Vehicular Technology Conference – VTC Spring 99*, Houston, TX, vol. 2, pp. 1079-1083, May 1999.

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J.-A. Tsai and R.M. Buehrer, "Frequency Reuse Reduction for IS-136 Using a Four Element Adaptive Array," *8th Virginia Tech Symposium on Wireless Personal Communications*, Blacksburg, VA, pp. 11-22, June 10-12, 1998.

N.S. Correal, R.M. Buehrer, and B.D. Woerner, "Real-Time DSP Implementation of a Coherent Partial Interference Cancellation Multiuser Receiver for DS-CDMA," *IEEE International Conference on Communications - ICC*, Atlanta, GA, vol. 3, pp. 1536-1540, May 1998.

R.M. Buehrer and B.D. Woerner, "The Asymptotic Multiuser Efficiency of M -Stage Interference Cancellation Receivers," *8th IEEE International Symposium on Personal, Mobile, and Indoor Radio Conference*, Helsinki, Finland, vol. 2, pp. 570-574, September 1997.

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R.M. Buehrer, N.S. Correal, and B.D. Woerner, "A Comparison of Multiuser Receivers for Cellular CDMA," *IEEE Global Telecommunications Conference '96*, London, England, pp. 1571-1577, November 11-18, 1996.

J. Feil, L. Ippolito, M. Buehrer, G. Feldhake, and S. Horan, "The First Two Years of Experimental Results from the New Mexico ACTS Propagation Terminal at 20.185 and 27.505 GHz," *1996 IEEE International Symposium on Antennas and Propagation*, Baltimore, MD, vol. 3, pp. 1868-1871, July 21-26, 1996.

J. Feil, L. Ippolito, M. Buehrer, G. Feldhake, and S. Horan, "First Year Propagation Experiment Results from the New Mexico ACTS Receiver Terminal at 20.185 and 27.505 GHz," *16th AIAA International Communications Satellite Systems Conference*, Washington, D.C. pp. 1-11, February 1996.

R.M. Buehrer and B.D. Woerner, "Performance of CDMA Multistage Interference Cancellation with Phase and Timing Errors," *1995 IEEE Conference on Universal Personal Communications – UPC'95*, Tokyo, Japan, pp. 153-157, November 6-9, 1995.

R.M. Buehrer and B.D. Woerner, "Analysis of Adaptive Multistage Interference Cancellation for CDMA Using an Improved Gaussian Approximation," *1995 IEEE Military Communications Conference*, San Diego, CA, vol. 3, pp. 1195-1199, November 5-8, 1995.

A. Park, R.M. Buehrer, and B.D. Woerner, "Throughput Performance for a FHMA System with Variable Rate Coding," *1995 IEEE Military Communications Conference*, San Diego, CA, vol. 1, pp. 320-324, November 5-8, 1995.

R.M. Buehrer and B.D. Woerner, "Spread Spectrum for Wireless Communications," *4th Virginia Tech Symposium on Wireless Personal Communications*, Blacksburg, VA, pp. 3-1 – 3-20, June 1994.

R.M. Buehrer, S.C. Kwatra, and J. Kim, "A Satellite/Terrestrial Hybrid System for the National Research and Education Network," *15th AIAA International Communications Satellite Systems Conference*, San Diego, CA, March 1994.

M. Keaton, R.M. Buehrer, S.C. Kwatra, and J. Kim, "A Wideband Communications Satellite for the National Research and Education Network," *1993 IEEE Global Communications Conference*, Houston, TX, vol. 3, 1644-1648, December 1993.

M. Keaton, R.M. Buehrer, S.C. Kwatra, and J. Kim, "Network Requirements for a Satellite Based National Research and Education Network," *1993 IEEE Military Communications Conference*, Boston, MA, vol. 3, pp. 993-997, November 1993.

Technical Reports

National Research Council. 2009. "Toward a Universal Radio Frequency System for Special Operations Forces", Washington, D.C.: The National Academies Press.

R. M. Buehrer, W.A. Davis, A. Saffai-Jazi, and D. Sweeney, "Ultra-wideband Propagation Measurements and Modeling - Final Report," submitted to DARPA as part of the NETEX Program.

R. M. Buehrer, A. Saffai-Jazi, W. A. Davis, D. Sweeney, "Path Loss Calculations for Ultra-wideband Signals in Indoor Environments," invited contribution to the International Telecommunications Union, Document Number USWP 3K-1, October 26, 2003.

15 technical memoranda in the areas of multiuser detection, intelligent antennas, and OFDM for Bell Labs – Lucent Technologies. Titles and abstracts are proprietary information.

Professional Affiliations

- *Fellow*, Institute of Electrical and Electronics Engineers (IEEE)
- Member, IEEE Communications Society
- Member, IEEE Vehicular Technologies Society
- Member, IEEE Signal Processing Society
- Member, Eta Kappa Nu
- Member, Tau Beta Pi
- Member, Pi Mu Epsilon

Selected Professional Activities

- Area Editor, *IEEE Transactions on Wireless Communications*, 2017 - present.

- Guest Lead Editor, *IEEE Journal on Special Topics in Signal Processing*, special issue on non-cooperative position location networks.
- Guest Editor, *Proceedings of the IEEE*, special issue on cooperative localization.
- Associate Editor, *IEEE Wireless Communications Letters*, 2010 - 2014
- Associate Editor, *IEEE Transactions on Communications*, 2009 - 2014
- Associate Editor, *IEEE Transactions on Wireless Communications*, 2005 - 2012, 2015 - 2017
- Associate Editor, *IEEE Transactions on Vehicular Technologies*, 2005 - 2009
- Associate Editor, *IEEE Transactions on Signal Processing*, 2006-2007
- Associate Editor, *IEEE Transactions on Education*, 1997-2000
- Organizer and Technical Co-Chair, 2015 IEEE Global Communications Conference Workshop on Localization and Tracking: Indoors, Outdoors and Emerging Networks (GC - LION 15), December 6, 2015. Signal Processing for Communications symposium co-chair for IEEE ICC 2017 i
- Symposium co-chair for IEEE ICC 2017 Signal Processing for Communications Symposium
- Technical Program Co-Chair, WPNC 2013.
- Technical Program Chair for UWBST2003.
- Technical Program Committee, 2008-2016 IEEE Global Communications Conference
- Technical Program Committee, 2007-2016 IEEE International Conference on Communications
- Technical Program Committee, IEEE RWS 2006
- Technical Program Committee, IEEE 2006 International Conference on Ultra Wideband
- Technical Program Committee, IEEE Vehicular Technology Conference 2006 - Fall
- Technical Program Committee, 2004 IEEE International Workshop on Ultra Wideband Systems / Ultra Wideband Systems and Technologies.
- Technical Program Committee, 2004 IEEE Radio and Wireless Conference (RAWCON), September 2004.
- Technical Program Committee, 2005 Wireless Communications and Networking Conference.
- Reviewer for *IEEE Journal on Selected Areas in Communications*, *IEEE Transactions on Communications*, *IEEE Transactions on Vehicular Technology*, *IEEE Communications Letters*, *IEEE Transactions on Signal Processing*, *ETRI Research Journal*, *Army Research Office*, *State of Tennessee*
- Session Chair, IEEE Vehicular Technology Conference – Fall 2002

Selected Consulting

- Lutron Electronics
 - Provided recommendations on the design and testing of indoor wireless networks, August - Sept. 2019.
 - Evaluated RF coexistence plan, March 2020.
- Polaris Wireless - Provided an evaluation of Z-axis estimation algorithm, Sept-Oct 2018.
- ENSCO, Inc. – Provided an evaluation of spread spectrum ranging system. March 2011.
- FCC – Delivered short courses on various topics in wireless communications including WiFi, spread spectrum, and 3G technologies. Summer 2004, Summer 2005.

Expert Witness Experience

- Tesla, Inc.
 - Law firm: Munger, Tolles, & Olson
 - Served as testifying expert witness
 - Technology: Control channels/information in cellular systems
 - Dates: November 2020 - present
- Apple, Inc.
 - Law firm: Wilmer-Hale
 - Wrote declaration in support of request for ex parte reexamination
 - Technology: Control information in cellular systems
 - Dates: November 2020 - January 2021
- Phillips vs. Garmin
 - Law firm: Alston-Bird
 - Represented: Garmin (defendant)
 - Served as testifying expert witness for Federal Trade Commission proceedings
 - Technology: Local and Cellular Wireless Connections in Personal Emergency Response Systems
 - District: FTC
 - Dates: June - July 2020
- ZTE vs. Sisvel International
 - Law firm: Banner-Witcoff
 - Represented: ZTE (Petitioner)
 - Served as expert in Inter Partes Review proceedings. Wrote declaration supporting petitioner.
 - Technology: Cell selection and reselection in Radio Resource Control
 - Dates: April 2020 - June 2020
- Apple, Inc. vs. Optis
 - Law firm: Wilmer-Hale
 - Represented: Apple (Plaintiff)
 - Served as testifying expert witness for litigation
 - Technology: Control information in cellular systems
 - District: Eastern District of Texas
 - Dates: July 2019 - August 2020.
- Apple, Inc. vs. Wi-LAN
 - Law firm: DLA Piper
 - Represented: Apple (Plaintiff)
 - Served as testifying expert witness for litigation
 - Technology: Resource Allocation in Wireless Systems
 - District: Southern District of California
 - Dates: January '19 - January '20

- TELUS Communications, Bell Mobility, and Rogers Communications vs. WiLAN, Inc.
 - Law firm: Torys, LLP.
 - Represented: TELUS Communications, Bell Mobility, and Rogers Communications
 - Served as testifying expert. Analyzed certain patents (and the prior art) and provided technical reports on sufficiency, validity and potential double-patenting.
 - Technology: Resource allocation in wireless networks
 - Dates: January 2019 - November 2019
- Samsung vs. Sharp
 - Law firm: Fish and Richardson
 - Represented: Samsung
 - Analyzed technical aspects of patent to aid validity/invalidity analysis.
 - Technology: Feedback in MIMO-OFDM systems
 - Dates: April 2019 - July 2019
- American Patents, LLC vs. HP, Inc.
 - Law firm: DLA Piper
 - Represented: HP, Inc.
 - Analyzed technical aspects of two patents to aid validity/invalidity analysis.
 - Technology: MIMO/OFDM synchronization in cellular systems
 - Dates: June 2019
- Blackberry vs. Uniloc, LLC.
 - Law firm: Oblon
 - Represented: Blackberry (Petitioner)
 - Wrote declaration to the USPTO concerning the disclosure of certain features of two patents in previous references.
 - Technology: Traffic mapping between logical channels and transport channels in wireless systems
 - Dates: June 2019.
- Apple, Inc. vs. Wi-LAN
 - Law firm: DLA Piper
 - Represented: Apple (Plaintiff)
 - Served as testifying expert witness for litigation (non-infringing alternatives)
 - Technology: Resource Allocation in Wireless Systems
 - District: Southern District of California
 - Dates: November '17 - July '18
- Apple, Inc., LG Electronics Inc., Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc. vs. Uniloc, LLC.
 - Law firm: Fish and Richardson
 - Represented: Apple, Inc., LG Electronics Inc., Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc. (Petitioner)
 - Wrote declarations to the USPTO concerning the disclosure of certain features of two patents in previous references.

- Technology: Traffic mapping between logical channels and transport channels in Wireless Systems; Multi-mode transceivers
- Dates: September 2018 - November 2019.
- Apple, Inc. vs. Wi-LAN
 - Law firm: DLA Piper
 - Represented: Apple (Plaintiff)
 - Served as testifying expert witness for litigation (infringement analysis and non-infringing alternatives)
 - Technology: Resource Allocation in Wireless Systems
 - District: Southern District of California
 - Dates: Fall 2017 - July 2018
- CCE vs. Apple, Inc.
 - Law firm: DLA Piper
 - Represented: Apple (Defendant)
 - Served as testifying expert witness for litigation (infringement analysis)
 - Technology: Power Headroom Reporting in Cellular Systems
 - District: Eastern District of Texas
 - Dates: January 2017 - July 2017
- Nokia Technologies vs. Apple, Inc.
 - Law firm: Wilmer-Hale
 - Represented: Apple (Defendant)
 - Served as testifying expert witness for litigation (infringement analysis)
 - Technology: antennas for handheld mobile devices
 - District: Eastern District of Texas
 - Dates: January 2017 - June 2017
- Core Wireless vs. Apple, Inc.
 - Law Firm: Wilmer-Hale
 - Represented: Apple (Defendant)
 - Role: Served as testifying expert witness for litigation (infringement and validity analysis).
 - Technology: Control Channels and Frame Stealing in 2G (GSM) cellular networks.
 - District: The US District Court for the Northern District of California
 - Dates: May 2015 - December 2016.
- AMERICAN SYSTEMS vs. US Navy
 - Law Firm: Miles and Stockbridge
 - Represented: AMERICAN SYSTEMS (Plaintiff)
 - Role: Served as testifying expert witness for litigation (case settled prior to expert reports being filed).
 - Technology: Wireless mesh networks.
 - Dates: Nov. 2014 - June 2015.
- TruPosition, Inc. vs. LM Ericsson Telephone Company, et. al.
 - Law Firm: Constantine-Cannon LLP

- Represented: TruePosition (Plaintiff)
 - Role: Served as testifying expert witness for litigation. Case settled prior to depositions being taken.
 - Technology: Cellular-based geolocation for 4G (LTE) cellular networks.
 - District: The US District Court for the Eastern District of Pennsylvania
 - Dates: March 2013 - July 2014.
- Andrew, LLC vs TruPosition, Inc.
 - Law Firm: Patterson Belknap Webb & Tyler LLP
 - Represented: Andrew, LLC (Plaintiff)
 - Role: Served as testifying expert witness for patent litigation. Case settled before trial, but after depositions were taken.
 - Technology: Cellular-based (2G, 3G) geolocation.
 - District: The US District Court for the District of Delaware
 - Dates: Nov. 2009 - March 2010.
- TCL vs. Ericsson
 - Law Firm: Sheppard Mullin
 - Provided Services for: TCL (Plaintiff)
 - Role: Served as consulting expert witness for essentiality analysis.
 - Technology: digital communications in 2G, 3G, and 4G cellular systems.
 - District: The US District Court for the Central District of California
 - Dates: March 2015 - December 2015.
- Univ. of Minnesota vs. Sprint
 - Law Firm: McGuire-Woods
 - Provided Services for: Sprint (Defendant)
 - Role: Served as consulting expert for validity analysis.
 - Technology: 4G cellular networks.
 - Dates: October 2015 - January 2016.
- Eon Corp, IP Holdings, LLC vs Research In Motion Corporation, et. al.
 - Law Firm: Sidley-Austin
 - Provided Services for: Research in Motion Corporation (Defendant)
 - Served as consulting expert for patent litigation
 - Technology: Cellular technologies
 - Dates: March 2012
- InterDigital vs. Nokia
 - Law Firm: Alston-Bird LLP
 - Provided Services for: Nokia
 - Served as a consulting expert
 - Technology: Cellular CDMA and power control
 - Date: Oct. 2011 - Dec. 2011.
- SPH America, LLC vs Acer, Inc.

- Law Firm: Spotts Fain PC
- Provided Services for: UT Starcomm
- Role: Served as a consulting expert for patent litigation
- Technology: CDMA (spread spectrum) and 3G cellular technologies.
- Dates: Jan. 2011 - March 2011

References

Available upon request.