

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ERICSSON INC. and
NOKIA OF AMERICA CORPORATION,
Petitioners,

v.

ACTIVE WIRELESS TECHNOLOGIES LLC,
Patent Owner.

U.S. PATENT NO. 10,785,764
Title: INFORMATION CHANGE TRANSMISSION METHOD AND DEVICE
FOR SINGLE-CELL MULTICAST SERVICE

Inter Partes Review No.: IPR2024-00986

PETITION FOR *INTER PARTES* REVIEW OF U.S. PAT. NO. 10,785,764

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Petitioner's Exhibit List

<i>Exhibit #</i>	<i>Description</i>
1001	U.S. Patent No. 10,785,764 (the “’764 Patent”)
1002	Prosecution history of the ’764 Patent (“File History”)
1003	Declaration of Petitioner’s Expert Mark Mahon, PhD.
1004	Certified Translation of U.S. Provisional Application No. 62/372,323 (“Shin ’323”)
1005	U.S. Patent No. 11,160,094 (“Shin ’094”)
1006	U.S. Patent No. 10,785,752 (“Xu”)
1007	3GPP TS 36.212 v.13.2.0 (“TS-36.212”)
1008	3GPP TS 36.213 v.13.2.0 (“TS-36.213”)
1009	3GPP TS 36.331 v.13.2.0 (“TS-36.331”)
1010	Certified Translation of U.S. Provisional Application No. 62/372,919 (“Fujishiro 919”)
1011	U.S. Patent Publication No. 2019/0182632 (“Fujishiro”)
1012	3GPP TS 36.321 v.13.2.0 (“TS-36.321”)
1013	U.S. Provisional Application No. 62/372,323 (“’323 Provisional”)
1014	U.S. Provisional Application No. 62/372,919
1015	U.S. Provisional Application No. 62/372,324 (“’324 Provisional”)
1016	Certified Translation of U.S. Provisional Application No. 62/372,324 (“Shin ’324”)
1017	PCT Publication No. WO 2018/030793 (“Shin PCT”)
1018	PCT Publication No. WO 2018/030305

I. INTRODUCTION

Pursuant to 35 U.S.C. §§ 311 *et seq.* and 37 C.F.R. §§ 42.1 *et seq.*, Ericsson Inc. and Nokia of America Corporation (“Petitioners”) hereby petitions for an *inter partes* review of U.S. Patent No. 10,785,764 (the “’764 Patent”). Petitioners respectfully submit that claims 3, 4, and 6 (the “Challenged Claims”) of the ’764 Patent are unpatentable under 35 U.S.C. §103 in view of the prior art herein.

II. OVERVIEW

The ’764 Patent is generally directed to a wireless communication system where a single base station (BS) transmits the same communication to multiple mobile user equipment (UE) which is known as single-cell multicast service.

Ordinarily, in a system which conforms to the Long Term Evolution Project (LTE) standard, which is admittedly prior art to the ’764 Patent, two logical channels are used, the single-channel multicast control channel (SC-MCCH) and the single channel multicast traffic channel (SC-MTCH). The SC-MCCH carries control information including a multicast service type, and scheduling and receiving configurations of the SC-MTCH. The SC-MTCH is the traffic channel, which provides traffic content to the UE. A UE interested in receiving a multicast service first must acquire scheduling and configuration of an SC-MCCH. The UE can then acquire the necessary control information from that SC-MCCH. The UE periodically monitors whether any information on the SC-MCCH changes so it can

obtain the updated information. Changes to the SC-MCCH only occur during specified change periods.

In the prior art, when a new service began or ended and information on the SC-MCCH therefore needed to change, a BS broadcasted two things in the same subframe: 1) an indication that the SC-MCCH information has changed, and 2) information corresponding to a physical downlink control channel (PDCCH) which will schedule the new SC-MCCH transmission. EX-1001, 1:64-65, 1:67-2:1, 2:10-33.

However, in the context of a narrowband of internet of things infrastructure (NB-IoT system), in order to reduce power consumption, the NB-IoT system does not support transmitting a change indication and scheduling a new SC-MCCH transmission in the same subframe. The '764 Patent is directed to providing indication of a change SC-MCCH information for a NB-IoT system. The '764 Patent's purported solution consists of an information change transmission method and device wherein the change indication and scheduling of the updated SC-MCCH information are transmitted in different subframes. EX-1001, 2:55-3:3.

The Challenged Claims require a BS configured to send downlink control information (DCI) on a second narrowband physical downlink control channel (NPDCCH) wherein the DCI includes a change notification for a SC-MCCH. The SC-MCCH change notification is indicated by one bit or a plurality of bits. The

DCI format may be an existing DCI format, such as DCI format N1 or N2, or a newly designed DCI format. The Challenged Claims further require a BS configured to send DCI on a first NPDCCH, which indicates transmission of updated SC-MCCH information. EX-1001, 5:58-67; 6:27-28; 9:6-10.

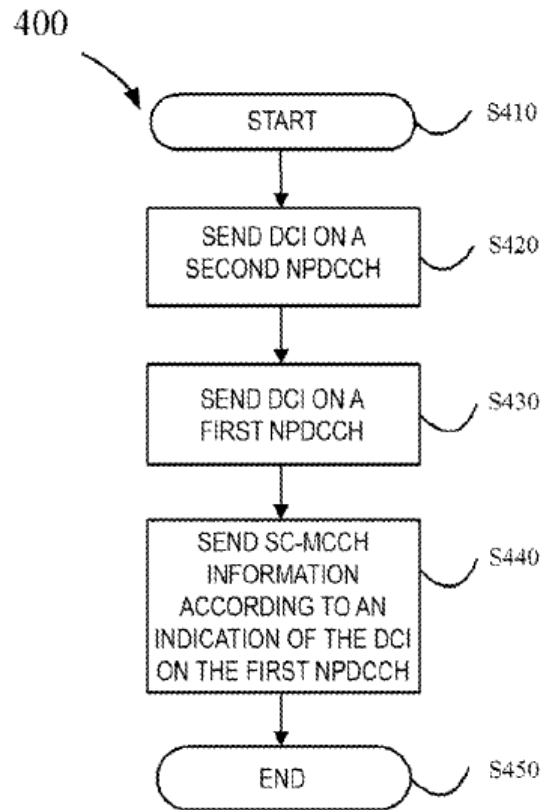


FIG. 4

EX-1001, FIG. 4.

The Challenged Claims also recite that when the first NPDCCH and the second NPDCCH are on the same carrier, the first NPDCCH and the second

NPDCCH are not within the same subframe. EX-1001, 6:7-9.

However, as acknowledged by the '764 Patent itself, there is nothing novel about transmitting SC-MCCH change information nor about transmitting DCI over NPDCCHs. Shin as well as Xu in view of RAN72 and Fujishiro disclose sending a SC-MCCH change notification in different subframes from the scheduling of updated SC-MCCH information. This Petition demonstrates a reasonable likelihood of unpatentability for at least one challenged claim and therefore Petitioners respectfully request that the Board institute *inter partes* review.

III. GROUNDS FOR STANDING (37 C.F.R. § 42.104(A))

Petitioners certify that the '764 Patent is available for IPR and that Petitioners are not barred or estopped from requesting an IPR of the Challenged Claims on the grounds identified herein. 37 C.F.R. § 42.104(a).

IV. REASONS FOR THE REQUESTED RELIEF

As explained below and in the attached Declaration of Petitioners' Expert (EX-1003), the Challenged Claims were obvious over the prior art to a person of ordinary skill in the art (POSITA) at the time of the invention.

V. BACKGROUND

A. Summary of the '764 Patent

As described in the Overview, the '764 Patent claims a technique for communicating information change between a BS and UE of a control channel in an NB-IoT system.

B. Prosecution History

The '764 Patent issued from U.S. Patent Application No. 16/324,359, which was filed on February 8, 2019 as a National Stage Entry of International Application No. PCT/CN2017/096794.

Before examination, the Applicant cancelled the original 44 claims in a preliminary amendment and added claims 45-48. EX-1002, 67-71. During prosecution, the Examiner rejected these new claims as being obvious from U.S. Provisional Application No. 62/372,324 ("'324 Provisional")¹, which was partially in Korean, in view of U.S. Patent Publication No. 2019/0182632 ("Fujishiro"). EX-1002, 171-181. In response, the Applicant amended Claims 45-48 (issued Claims 1-4) to require multiple DCI formats and to be carried in different subframes, and added Claims 49 and 50 (issued Claims 5-6). EX-1002, 208-211. Applicant argued the '324 Provisional fails to disclose the feature of "more than one second subframe" as recited in the independent claims. EX-1002, 212-214. Applicant further argued that both '324 Provisional and Fujishiro fail to disclose whether "a period of the more than one first subframe in which a resource for a

¹ The examiner cited to the application published as U.S. Patent Application Publication No. 2019/0223197 ("Shin 197"), which claims priority to and incorporates by reference, the '324 Provisional. EX-1002, 174.

transmission of the another SC-MCCH information is received is different from a period of the more than one second subframe in which an SC-MCCH information change notification is received,” as recited by the independent claims. EX-1002, 213-214.

A Notice of Allowance then issued. EX-1002, 217. The Notice of Allowance provided a Reason for Allowance stating:

Each independent claim identifies the uniquely distinct features, particularly:

receiving circuitry configured to receive, in more than one second subframe, a second downlink control information (DCI) format carried on a second narrowband physical downlink control channel (NPDCCH), after receiving Single-Cell Multicast Control Channel (SC-MCCH) information; and

processing circuitry configured to acquire, on the basis of a first DCI format carried on a first NPDCCH and received in more than one first subframe, another SC-MCCH information, in a case that the second DCI format indicates an SC-MCCH information change notification wherein

a period of the more than one first subframe is different from a period of the more than one second subframe, and

the first DCI format indicates a resource for a transmission of the another SC-MCCH information.

EX-1002, 223-224.

The Reason for Allowance also listed the closest prior art as Shin 197 (disclosing a method for transmitting/receiving data in a wireless communication system supporting NB-IoT), Fujishiro (disclosing a method of SC-MCCH channel management in narrowband IoT), and U.S. Patent Publication No. 2010/0178895 (disclosing a method for emergency information broadcasting in a wireless network). EX-1002, 224.

C. Priority Date

The Patent Owner bears the burden of establishing that it is entitled to the priority date of Chinese Patent Application No. CN2016/0658544 ('544 Provisional) filed on August 11, 2016. For purposes of this Petition, because each of the cited prior art references is prior art to the Challenged Claims of the '764 Patent regardless of whether the Challenged Claims are entitled to the filing date of the '544 Provisional, that issue does not need to be resolved currently.

D. Claim Construction

Petitioners propose that each claim term be given its plain and ordinary meaning herein. The prior art herein meets each claim limitation under any reasonable construction.

E. Person of Ordinary Skill in the Art

With respect to the '764 Patent, a POSITA in August 2016 would have been familiar with wireless communications networks, equipment, and integrated circuit

chips, and would have had at least a working knowledge of the communication protocols used in LTE and 5G radio access networks (RAN). A POSITA would have had at least a Bachelor's degree in Electrical Engineering or related field, and at least two years of work experience in design, development, and/or testing wireless telecommunication systems. A POSITA would have had familiarity with the wireless standards and protocols related to data transmission and network management. To the extent a POSITA would have had a more advanced degree, such as a Master's degree in Electrical Engineering or related field, then a POSITA may have had less work experience. EX-1003 ¶39.

F. State of the Art

The following section describes the relevant state of the art as of the priority date. The prior art references, and the discussions of what was known to a POSITA, provide the factual support for the general description of the state of the art, assist in understanding how a POSITA would have understood the prior art, and provide the motivation to modify or combine the teachings of references.

1. SC-PTM

Single-cell point-to-multipoint ("SC-PTM") refers to multicast transmission of a multimedia broadcast performed within a single cell. EX-1001, 51-53. A representation of a SC-PTM transmission is shown in Figure 1 of Xu, reproduced below.

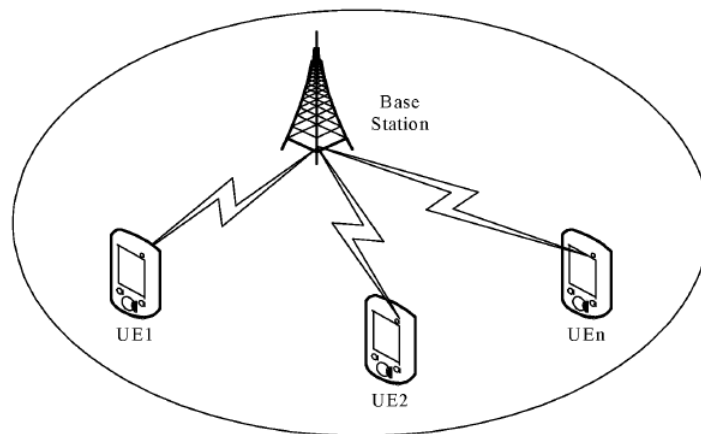


Fig. 1

EX-1006, Fig. 1.

A group known as the 3rd Generation Partnership Project (3GPP) defines global technical specifications and reports for present and future wireless communication systems, including a Multimedia Broadcast/Multicast Service (“MBMS”). EX-1003 ¶45. These standards are used by equipment manufacturers – both for network equipment, such as base stations (“BS”), and end-user devices, referred to as user equipment (“UE”) – to ensure that the devices may communicate with one another. EX-1003 ¶45. Standards for SC-PTM were longstanding by August 2016. For example, 3GPP Technical Specification 36.331 v.13.2.0, which was publicly available and accessible by July 11, 2016, discloses providing SC-PTM control information on a specific logical channel, the SC-MCCH, which indicates ongoing MBMS sessions. EX-1009, Section 5.8a.1.1; EX-1003 ¶¶45, 91.

MBMS was also well known in the art. EX-1003 ¶46. 3GPP proposed MBMS to effectively utilize mobile network resources. EX 1004, 1:28-30. MBMS is a technology used to transmit from a data source (e.g., a BS) to multiple target mobile terminals (e.g., UEs) to implement sharing of a network resource and increase the resource's utilization. EX-1006, 1:30-35; EX-1003 ¶46.

SC-MCCH refers to a single-cell multicast control channel, which carries information necessary to schedule and configure the transmission of a MBMS. EX-1001, 1:56-63. The use of change notifications to indicate a change in SC-MCCH information was also well established in the prior 3GPP specifications. For example:

When the network changes (some of) the SC-MCCH information, it notifies the UEs about the change in the first subframe which can be used for SC-MCCH transmission in a repetition period. LSB bit in 8-bit bitmap when set to '1' indicates the change in SC-MCCH. *Upon receiving a change notification, a UE interested to receive MBMS services transmitted using SC-PTM acquires the new SC-MCCH information* starting from the same subframe.

EX-1009, Section 5.8a.1.3; EX-1003 ¶47.

2. NB-IoT

As admitted by the '764 Patent, NB-IoT was a project implemented by the 3GPP prior to the filing of the '544 Provisional. EX-1001, 1:25-30. The project aimed to meet the requirements of terminals in the IoT, such as low power

consumption, long standby, cost reduction, and wide coverage. EX-1001, 1:34-36. To meet these requirements, the NB-IoT was configured to be a narrow band system that operates on 180 kHz uplink and downlink. EX-1001, 1:31-34; EX-1003 ¶48. The 180 kHz bandwidth corresponds to the size of one resource block (“RB”)/physical resource block (“PRB”) in the frequency direction, which is made up of 12 15KHz subcarriers and is 1/6 the number of usable resource blocks of the narrowest LTE system bandwidth (1.4MHz). EX-1011 ¶85; EX-1004, 31; EX-1003 ¶48. An RB includes a plurality of subcarriers in the frequency direction. EX-1011 ¶64; EX-1003 ¶48.

By August 2016, established support and standards already existed for basic function designs for the NB-IoT including broadcast notification of system information, point-to-point unicast uplink data transmission, and downlink data transmission. EX-1001, 1:35-40; EX-1003 ¶49. Specifically, at the 3GPP RAN #72 plenary meeting held in June 2016, it was decided that multicast transmission in the NB-IoT system was to be implemented on the basis of the features of the existing version 13 LTE SC-PTM. EX-1001, 1:36-50; EX-1003 ¶49.

3. DCI Formats

Downlink control information (“DCI”) is control information sent from the BS to the UEs. The admitted prior art version of the 3GPP specification, i.e., version 13, defined several DCI formats, including three DCI formats for NB-IoT:

N0, N1, and N2. EX-1003 ¶50. DCI format N0 “is used for the scheduling of NPUSCH in one UL cell.” EX-1007, Section 6.4.3.1. DCI format N1 “is used for the scheduling of one NPDSCH codeword in one cell and random access procedure initiated by a NPDCCH order.” The DCI corresponding to a NPDCCH order is carried by NPDCCH.” EX-1007, Section 6.4.3.2. DCI format N2 “is used for paging and direct indication.” EX-1007, Section 6.4.3.3. The particular structure of these DCI formats can be found in Sections 6.4.3.1-6.4.3.3 of the standard. EX-1007, Sections 6.4.3.1-6.4.3.3; EX-1003 ¶50.

DCI is responsible for transporting several categories of instructions including downlink scheduling information and notifications of MCCH and SC-MCCH change. EX-1007, Section 5.3.3; EX-1003 ¶51. NB-IoT DCI is carried on narrowband physical downlink control channels (“NPDCCH”). EX-1007, Section 6.1; EX-1003 ¶51.

4. RNTI

For each DCI, one Radio Network Temporary Identifier (“RNTI”) value is implicitly encoded for a Cyclic Redundancy Check (“CRC”). EX-1007, 5.3.3; EX-1003 ¶52. The CRC provides error detection on DCI transmissions. EX-1007, at 5.3.3.2; EX-1003 ¶53. RNTI values are used to scramble CRC parity bits to be checked by the UE. EX-1007, 5.3.3.2; EX-1003 ¶53.

In addition to its involvement in error detection, RNTI values can be used to

indicate different DCI uses. EX-1003 ¶54. Because of this, the detection of different RNTI values are used by UEs in receiving and decoding NPDCCHs and narrowband physical downlink shared channels (“NPDSCH”). EX-1003 ¶54. For example, if the CRC of a DCI is scrambled by paging RNTI (“P-RNTI”), it indicates that the UE will decode the corresponding NPDCCH and NPDSCH assuming DCI format N2 in a Type-1 Common search space. EX-1008, Section 16.4.1 (Table 16.4.1-2); EX-1003 ¶54.

Similarly, when scrambled with a cell RNTI (“C-RNTI”), the UE will decode by assuming DCI format N1 in a UE-specific search space. EX-1008, Section 16.4.1 (Table 16.4.1-4); EX-1003 ¶55.

VI. IDENTIFICATION OF CHALLENGES

A. Challenged Claims

This Petition challenges claims 3, 4, and 6 of the ’764 Patent.

B. Statutory Grounds for Challenges

The Challenges are detailed below and summarized as follows:

Ground	Claims	Basis	Reference(s)
1	3, 4, and 6	§ 103	Shin
2	3, 4, and 6	§ 103	Xu, in view of RAN72 and Fujishiro

United States Patent No. 11,160,094 to Shin et al. (EX-1005) (“Shin ’094”) is the National Stage Entry under 35 U.S.C. § 371 of International Application No. PCT/KR2017/008647, filed on Aug. 9, 2017 and published as WO 2018/030793

(“Shin PCT”) (EX-1017) which claims the benefit of U.S. Provisional Application No. 62/372,323 (EX-1013, “’323 Provisional”), filed on Aug. 9, 2016 and qualifies as prior art under 35 U.S.C. §102(a)(2). The ’323 Provisional is written partly in Korean and partly English, and a certified full English translation of the ’323 Provisional is EX-1004 (“Shin ’323”). Shin also expressly incorporated by reference, the entirety of Shin ’323. Ex-1005 1:10-23. Thus, the disclosure of Shin ’323 forms part of Shin for all purposes as if explicitly contained therein. MPEP (8th Ed) §2163.07(b) (“information incorporated is as much a part of the application as filed as if the text was repeated in the application, and should be treated as part of the text of the application as filed.”); *Ultradent Prods., Inc. v. Life-Like Cosmetics, Inc.*, 127 F.3d 1065, 1069 (Fed. Cir. 1997) (rejecting argument that anticipatory reference “sa[id] nothing” about pertinent portions of an incorporated reference because “the entire contents” were incorporated); *Apple Inc. v. Koss Corporation*, IPR2021- 00255, Paper 54 (Final Written Decision) (May 31, 2022), at 25-30 (holding claims obvious over host reference, relying on material from two provisional applications incorporated in their entirety). Thus, because Shin includes the entirety of Shin ’323, Shin ’323 should be treated as part of the text of Shin and thus, for this Petition, citations to Shin include citations to EX-1004 and EX-1005. Further, Shin meets the procedural requirements for claiming priority to the Shin PCT, and meets the ministerial requirements for claiming

priority to Shin '323 (and the '324 Provisional) because it properly claims the benefit of Shin '323 and the '324 Provisional and the Shin PCT was filed co-pending with Shin '323 and the '324 Provisional. *Penumbra, Inc. v. RapidPulse, Inc.* (IPR2021-01466), Paper 34 (March 10, 2023).

United States Patent No. 10,785,752 to Xu et al. (“Xu”) is a continuation of International Patent Application PCT/CN2016/083166, filed on May 24, 2016, and qualifies as prior art under 35 U.S.C. §102(a)(1).

3GPP TS-36.212, TS-36.213, and TS-36.331 v.13.2.0 (“RAN72”) was made available to the public no later than July 2016. EX-1007, EX-1008, EX-1009; EX-1003 ¶¶85-96. This publication qualifies as prior art under 35 U.S.C. §102(a)(1). Xu was cited during the prosecution of the '764 Patent, but was not considered in combination with RAN72.

U.S. Patent Publication No. 2019/0182632 to Fujishiro et al. was published on June 13, 2019 (EX-1011, “Fujishiro”) from U.S. Patent Application No. 16/271,391, filed on February 8, 2019, which is a continuation of International Patent Application PCT/CN2016/083166, filed on August 4, 2017, which claims which claims the benefit of U.S. Provisional Application No. 62/372,919 (EX-1010), filed on Aug. 10, 2016 (“Fujishiro 919”) and qualifies as prior art under 35 U.S.C. §102(a)(2). Fujishiro also expressly incorporated by reference, the entirety of Fujishiro 919. EX-1011 ¶1. Thus, the disclosure of Fujishiro 919 forms part of

Fujishiro for all purposes as if explicitly contained therein. For this Petition, citations to Fujishiro include citations to EX-1010 and EX-1011. Further, Fujishiro meets the procedural requirements for claiming priority to the PCT/CN2016/083166 application, and meets the ministerial requirements for claiming priority to Fujishiro 919 because it properly claims the benefit of Fujishiro 919 and the PCT/CN2016/083166 application was filed co-pending with Fujishiro 919.

VII. IDENTIFICATION OF HOW THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Ground 1: Claims 3, 4, and 6 are unpatentable over Shin

Ground 1 is that Shin renders the Challenged Claims obvious.

1. Overview of Shin

Shin is directed to determining appropriate PRBs on which NPDCCHs and NPDSCHs may transmit SC-PTM related information in an NB-IoT system. As shown in figure 5, reproduced below, Shin discloses a BS, which includes a processor that can be configured to implement the disclosed invention.

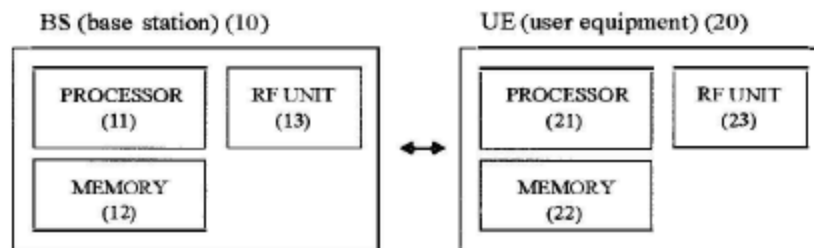


Figure 5. System for implementing present invention

EX-1004, FIG. 5, 17; EX-1005, FIG. 15, 1:58-67, 5:55-57.

a. **Shin's Disclosure of 3GPP Technical Specifications**

Shin recites several 3GPP technical specifications ("TS") including TS-36.211, TS-36.212, TS-36.213 and TS-36.331. Through its recitation of TS-36.212, Shin discloses three DCI formats used to transmit information in a NB-IoT system: N0, N1, and N2. EX-1004, 28-30; EX-1005, 25:38-26:25.

With its recitation to TS-36.213, Shin discloses the procedure by which a UE monitors a NPDCCH search space to receive a NPDCCH. Specifically, a NPDCCH search space is defined by an aggregation level, $L' \in \{1, 2\}$, and a repetition level $R \in \{1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048\}$. The search space consists of a set of NPDCCH candidates where each candidate is repeated in a set of R consecutive NB-IoT downlink subframes, excluding subframes used for SI messages. A UE is configured to monitor two NPDCCH common search spaces: Type1 and Type2. EX-1004, at 25. For Type1, the starting subframe of the search space is determined based on locations of NB-IoT paging opportunity subframes. EX-1004, 25-26; EX-1005, 18:26-63.

Through its recitation of TS-36.331, Shin discloses legacy procedures for sending and acquiring SC-PTM information in a non-NB-IoT system. SC-PTM control information is carried on a specific logical channel: SC-MCCH. Information that is transmitted in messages sent over SC-MCCH ("SC-MCCH information") is transmitted periodically using a repetition period. SC-MCCH

transmissions are indicated on PDCCH. When SC-MCCH information changes, it notifies the UE of the change in the first subframe used for SC-MCCH transmission in a repetition period. In a typical (i.e. non-NB-IoT) change notification, the least significant bit (“LSB”) in an 8-bit bitmap is set to “1” which indicates a change in the SC-MCCH. Upon receiving a change notification, an interested UE acquires the SC-MCCH information starting from the same subframe. EX-1004, 22; EX-1005, 15:19-63.

b. New Procedures for Transmitting SC-PTM-related Information

Shin discloses new procedures for sending and receiving SC-PTM information in a NB-IoT system. Specifically, Shin presents procedures for determining the appropriate PRB where NPDCCH/NPDSCH carrying SC-PTM is transmitted and how the corresponding PRB(s) are allocated. EX-1004, 14; EX-1005 1:63-2:4.

One disclosed procedure is to transmit the NPDCCH transmitting SC-MCCH control information and the NPDCCH transmitting the SC-MTCH on PRBs different from the PRBs from those used in other NB-IoT transmissions, such as unicast. Because the SC-PTM information are transmitted on a different PRB than other NPDCCH applications, there is no chance that a unicast NPDCCH or paging NPDCCH will be transmitted to the same PRB as a SC-PTM NPDCCH. Shin discloses that the corresponding NPDCCH may be transmitted to one PRB or

transmitted through several PRBs. In either, the information carried on the NPDCCH may be transmitted with DCI format N1, DCI format N2, or a new DCI format. In either, a UE can obtain SC-MCCH change notification information by monitoring a common search space and the change notification may be sent using DCI format N1, N2, or a new DCI format. EX-1004, 31-34; EX-1005, 29:25-33, 30:20-24, 31:57-60, 33:28-41, 34:7-13.

Another procedure disclosed by Shin is that the NPDCCH carrying the SC-MCCH control information and the NPDCCH carrying the SC-MTCH control information utilize the existing PRBs used for legacy NB-IoT (i.e., PRBs used for existing NPDCCH procedures). In such a procedure, SC-MCCH control information may also be sent with either DCI format N1 or DCI format N2. Additional actions may be performed to use each format depending on whether the UE is in idle mode or connected mode. In connected mode and sent with DCI format N1, SC-MCCH control information may be distinguished by using CRC masking where different RNTIs are used to differentiate between transmitted in NPDCCH UE-specific search space without frequency shift or unicast interruption since both utilize DCI format N1. In idle mode, the DCI format of the NPDCCH carrying the SC-MCCH control information can still be set to DCI format N1, but additional actions are performed. Idle mode UEs monitor for DCI format N2 using the P-RNTI (Radio Network Temporary Identifier) value, which is used to identify

paging. When SC-PTM specific DCI (i.e. in DCI format N1) is transmitted in the same subframe, it can be decoded as long as the terminal is capable of performing Blind Decoding (“BD”) of additional RNTIs. Such a terminal can obtain the SC-PTM related information by additional monitoring for DCI format N1 by using SC-RNTI or G-RNTI. If a UE is capable of adding additional an additional Blind Decoder (“BD”) then the UE can monitor for the DCI format N1 by using one of two RNTIs (Radio Network Temporary Identifiers): SC-RNTI or G-RNTI. EX-1004, 34-35; EX-1005, 34:46-48; 36:1-38.

Finally, Shin also discloses a procedure by which the NPDCCH, which transmits MCCH control information, may be transmitted through multiple PRBs. These PRBs may be semi-statically selected by the BS. EX-1004, 36; EX-1005, 45:18-27.

2. Detailed Application of Shin to the Challenged Claims

a. Claim 3

i. [3.0] A base station comprising:

To the extent the preamble is limiting, Shin discloses² this claim element. EX-1003 ¶111. Specifically, Shin discloses a **base station** (i.e. BS 10, also referred

² As used throughout this Petition, “discloses” encompasses what a reference would teach, suggest, or render obvious to a POSITA.

to as an E-UTRAN):

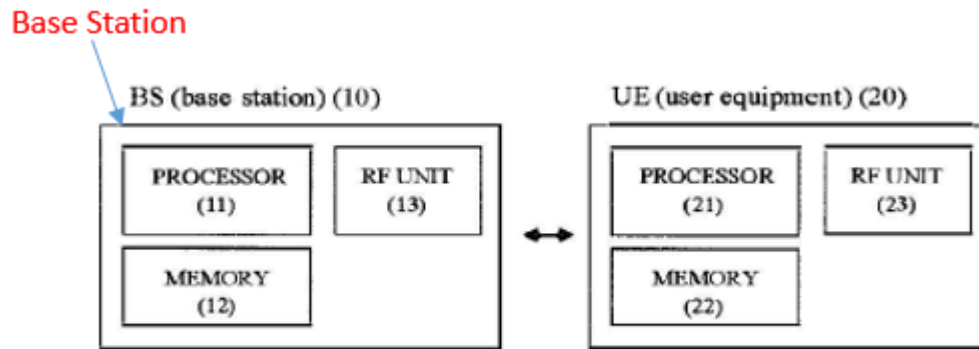


Figure 5. System for implementing present invention

EX-1004, FIG. 5 (annotated); EX-1005, FIG. 15 (a substantially similar figure); EX-1003 ¶111.

Shin further discloses that the base station is configured to implement the disclosed applications:

In Figure 5, a wireless communication system includes a **BS 10** and one or more UE 20. ... A BS 10 may include a processor 11, a memory 12, and a radio frequency (RF) unit 13. The *processor 11 may be configured to implement proposed procedures and/or methods described in this application.*

EX-1004, 17³; EX-1005, 5:55-57; EX-1003 ¶112.

Shin thus discloses limitation [3.0]. EX-1003 ¶113.

³ All emphasis added unless otherwise stated.

- ii. [3.1] transmitting circuitry configured to transmit Single-Cell Multicast Control Channel (SC-MCCH) information; and

Shin discloses this limitation. EX-1003 ¶114. Shin discloses that the base station 10 (base station) includes an RF unit 13 (transmitting circuitry):

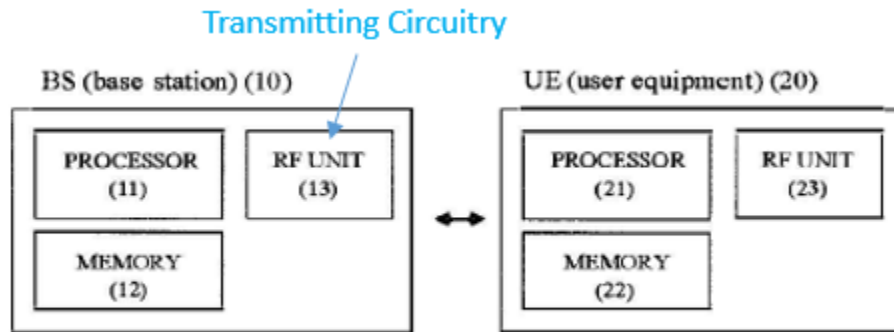


Figure 5. System for implementing present invention

EX-1004, FIG. 5 (annotated), 17-18 (“The RF unit 13 is coupled with the processor 11 and transmits and/or receives a radio signal.”); EX-1005, FIG. 15 (similar figure); EX-1003 ¶114.

Shin discloses transmitting SC-MCCH information:

The SC-MCCH information (i.e. information transmitted in messages sent over SC-MCCH) is transmitted periodically, using a configurable repetition period.

EX-1004, 18; EX-1005, 15:33-39; EX-1003 ¶115.

Shin further discloses transmitting this information from a Base Station (i.e., E-UTRAN):

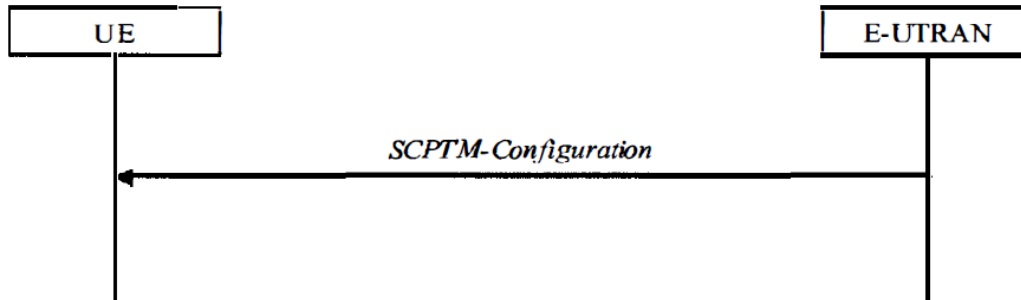


Figure 5.8a.2.1-1: SC-MCCH information acquisition

EX-1004, 22; *see also id.* (“The UE applies the SC-MCCH information acquisition procedure to acquire the SC-PTM control information that is broadcast by the E-UTRAN.”); EX-1005, 16:3-5; EX-1003 ¶116.

Shin accordingly discloses limitation [3.1]. EX-1003 ¶117.

- iii. *[3.2] generating circuitry configured to generate a second downlink control information (DCI) format indicating an SC-MCCH information change notification, wherein*

Shin discloses this limitation. EX-1003 ¶118. Shin discloses [a processor 11 \(generating circuitry\)](#):

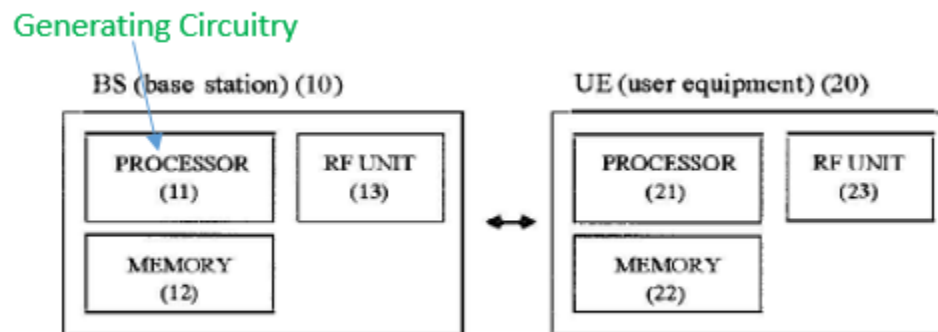


Figure 5. System for implementing present invention

EX-1004, FIG. 5 (annotated), 17 (“The processor 11 may be configured to

implement proposed procedures and/or methods described in this application.”); EX-1005, FIG. 15 (similar figure); EX-1003 ¶118.

Shin further discloses that the processor (*generating circuitry*) of the base station is configured to indicate an SC-MCCH change notification:

When the network changes (some of) the SC-MCCH information, ***it notifies the UEs about the change*** in the first subframe which can be used for SC-MCCH transmission in a repetition period. LSB bit in 8-bit bitmap when set to '1' ***indicates the change in SC-MCCH***.

EX-1004, 22; EX-1005, 15:51-63; EX-1003 ¶119.

Shin further discloses sending this SC-MCCH change notification by generating a DCI format (i.e., DCI Format N1/N2 or a new DCI format):

Furthermore, for both I and II above, the UE may obtain the SC-MCCH change notification information by monitoring a pre-arranged (or preset) common search space (CSS) area in the representative PRB. In this case, the UE may be set to monitor [sic] the aforementioned CSS area using the SC-RNTI value or another pre-arranged RNTI value. ***Further, the DCI format used in this case may be set to use the DCI format N1 or N2 used in the existing NB-IoT....***

EX-1004, at 34; EX-1005, 33:28-40; EX-1003 ¶120.

When using the same PRBs as in other NB-IoT applications, Shin discloses

that DCI format N2 should be used to transmit a SC-MCCH change notification⁴:

In I and II above, *the MCCH changing notification is transmitted in CSS type 1 using DCI format N2*, but it is transmitted once in a very long time, and *since the MCCH changing notification is transmitted to a different SF than the SF from which MCCH control is transmitted*, it can be said that no additional BD problems occur in either connected mode or idle mode.

EX-1004, 36; EX-1005, 42:37-46.

A POSITA understood the advantage of using this format to transmit change notification in a NB-IoT system. EX-1003 ¶122. Because of the lower power requirements of NB-IoT, UEs are often set in idle mode. EX-1003 ¶122.

When MCCH control information changes, a POSITA would understand that a change notification sent as a page with DCI format N2 would allow an idle UE to begin monitoring for the updated SC-MCCH control information. EX-1003 ¶123.

Thus, Shin discloses limitation [3.2]. EX-1003 ¶124.

⁴ Shin is directed to applying legacy transmission methods for MCCH to SC-PTM. A POSITA would thus understand that its reference to MCCH would be applied to SC-MCCH. EX-1003 ¶121.

- iv. ***[3.3] the transmitting circuitry is configured to transmit, in more than one second subframe, the second DCI format carried on a second narrowband physical downlink control channel (NPDCCH),***

Shin discloses this limitation. EX-1003 ¶125. Shin discloses that the RF unit (transmitting circuitry) of the base station is configured to transmit the second DCI format (i.e. DCI format N2) on a NPDCCH:

If a NB-IoT UE detects ***NPDCCH with DCI Format N1 or N2*** ending in subframe n, and if the corresponding NPDSCH transmission starts from n+k, the UE is not required to monitor NPDCCH in any subframe starting from subframe n+1 to subframe n+k-1.

EX-1004, 27; EX-1005, 20:49-54; EX-1003 ¶125.

A POSITA understood that the NPDCCH is the control channel between the BS and the UE, and thus if the UE detects the NPDCCH, the NPDCCH has been transmitted by the BS. EX-1003 ¶126.

Shin further discloses transmitting the second DCI format (e.g., DCI format N2) in more than one subframe. DCI Format N2 includes a “DCI subframe repetition number” which is “2 bits as defined in section 16.6 of [3].” EX-1004, 29; EX-1005, 26:24-25; EX-1003 ¶127. A UE searches for NPDCCH transmissions in NPDCCH search spaces and these NPDCCH transmissions are repeated in several subframes in these search spaces:

An NPDCCH search space $NS_k^{(L',R)}$ at aggregation level $L' \in \{1,2\}$ and repetition level $R \in \{1,2,4,8,16,32,64,128,256,512,1024,2048\}$ is defined by a set of NPDCCH candidates where *each candidate is repeated in a set of R consecutive NB-IoT downlink subframes* excluding subframes used for transmission of SI messages starting with subframe k .

EX-1004, 25; EX-1005, 18:58-64; EX-1003 ¶127.

Therefore, Shin discloses transmitting the DCI in more than one subframe on a NPDCCH. Accordingly, Shin renders obvious limitation [3.3]. EX-1003 ¶128.

- v. ***[3.4] the generating circuitry configured to generate a first DCI format indicating a resource for a transmission of another SC-MCCH information,***

Shin discloses this limitation. EX-1003 ¶129. Shin discloses that the processor (*generating circuitry*) is configured to indicate a resource (*NPDCCH transmitting MCCH control information*) for a transmission of another SC-MCCH information (*SC-MCCH control information*):

First of all, ***N-PDCCH, which transmits control information of MCCH***, and N-PDCCH, which transmits control information of MTCH, may be transmitted in the same PRB, or they may be transmitted through different PRBs.

EX-1004, 31; EX-1005, 29:25-34; EX-1003 ¶129.

Shin discloses that SC-MCCH control information may be sent with either

DCI format N1 or N2:

In addition, the DCI format used in this case can be set to use *the DCI format N1 or N2 used in the existing NB-IoT*, or a new DCI format can be created and used (i.e., DCI format Nm, where m is an integer).

EX-1004, 32; EX-1005, 30:20-24, 31:57-60; EX-1003 ¶130.

When using the legacy NB-IoT PRBs specifically, Shin discloses procedures by which the SC-MCCH control information may be sent with DCI format N1 in both connected mode and idle mode. When a UE is in connected mode, Shin discloses that the SC-MCCH control information may be transmitted using format N1 in a UE-specific search space without requiring any additional BD and without frequency shift or unicast interruption:

[T]he connected mode UE may be distinguished using CRC masking by employing different RNTI values (e.g., unicast: C-RNTI, MCCH: SC-RNTI, MTCH: G-RNTI) for the unicast control DCI and the DCI of the MCCH or the MTCH it was looking at *without any additional BD*. In addition, the *UE will be able to decode MCCH control or MTCH control without frequency shift and without unicast interruption*.

EX-1004, 35; EX-1005, 36:1-15; EX-1003 ¶131.

When a UE is in idle mode, Shin discloses that when a terminal is capable of additional blind decoding (i.e. “BD”), DCI format N1 can be used by monitoring for SC-RNTI or G-RNTI:

The idle mode UEs will monitor the DCI format N2 size using P-RNTI to view the paging that was originally intended to be viewed during the UE DRX cycle. In this case, when SC-PtM (i.e., MCCH or MTCH control) related DCI is transmitted in the same subframe, it is tailored to DCI format N1 size and cannot be decoded without additional BD (i.e., to satisfy the max BD requirement), so it is impossible to obtain SC-PtM related information. However, *if the terminal is capable of performing additional BD, it can obtain SC-PtM related information by additionally monitoring the DCI format N1 size using SC-RNTI or G-RNTI.*

EX-1004, 35: EX-1005, 36:25-38; EX-1003 ¶132.

As mentioned above in VII.A.2.a.iii, when SC-MCCH control information is transmitted using NB-IoT legacy PRBs, Shin discloses that DCI format N2 is used. Shin therefore discloses using a different DCI format to indicate a resource for transmission of SC-MCCH information (i.e. SC-MCCH control information) than to transmit a SC-MCCH change notification.

Shin thus discloses limitation [3.4]. EX-1003 ¶134.

- vi. *[3.5] the transmitting circuitry is configured to transmit, in more than one first subframe, the first DCI format carried on a first NPDDCH⁵,*

Shin discloses this limitation. EX-1003 ¶135. Shin discloses that the RF

⁵ We direct the Board's attention to what is seemingly a typographical error in the

unit (transmitting circuitry) is configured to transmit first DCI format (DCI format N1) on a NPDCCH:

DCI format N1 is used for scheduling of one NPDSCH codeword in one cell and random access procedure initiated by a NPDCCH order.

The DCI corresponding to a NPDCCH order is carried by NPDCCH.

EX-1004, 29; EX-1005, 25:41-43; EX-1003 ¶135.

As with limitation [3.3], Shin discloses that the NPDCCH UE search space is configured to allow a NPDCCH to be transmitted in more than one consecutive subframe. *See* VII.A.2.a.iv; EX-1003 ¶136. Shin further discloses that a change in SC-MCCH modification occurs during a “modification period” in which SC-MCCH information is repeated:

Change of SC-MCCH information only occurs at specific radio frames, i.e. the concept of a modification period is used. ***Within a modification period, the same SC-MCCH information may be transmitted a number of times, as defined by its scheduling (which is based on a repetition period).***

EX-1004, at 22; EX-1005, 25:40-50; EX-1003 ¶136.

In addition to disclosing that SC-MCCH control information can be

claim language. By all apparent context, in claim element 3.5, “NPDDCH” should read “NPDCCH.”

repeated, Shin also discloses that the SC-MCCH control information can be sent in multiple resource blocks (PRBs):

It is possible to consider a method where N-PDCCH transmitting MCCH control information is *transmitted with multiple PRBs* instead of being transmitted with one PRB.

EX-1004, 36; EX-1005, 45:18-27; EX-1003 ¶137.

The entire system bandwidth for an NB-IoT system is limited to one PRB. EX-1004, 31; EX-1003 ¶138. A POSITA therefore understood that multiple PRBs would necessarily correspond to multiple subframes. EX-1003 ¶138.

Shin thus discloses limitation [3.5]. EX-1003 ¶139.

vii. [3.6] a period of the more than one first subframe is different from a period of the more than one second subframe, and

Shin discloses this limitation. EX-1003 ¶140. As mentioned above, Shin discloses that bandwidth in a NB-IoT system is limited to a single PRB.

VII.A.2.a.vi; EX-1003 ¶140. Due to this constraint, it would be necessary to send the period of the more than one first subframe (i.e. the SC-MCCH control information) and the period of the more than one second subframe (i.e. the SC-MCCH change notification) in different subframes as the '764 Patent acknowledges:

However, in the NB-IoT system, in order to reduce costs, the system based on a narrowband design *does not support transmitting a change*

indication and scheduling a new SC-MCCH information transmission in the same subframe. Therefore, when the SC-PTM feature is introduced for the NB-IoT system, a new change notification is needed for the NB-IoT system.

EX-1001, 2:34-40; EX-1003 ¶140.

When SC-MCCH information is sent using legacy NB-IoT PRBs, Shin discloses that the SC-MCCH change notification (i.e. MCCH changing notification) and the SC-MCCH control information (i.e. MCCH control information) must be sent in different subframes (“SFs”):

In I and II above, the MCCH changing notification is transmitted in CSS type 1 using DCI format N2, but it is transmitted once in a very long time, and *since the MCCH changing notification is transmitted to a different SF than the SF from which MCCH control is transmitted*, it can be said that no additional BD problems occur in either connected mode or idle mode.

EX-1004, 36; EX-1005, at 42:37-46.

Shin therefore discloses the period of more than one first subframe is different from the period of more than one second subframe. EX-1003 ¶142.

Thus, Shin discloses limitation [3.6]. EX-1003 ¶143.

viii. [3.7] the transmitting circuitry is configured to transmit the another SC-MCCH information with use of the resource indicated by the first DCI format and in accordance with the second DCI format.

Shin discloses this limitation. EX-1003 ¶144. Shin discloses that SC-MCCH information is transmitted that SC-MCCH information is transmitted with the resource indicated by the first DCI format, and the SC-MCCH information is indicated on PDCCH:

The SC-MCCH information (i.e. information transmitted in messages sent over SC-MCCH) is transmitted periodically, using a configurable repetition period. ***SC-MCCH transmissions (and the associated radio resources and MCS) are indicated on PDCCH.***

EX-1004, 22; 15:33-39; EX-1003 ¶144.

Further, Shin discloses that the data region, which contains SC-MCCH information carried on a PDSCH, immediately follows (and is thus indicated by) a control region which contains the first DCI format carried on a PDCCH (*the SC-MCCH control information*):

For both I and II above, it is common for the N-PDSCH transmitting the MCCH to be transmitted in the same PRB as the PRB in which the N-PDCCH transmitting the control information of the MCCH is transmitted[.]

EX-1004, 33; EX-1005, 32:59-63.

This is illustrated in Figure 3, reproduced below which shows:

[A] maximum of three OFDM symbols located in a front portion of a first slot within a subframe correspond to a control region to be assigned with a control channel. The remaining OFDM symbols correspond to a data region to be assigned with a physical downlink shared channel (PDSCH) Control information transmitted through the PDCCH is referred to as downlink control information (DCI).

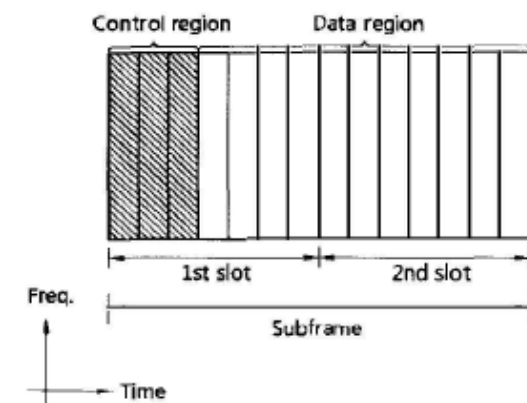


Figure 3. Structure of downlink subframe

EX-1004, 16, FIG. 3; EX-1005, 9:45-64, FIG. 3; EX-1003 ¶146.

A POSITA understood that the purpose of such control information is to indicate the corresponding PDSCH for a transmission (i.e. for transmission of another SC-MCCH information). EX-1003 ¶147. Shin further discloses that upon receiving a SC-MCCH change notification, updated SC-MCCH information is acquired. EX-1004, 22; EX-1005, at 15:58-61; EX-1003 ¶147.

Shin therefore discloses that the SC-MCCH information is transmitted with use of the resource indicated by the first DCI format (i.e., the SC-MCCH control

information) and in accordance with the second DCI format (i.e., the change notification). Therefore, Shin discloses limitation [3.7]. EX-1003 ¶148. Thus, for at least the foregoing reasons, Shin renders obvious claim 3 of the '764 Patent. EX-1003 ¶149.

b. Claim 4

i. [4.0] The base station, according to claim 3, wherein

Shin renders obvious claim 3 for reasons discussed above in VII.A.2.a. EX-1003 ¶150. Thus, Shin renders obvious limitation [4.0]. EX-1003 ¶150.

ii. [4.1] the second DCI format includes a field of multiple bits, and the SC-MCCH information change notification is indicated by the field of the multiple bits, one of the multiple bits indicating that a multimedia broadcast multicast service (MBMS) service is changed.

Shin discloses limitation [4.1]. EX-1003 ¶151. Shin discloses defining a SC-MCCH information change notification with multiple bits, as it discloses that a SC-MCCH change notification may be transmitted using an 8-bit bitmap:

When the network changes (some of) the SC-MCCH information, it notifies the UEs about the change in the first subframe which can be used for SC-MCCH transmission in a repetition period. LSB bit ***in 8-bit bitmap when set to '1' indicates the change in SC-MCCH.***

EX-1004, 22; EX-1005, at 15:51-63; EX-1003 ¶151.

Shin further discloses that the SC-MCCH information includes a temporary mobile group identity (TMGI), which corresponds to an MBMS service:

Subsequently, the UE may obtain SC-MTCH scheduling information (i.e., N-PDSCH scheduling) by monitoring the pre-arranged (or preset) common search space (CSS) area, user-specific search space (USS), or group-specific search space (GSS) in the M-PRB corresponding to the G-RNTI (or a specific G-RNTI group) of the TMGI to be received. In this case, the UE may be set to monitor the aforementioned CSS or USS or GSS area using a G-RNTI value corresponding to the TMGI it wishes to receive or another pre-arranged RNTI value. In addition, the DCI format used in this case can be set to use the DCI format N1 or N2 used in the existing NB-IoT, or a new DCI format can be created and set to be used (i.e., DCI format Nm, where m is an integer). Therefore, by decoding the corresponding N-PDSCH to obtain SC-MTCH information, *the UE can obtain MBMS data.*

EX-1004, 32; EX-1005, 32:45-58; EX-1003 ¶152.

A POSITA understood that the TMGI corresponds to an MBMS services, and thus the bit in the SC-MCCH would indicate a change to the MBMS service.

EX-1003 ¶153.

Shin therefore discloses this limitation. EX-1003 ¶153. Accordingly, for at least the foregoing reasons, Shin renders obvious claim 4 of the '764 Patent. EX-1003 ¶153.

c. **Claim 6**

i. ***[6.0] A method performed by a base station comprising:***

Shin discloses this limitation for the reasons discussed above in limitation [3.0]. VII.A.2.a.i; EX-1003 ¶154.

ii. ***[6.1] transmitting Single-Cell Multicast Control Channel (SC-MCCH) information;***

Shin discloses this limitation for the same reasons as set forth above in limitation [3.1]. VII.A.2.a.ii; EX-1003 ¶155.

iii. ***[6.2] generating a second downlink control information (DCI) format indicating an SC-MCCH information change notification;***

Shin discloses this limitation for the same reasons as set forth above in limitation [3.2]. VII.A.2.a.iii; EX-1003 ¶156.

iv. ***[6.3] transmitting, in more than one second subframe, the second DCI format carried on a second narrowband physical downlink control channel (NPDCCH);***

Shin discloses this limitation for the same reasons as set forth above in limitation [3.3]. VII.A.2.a.iv; EX-1003 ¶157.

v. ***[6.4] generating a first DCI format indicating a resource for a transmission of another SC-MCCH information;***

Shin discloses this limitation for the same reasons as set forth above in

limitation [3.4]. VII.A.2.a.v; EX-1003 ¶158.

- vi. [6.5] transmitting, in more than one first subframe, the first DCI format carried on a first NPDDCH; and*

Shin discloses this limitation for the same reasons as set forth above in limitation [3.5]. VII.A.2.a.vi; EX-1003 ¶159.

- vii. [6.6] transmitting the another SC-MCCH information with use of the resource indicated by the first DCI format and in accordance with the second DCI format, wherein*

Shin discloses this limitation for the same reasons as set forth above in limitation [3.7]. VII.A.2.a.viii; EX-1003 ¶160.

- viii. [6.7] a period of the more than one first subframe is different from a period of the more than one second subframe.*

Shin discloses this limitation for the same reasons as set forth above in limitation [3.6]. VII.A.2.a.vii.; EX-1003 ¶161. Therefore for at least the foregoing reasons, Shin renders obvious claim 6 of the '764 Patent. EX-1003 ¶161.

B. Ground 2: Claims 3, 4, and 6 are unpatentable over Xu, alone, or in view of RAN72 and Fujishiro

Ground 2 is that Xu in view of RAN72 and Fujishiro renders the Challenged Claims obvious.

1. Overview of Xu

Xu discloses a resource configuration method, system and device for a

Single-Cell Multicast Control Channel (“SC-MCCH”). Xu discloses that the method consists of sending a broadcast message containing configuration information of the SC-MCCH configured by a base station. This configuration information can include a modification period of the SC-MCCH, time-domain location information of the SC-MCCH, and at least one of: a repetition period of the SC-MCCH, configuration information of SC-MCCH change notification, and a value tag. EX-1006, Abstract, 3:16-26.

The configuration information of the SC-MCCH change notification can be used for indicating the locations of a radio frame and radio subframe where the SC-MCCH change notification is located. EX-1006, 3:34-41.

FIG. 13, reproduced below, illustrates an embodiment of the disclosed SC-MCCH change notification. EX-1006, 19:51-55.

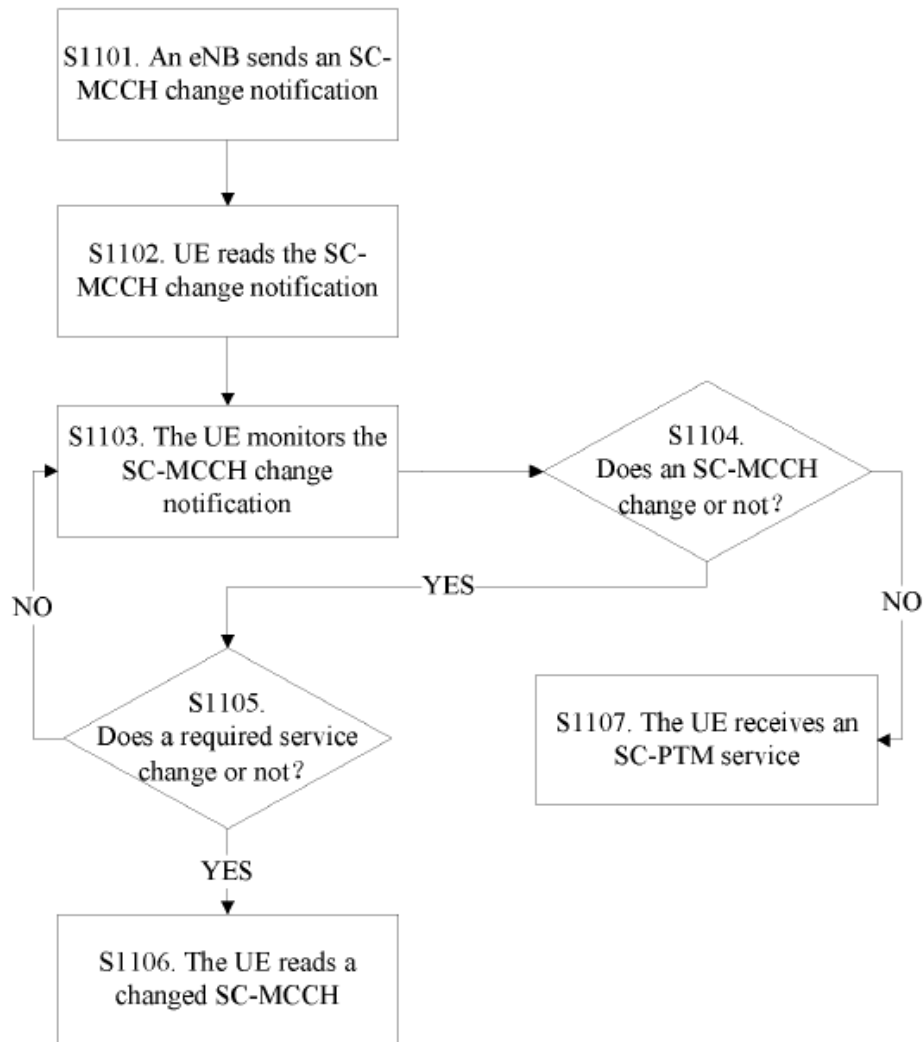


Fig. 13

EX-1006, FIG. 13.

Xu discloses that this SC-MCCH change notification information may be indicated by 1) a value tag or 2) DCI in a PDCCH. When an SC-MCCH change notification information is borne on the DCI in the PDCCH of the time-domain subframe, Xu discloses using DCI format 1-c. The notification message can indicate only if the SC-MCCH changes or not in which case a single bit may be

adopted. The message can also include a second bit to indicate whether a public service or an ordinary service has changed. Xu further discloses that more than two bits may be used to indicate more change information. EX-1006, 16:20-22, 16:51-65.

Xu also discloses that SC-MCCH information may be sent through the PDCCH of the SC-MCCH, and specifically, through DCI in the PDCCH. The DCI used to send the SC-MCCH information may include at least the scheduling information of the SC-MCCH on the frequency domain. EX-1006, 17:15-20.

2. Overview of RAN72

RAN72 includes technical specifications (“TS”) 36.212, 36.213, and 36.331.

a. TS 36.212 v.13.2.0

3GPP TS 36.212 v.13.2.0 (“TS-36.212”) provides the standards for the coding, multiplexing and mapping to physical channels for Evolved Universal Terrestrial Radio Access (E-UTRA). EX-1007, Scope. TS-36.212 discloses encoding and decoding data and control schemes from/to the MAC layer to offer transport and control services over a radio transmission link. EX-1007, Section 5.

Specifically, TS-36.212 defines the standard procedures by which a BS is configured to transmit DCI on a PDCCH. TS-36.212 discloses several DCI formats to use when transmitting information on a PDCCH.

5.3.3	Downlink control information.....	100
5.3.3.1	DCI formats.....	100
5.3.3.1.1	Format 0.....	100
5.3.3.1.2	Format 1.....	102
5.3.3.1.3	Format 1A.....	103
5.3.3.1.3A	Format 1B.....	105
5.3.3.1.4	Format 1C.....	106
5.3.3.1.4A	Format 1D.....	107
5.3.3.1.5	Format 2.....	108
5.3.3.1.5A	Format 2A.....	112
5.3.3.1.5B	Format 2B.....	114
5.3.3.1.5C	Format 2C.....	115
5.3.3.1.5D	Format 2D.....	117
5.3.3.1.6	Format 3.....	118
5.3.3.1.7	Format 3A.....	119
5.3.3.1.8	Format 4.....	119
5.3.3.1.9	Format 5.....	121
5.3.3.1.10	Format 6-0A.....	122
5.3.3.1.11	Format 6-0B.....	122
5.3.3.1.12	Format 6-1A.....	123
5.3.3.1.13	Format 6-1B.....	124
5.3.3.1.14	Format 6-2.....	125

EX-1007, Table of Contents.

TS-36.212 specifies the mapping of downlink control information to a corresponding physical channel as follows:

Table 4.2-2

Control information	Physical Channel
CFI	PCFICH
HI	PHICH
DCI	PDCCH, EPDCCH, MPDCCH

EX-1007, Table 4.2-2.

These DCI formats are comprised of fields of bits, which convey information to a UE. Format 1C is used to schedule notify MCCH change as well as SC-MCCH change. When used for notifying SC-MCCH change, Format 1C uses 8 bits to convey information for a SC-MCCH notification and reserves the remaining bits. EX-1007, Section 5.3.3.1.4.

TS-36.212 also discloses DCI formats specifically designed to carry information in NB-IoT systems. As with non-NB-IoT DCI formats, these formats

are mapped on to their corresponding narrowband physical channels with DCI being mapped onto NPDCCH:

Table 6.1-3

Control information	Physical Channel
UCI	NPUSCH (format 2)
DCI	NPDCCH

EX-1007, Table 6.1-3.

TS-36.212 discloses that DCI Format N1 can be used to schedule a Narrowband Physical Downlink Shared channel (“NPDSCH”) in one cell or a random access procedure initiated by an NPDCCH order. EX-1007, Section 6.4.3.2. The fields in DCI format N1 are defined in Section 6.4.3.2 of the standard. EX-1007, Section 6.4.3.2; EX-1003, ¶102.

TS-36.212 discloses that DCI format N2 can be used for paging or direct indication. EX-1007, Section 6.4.3.3. The fields of DCI Format N2 are defined in Section 6.4.3.3 of the standard. EX-1007, Section 6.4.3.3; EX-1003 ¶103.

b. TS 36.213 v.13.2.0

3GPP TS 36.213 v.13.2.0 (“TS-36.213”) provides the standards for the characteristics of the physical layer procedures in E-UTRA. Specifically, 36.213 specifies procedures for “cell search” where a UE acquires time and frequency synchronization with a cell and detects the narrowband physical layer Cell ID. TS-36.213 discloses the procedure by which a UE receives a NPDCCH. TS-36.213 discloses that a NPDCCH search space is defined by an aggregation level, $L' \in \{1,2\}$,

and a repetition level $R \in \{1,2,4,8,16,32,64,128,256,512,1024,2048\}$. The search space consists of a set of NPDCCH candidates where each candidate is repeated in a set of R consecutive NB-IoT downlink subframes excluding subframes used for SI messages. EX-1008, Scope, Sections 16.1.1, 16.6.

A UE uses this search space definition to receive other channels such as a NPDSCH. Upon detecting a NPDCCH with DCI format N1 or N2 ending in subframe n , the UE can decode the corresponding NPDSCH transmission in N consecutive NB-IoT subframes. n (the last subframe in which the NPDCCH) is transmitted is determined by using the starting subframe of the NPDCCH transmission and the “DCI subframe repetition number” field in the corresponding DCI. N is defined by multiplying the “repetition number” and “resource assignment” fields from the corresponding DCI. EX-1008, Section 16.4.1.

c. TS 36.331 v.13.2.0

3GPP TS 36.331 v.13.2.0 (“TS-36.331”) provides the standards for the Radio Resource Control protocol for the radio interface between UE and Evolved Universal Terrestrial Radio Access Network (E-UTRAN). TS-36.331 discloses the procedure for transmitting SC-PTM control information. SC-PTM control information is carried on a specific logical channel: SC-MCCH. Information that is transmitted in messages sent over SC-MCCH (“SC-MCCH information”) is transmitted periodically using a repetition period. SC-MCCH transmissions are

indicated on PDCCH. EX-1009, Scope, Sections 5.8a.1.1-5.8a.1.2.

TS-36.331 also discloses general procedures for notifying a UE when SC-MCCH information changes. When SC-MCCH information changes, it notifies the UE of the change in the first subframe used for SC-MCCH transmission in a repetition period. In a typical (i.e. non-NB-IoT) change notification, the least significant bit (“LSB”) in a 8-bit bitmap is set to “1” which indicates a change in the SC-MCCH. Upon receiving a change notification, an interested UE acquires the SC-MCCH information starting from the same subframe. EX-1009, Section 5.8a.1.3.

3. Overview of Fujishiro

Fujishiro relates to providing MBMS services via SC-PTM on a reduced bandwidth network such as NB-IoT. Fujishiro discloses transmitting update notification information through direct indication on NPDCCH. Then a UE receives a system information block (i.e. SIB20) which includes scheduling information necessary to acquire a SC-MCCH. Fujishiro discloses that the UE then can then receive SC-PTM configuration information via the SC-MCCH based on the scheduling information sent via the SIB-20. EX-1011 ¶¶6, 92-93; EX-1010, 15, 22; EX-1003 ¶110.

4. Reasons to Combine Xu, RAN72, and Fujishiro

A POSITA understood that because RAN72 sets the standards by which

wireless mobile networks communicate, following the 3GPP standards is necessary for a BS to communicate effectively with UEs. EX-1003 ¶162.

Xu references version 13 of the 3rd Generation Partnership Project Specification. *See* EX-1006, 1:28-30 (“In order to effectively utilize mobile network resources, the 3rd Generation Partnership Project (3GPP) proposes a Multimedia Broadcast/Multicast Services (MBMS).”); 2:36-37 (“The 3GPP proposes a research subject of single-cell MBMS in Release 13 (R13) LTE-Advance (LTE-A).”); EX-1003 ¶163. Xu further makes explicit reference to concepts such as DCI format 1-c, which are defined in RAN72. *See e.g.* EX-1006, 16:51-53; EX-1007, Section 5.3.3.1.4 (defining DCI format 1C). A POSITA would have been motivated to combine Xu and RAN72 for the simple reason of RAN72 disclosing the full specification of the operating environment in which the invention of Xu is to work. EX-1003 ¶163. As such, a POSITA would have thought it obvious to look to RAN72 to understand the operating environment and all of the various DCI formats available to transmit control information between a BS and a UE. EX-1003 ¶163.

A POSITA would further be motivated to combine the teachings of Fujishiro with those of Xu and RAN72. EX-1003 ¶164. Xu and Fujishiro are both directed to the same concept of transmitting MBMS services via SC-PTM. EX-1006, Abstract; EX-1011 ¶6; EX-1003 ¶164. As Xu does not disclose transmitting the

services in an NB-IoT system, it would have been obvious to a POSITA to turn to look to Fujishiro for this purpose given the express mandate from the RAN#69 and #72 meetings. EX-1001, 1:25-50; EX-1003 ¶165. Accordingly, a POSITA looking to address SC-PTM in wireless mobile communication systems disclosed by Xu and 3GPP would have thought it obvious to look for ways to handle NB-IoT communications given that Xu is silent on this issue. EX-1003 ¶166. A POSITA would thus have been motivated to combine the SC-PTM transmission methods described in Xu with the implementation in NB-IoT disclosed by Fujishiro in order to meet this goal. EX-1006, 1:28-30; EX-1003 ¶166.

5. Detailed Application of Xu, RAN72, Fujishiro to the Challenged Claims

a. Claim 3

i. [3.0] A base station comprising:

To the extent the preamble is limiting, Xu discloses this limitation. Specifically, Xu discloses a base station (i.e., base station 42). EX-1003 ¶167.

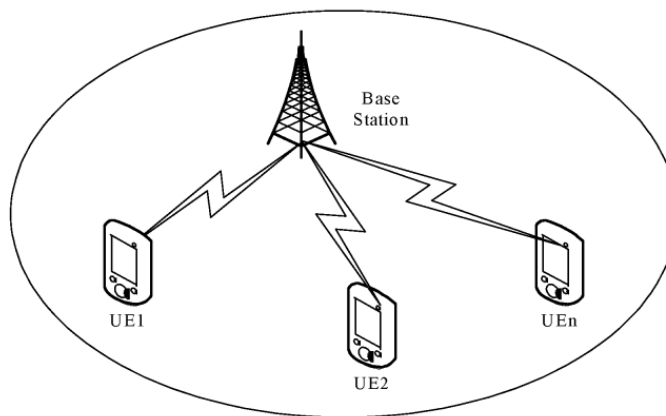


Fig. 1

EX-1006, Fig. 1.

An embodiment provides a resource configuration system for an SC-MCCH. FIG. 5 is a resource configuration system for an SC-MCCH according to an embodiment of the disclosure. As shown in FIG. 5, the system may include a *base station 42* and UE 44.

EX-1006, 10:63-11:9; EX-1003 ¶167.

Xu thus discloses limitation [3.0]. EX-1003 ¶168.

- ii. *[3.1] transmitting circuitry configured to transmit Single-Cell Multicast Control Channel (SC-MCCH) information; and*

Xu discloses this limitation. EX-1003 ¶169. As shown, the BS includes transmitting circuitry (e.g. sending module 52).

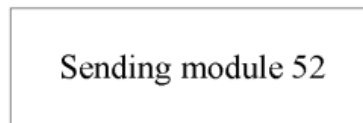


Fig. 6

EX-1006, FIG. 6; EX-1003 ¶169.

Xu discloses “[a] resource configuration method, system and device for a Single-Cell Multicast Control Channel (SC-MCCH).” EX-1006, Abstract. Xu further discloses that the BS may send configuration information of the SC-MCCH:

At act S202, a base station may send a system broadcast message. The system broadcast message may contain configuration information of

the SC-MCCH configured by the base station.

EX-1006, 7:41-50; EX-1003 ¶170.

Xu accordingly discloses limitation [3.1]. EX-1003 ¶171.

iii. [3.2] generating circuitry configured to generate a second downlink control information (DCI) format indicating an SC-MCCH information change notification, wherein

Xu, in view of RAN72 and Fujishiro, renders obvious this limitation. EX-1003 ¶172. Specifically, Xu discloses that “[t]he SC-MCCH change notification information may be indicated by any one of the following methods: 1) a value tag; and 2) **DCI in a PDCCH**.” EX-1006, 16:20-22. Xu further discloses that SC-MCCH may be identified by a first RNTI (Radio Network Temporary Identifier), and a SC-MCCH change notification may be identified by a second RNTI, including an RNTI that is configured to identify a UE or specific use:

In an embodiment of the disclosure, the SC-MCCH may be identified by a first RNTI; and the SC-MCCH change notification may be identified by a second RNTI.

EX-1006, 4:17-20, 8:49-52.

A PDCCH may serve as indication information for parsing PDSCH data...Information transmitted in the PDCCH is called DCI, which may be used for indicating information such as a resource configuration of the PDSCH and an uplink resource grant. A Cyclic Redundancy Check (CRC) at the tail of the PDCCH occupies 16 bit, and may be scrambled

by adopted a specific RNTI. *The RNTI may be configured to identify UE or a specific use.*

EX-1006, 2:41-53; EX-1003 ¶173.

In one example, Xu discloses that, if the DCI is adopted for indicating a change, then a specific RNTI may be used for the SC-MCCH change notification, with the SC-MCCH information being transmitted using a different RNTI:

If the DCI is adopted for indication, a specific RNTI, for example, SM-RNTI=FFFC, may be allocated to the SC-MCCH change notification information at first. Considering that the SC-MCCH is transmitted through a PDSCH and is scheduled through the PDCCH on a frequency domain, it is suggested to pre-allocate an RNTI, for example, SC-MCCH RNTI=FFFB, to the SC-MCCH, which may alternatively be SM-RNTI=FFFB and SC-MCCH RNTI=FFC.

EX-1006, 16:36-43; EX-1003 ¶174.

A POSITA understood that RNTI=FFFC corresponded to the CC-RNTI and RNTI=FFFB corresponded to SC-RNTI. EX-1012 (3GPP TS 36.321), Section 7.1; EX-1003 ¶175. Thus, Xu expressly discloses using different RNTIs for transmitting a SC-MCCH change notification and SC-MCCH. EX-1003 ¶176. Xu further discloses that the SC-MCCH change notification may be transmitted using DCI format 1C, but does not expressly state the DCI that is used to transmit the SC-MCCH. EX-1006, 16:51-53; EX-1003 ¶177. Xu does, however, disclose that the SC-MCCH may be transmitted separately from the SC-MCCH change

notification and may be sent through the DCI of the PDCCH. EX-1006, 17:5-18; EX-1003 ¶178.

Although Xu does not expressly disclose SC-MCCH in NB-IoT, Fujishiro does. EX-1003 ¶179. Fujishiro includes similar disclosures to those of Xu in that Fujishiro discloses receiving a SC-MCCH change notification separately from the SC-MCCH. EX-1003 ¶179. Specifically, Fujishiro discloses receiving a notification that system information has been updated via Direct Indication in the NPDCCH:

In step S2, the UE 100 receives the MPDCCH or the NPDCCH from the eNB 200. Each of the MPDCCH and NPDCCH includes update notification information (Direct Indication) indicating update of system information (SIB: System Information Block). FIGS. 11A and 11B are diagrams illustrating the Direct Indication. FIG. 11A illustrates the Direct Indication in the MPDCCH, and FIG. 11B illustrates the Direct Indication in the NPDCCH.... Here, it is assumed the SIB20 has been updated, and further explanation is provided.

EX-1011 ¶92; EX-1010, 22.

FIG. 11B

BIT	FIELD IN DIRECT INDICATION INFORMATION
1	systemInfoModification
2	systemInfoModification-eDRX
3, 4, 5, 6, 7, 8	NOT USED, AND SHALL BE IGNORED BY UE IF RECEIVED

EX-1011, FIG. 11B; EX-1010, FIG. 11B.

Fujishiro discloses that “[t]he update notification information (Direct Indication) may use an existing format or may define a new format.” EX-1011 ¶102; EX-1010, 24. A POSITA understood that a Direct Indication would be transmitted via DCI format N2, which was used for paging and direct indication. EX-1007, Section 6.4.3.3 (“DCI format N2 is used for for [sic] paging and *direct indication*.”); EX-1003 ¶180.

Similar to Xu, Fujishiro discloses that the SC-MCCH would be transmitted using an SC-RNTI:

In step S4, the UE 100 receives SCTPM setting information (SCPTM Configuration) from the eNB 200 via the SC-MCCH, based on the SIB20. For the SC-MCCH transmission in the physical layer, an SC-RNTI (Single Cell RNTI) is used.

EX-1011 ¶94; EX-1010, 22; EX-1003 ¶181.

It would have been obvious to a POSITA to apply Fujishiro’s method of

transmitting an SC-MCCH change notification in an NB-IoT system to Xu. EX-1003 ¶182. As the '764 Patent acknowledges, the 3GPP RAN #72 plenary meeting held in June 2016 added a new work item to enhance NB-IoT by achieving multicast using existing LTE SC-PTM. EX-1001, 1:40-50; EX-1003 ¶182. A POSITA would thus have been motivated to look beyond the SC-PTM system described by Xu to applications of SC-PTM in NB-IoT such as the one described by Fujishiro. EX-1003 ¶182. Applying Fujishiro's transmission of SC-MCCH change notification in NB-IoT systems to Xu would therefore have been obvious to a POSITA. EX-1003 ¶182.

Thus Xu, in view of RAN72 and Fujishiro, renders obvious limitation [3.2]. EX-1003 ¶183.

- iv. [3.3] the transmitting circuitry is configured to transmit, in more than one second subframe, the second DCI format carried on a second narrowband physical downlink control channel (NPDCCH),*

Xu in view of RAN72 and Fujishiro renders obvious this limitation. EX-1003 ¶184. As discussed above, Xu and RAN72 disclose that a base station includes transmitting circuitry (e.g., sending module) and generating circuitry that is configured to generate multiple DCI formats, including the three narrowband DCI formats N0, N1, and N2. VII.B.5.a.ii-VII.B.5.a.iii; EX-1003 ¶184. A POSITA understood the transmitting circuitry to be capable of transmitting the

generated DCI formats. EX-1003 ¶184.

RAN72 discloses that the DCI, which would be in of the three DCI formats N0, N1, and N2, is transmitted via the NPDCCH physical channel:

Table 6.1-3

Control information	Physical Channel
UCI	NPUSCH (format 2)
DCI	NPDCCH

EX-1007, Table 6.1-3; EX-1003 ¶185.

Accordingly, a POSITA understood that the base station transmitter (e.g., sending module) would have been configured to transmit the second DCI format, i.e., DCI format N2 used to transmit the update notification information via Direct Indication as taught by Xu, RAN72, and Fujishiro, to be transmitted on a second NPDCCH. EX-1003 ¶186.

In view of the teachings of Xu and 3GPP, a POSITA understood the transmission of the second DCI format (e.g., DCI format N2) to have been transmitted in more than one second subframe. EX-1003 ¶187. For example, Xu discloses that the SC-MCCH change notification may be indicated in the configuration information of the SC-MCCH and include a subframe location and repetition frequency:

If the DCI is adopted for indication, a specific RNTI, for example, SM-RNTI=FFFC, may be allocated to the SC-MCCH change notification information at first.... The time-domain location information, for example, a time-domain frame location and *a*

subframe index, for sending of the SC-MCCH change notification information and a notification information repetition frequency in one MP of the SC-MCCH may be indicated in the configuration information of the SC-MCCH change notification information on the system broadcast system.

EX-1006, 16:36-50; *see also id.*, 18:17-25; EX-1003 ¶187.

RAN72 disclose transmitting the second DCI format (i.e. DCI format N2) in more than one subframe. DCI Format N2 includes a “DCI subframe repetition number” which is “3 bits as defined in section 16.6 of [3GPP TS 36.213].” EX-1007, Section 6.4.3.3; EX-1003 ¶188. Section 16.6 of 36.213, referenced by TS-36.212 discloses how a UE searches for NPDCCH transmissions:

An NPDCCH search space $NS_k^{(L',R)}$ at aggregation level $L' \in \{1,2\}$ and repetition level $R \in \{1,2,4,8,16,32,64,128,256,512,1024,2048\}$ is defined by a set of NPDCCH candidates where *each candidate is repeated in a set of R consecutive NB-IoT downlink subframes* excluding subframes used for transmission of SI messages starting with subframe k .

EX-1008, Section 16.6; EX-1003 ¶188.

Therefore, Xu and RAN72 disclose transmitting the second DCI format in more than one subframe. Accordingly, Xu in view of RAN72 and Fujishiro renders obvious limitation [3.3]. EX-1003 ¶190.

- v. ***[3.4] the generating circuitry configured to generate a first DCI format indicating a resource for a transmission of another SC-MCCH information,***

Xu in view of RAN72 renders obvious this limitation. EX-1003 ¶191. As discussed above, TS-36.212 discloses that a base station should be capable of transmitting multiple DCI formats (e.g., formats 0, 1, 1A, 1B, 1C, 1D, 2, 2A, 2B, 2C, 2D, 3, 3A, 4, 6-0A, 6-0B, 6-1A, 6-1B, and 6-2), including several DCI formats for NB-IoT (e.g., formats N0, N1, and N2). VII.B.5.a.iii; EX-1003 ¶191. Thus, the generating circuitry disclosed by Xu would have been configured to generate a first DCI format (e.g., a DCI format distinct from the second DCI format). EX-1003 ¶191.

Xu discloses indicating a resource for a transmission of another SC-MCCH information:

By the act, the base station ***may send the system broadcast message containing the configuration information of the SC-MCCH configured by the base station,*** that is, ***the base station may configure the configuration information of the SC-MCCH in the system broadcast message.***

EX-1006, 14:4-11; EX-1003 ¶192.

Xu further discloses sending this information through a DCI carried on a PDCCH:

Frequency-domain scheduling information of the SC-MCCH may be sent *through the PDCCH of the corresponding subframe*, and specifically, may be sent *through the DCI in the PDCCH*.

EX-1006, 17:15-18; EX-1003 ¶193.

When the teachings of Xu (and RAN72) are combined with those of Fujishiro, a POSITA understood that the another SC-MCCH information would have been transmitted using a first DCI format, such as DCI format N1. EX-1003 ¶194. As discussed above, Fujishiro discloses that the SC-MCCH is transmitted in an SC-RNTI, as opposed to the format used for Direct Indication (e.g., Format N2):

In step S4, the UE 100 receives SCTPM setting information (SCPTM Configuration) from the eNB 200 via the SC-MCCH, based on the SIB20. For the SC-MCCH transmission in the physical layer, an SC-RNTI (Single Cell RNTI) is used.

EX-1011 ¶94; EX-1010, 22; EX-1003 ¶194.

A POSITA understood that the SC-MCCH information was sent using DCI Format N1 using SC-RNTI. *See* EX-1007, Section 6.4.3.2 (“DCI format N1 is used for the scheduling of one NPDSCH codeword in one cell and random access procedure initiated by a NPDCCH order.”); EX-1003 ¶195.

Thus, Xu in view of RAN72 and Fujishiro renders obvious limitation [3.4]. EX-1003 ¶196.

- vi. *[3.5] the transmitting circuitry is configured to transmit, in more than one first subframe, the first DCI format carried on a first NPDDCH,*

Xu in view of RAN72 and Fujishiro renders obvious this limitation. EX-1003 ¶197. As discussed above, Xu and RAN72 disclose that a base station includes transmitting circuitry (e.g., sending module) and generating circuitry that is configured to generate multiple DCI formats, including the three narrowband DCI formats N0, N1, and N2. VII.B.5.a.ii-VII.B.5.a.iii, VII.B.5.a.v; EX-1003 ¶197.

Also discussed above, Xu and RAN72 disclose transmitting DCI in multiple subframes. EX-1003 ¶198. For example, Xu discloses that the SC-MCCH information may be transmitted during a modification period (MP), which may be repeatedly transmitted in a repetition period (RP). EX-1006, 11:26-32; EX-1003 ¶198. Xu's disclosure is consistent with RAN72, which discloses that the NPDCCH UE search space is configured to allow a NPDCCH to be transmitted in more than one consecutive subframe. *See* VII.B.5.a.iv; EX-1003 ¶199. RAN72 further discloses that a change in SC-MCCH modification occurs during a “modification period” where SC-MCCH information is repeated:

Change of SC-MCCH information only occurs at specific radio frames, i.e. the concept of a modification period is used. *Within a modification period, the same SC-MCCH information may be transmitted a number of times, as defined by its scheduling (which is based on a*

repetition period).

EX-1009, Section 5.8a.1.3; EX-1003 ¶199.

Accordingly, a POSITA would have understood that the transmitting circuitry of the base station (e.g., sending module), is configured to transmit the first DCI format (e.g., DCI format N2) in more than one first subframe on a first NPDCCH. EX-1003 ¶200.

Xu in view of RAN72 and Fujishiro thus renders obvious limitation [3.5].
EX-1003 ¶201.

vii. [3.6] a period of the more than one first subframe is different from a period of the more than one second subframe, and

Xu in view of RAN72 and Fujishiro renders obvious this limitation. EX-1003 ¶202. For a change notification of MCCH information, both Xu and RAN72 disclose the use of a modification period:

In the embodiment of the disclosure, *the MP may be used for indicating a period of modification of the SC-MCCH*. The RP may be used for indicating a period of repeated sending of the SC-MCCH in one MP. The time-domain location information of the SC-MCCH may be used for indicating locations of a radio frame and radio subframe where the SC-MCCH is located. The MCS may be an MCS of the radio subframe where the SC-MCCH is located.

EX-1006, 11:26-40.

Change of MCCH information only occurs at specific radio frames, i.e. ***the concept of a modification period is used***. Within a modification period, the same MCCH information may be transmitted a number of times, as defined by its scheduling (which is based on a repetition period).

EX-1009, Section 5.8.1.3; EX-1003 ¶202.

When a MCCH change notification is sent, RAN72 also discloses that the change notification is transmitted in a separate modification period from the updated MCCH information:

When the network changes (some of) the MCCH information, it notifies the UEs about the change ***during a first modification period***. ***In the next modification period, the network transmits the updated MCCH information***. These general principles are illustrated in figure 5.8.1.3-1, in which different colours indicate different MCCH information.

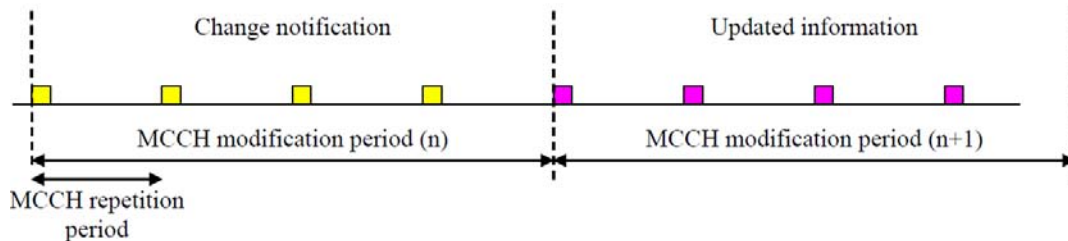


Figure 5.8.1.3-1: Change of MCCH Information

EX-1009, Section 5.8.1.3, Figure 5.8.1.3-1; EX-1003 ¶203.

As mentioned above, RAN72 discloses using a similar modification period for a change in SC-MCCH information. VII.B.5.a.iv; EX-1003 ¶204. For non-NB-IoT systems RAN72 discloses transmitting the SC-MCCH change notification

in the same subframe as the updated SC-MCCH information:

When the network changes (some of) the SC-MCCH information, it notifies the UEs about the change in the first subframe which can be used for SC-MCCH transmission in a repetition period. LSB bit in 8-bit bitmap when set to '1' indicates the change in SC-MCCH. Upon receiving a change notification, a UE interested to receive MBMS services transmitted using SC-PTM acquires the new SC-MCCH information starting from the same subframe.

EX-1009, Section 5.8a.1.3; EX-1003 ¶204.

However, the '764 Patent explains that in an NB-IoT system, this procedure is not feasible:

However, in the NB-IoT system, in order to reduce costs, the system based on a narrowband design *does not support transmitting a change indication and scheduling a new SC-MCCH information transmission in the same subframe*. Therefore, when the SC-PTM feature is introduced for the NB-IoT system, a new change notification is needed for the NB-IoT system.

EX-1001, 2:34-40; EX-1003 ¶205.

Thus, in an NB-IoT system, DCI indicating an SC-MCCH change notification *must* be transmitted in a different subframe from the DCI indicating a resource for the updated SC-MCCH information. A POSITA would thus have understood that the subframes carrying the change notification and the subframes carrying the scheduling of a new SC-MCCH resource would need to be different.

EX-1003 ¶206. It would thus have been obvious to a POSITA to turn to the solution disclosed by RAN72 for a MCCH change notification. EX-1003 ¶206. It would have been obvious for a POSITA to transmit the change notification (i.e. through DCI format N1) in a first set of subframes (i.e., a first modification period) and then transmit information indicating a resource for the SC-MCCH information (i.e. through DCI format N2) in a subsequent and distinct set of subframes (i.e., a second modification period). EX-1003 ¶206.

Thus, Xu in view of RAN72 renders obvious limitation [3.6]. EX-1003 ¶207.

viii. [3.7] the transmitting circuitry is configured to transmit the another SC-MCCH information with use of the resource indicated by the first DCI format and in accordance with the second DCI format.

Xu in view of RAN72 renders obvious this limitation. EX-1003 ¶208. Xu discloses transmitting SC-MCCH configuration information through DCI and carried on a PDCCH. Specifically, Xu discloses:

Frequency-domain scheduling information of the SC-MCCH may be sent through the PDCCH of the corresponding subframe, and specifically, may be sent through the DCI in the PDCCH.

The DCI may at least include: scheduling information of the SC-MCCH on the frequency domain.

EX-1006, 17:15-24.

Further, Xu discloses that the SC-MCCH information is acquired as a result of the change notification. Figure 12, reproduced below, illustrates that after a change notification is sent, a UE receives the changed SC-MCCH information:

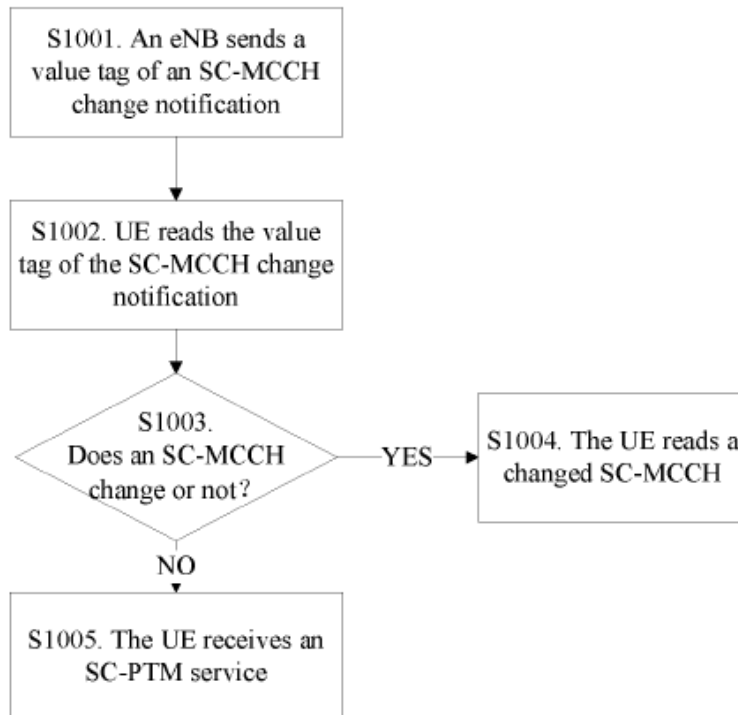


Fig. 12

EX-1006, FIG. 12; EX-1003 ¶209.

RAN72 similarly discloses that updated SC-MCCH information is transmitted after a change notification:

Upon receiving a change notification, a UE interested to receive MBMS services transmitted using SC-PTM acquires the new SC-MCCH information starting from the same subframe.

EX-1009, Section 5.8a.1.3; EX-1003 ¶210.

Therefore, Xu in view of RAN72 renders obvious limitation [3.7]. EX-1003 ¶211. Thus, for at least the foregoing reasons, Xu in view of RAN72 and Fujishiro renders obvious claim 3 of the '764 Patent. EX-1003 ¶212.

b. Claim 4

i. [4.0] The base station, according to claim 3, wherein

Xu in view of RAN72 and Fujishiro renders obvious claim 3 for the same reasons set forth above in VII.B.5.a. EX-1003 ¶213. Thus, Xu in view of RAN72, renders obvious limitation [4.0]. EX-1003 ¶213.

ii. [4.1] the second DCI format includes a field of multiple bits, and the SC-MCCH information change notification is indicated by the field of the multiple bits, one of the multiple bits indicating that a multimedia broadcast multicast service (MBMS) service is changed.

Xu in view of RAN72 and Fujishiro renders obvious limitation [4.1]. EX-1003 ¶214. Xu discloses utilizing multiple bits in a SC-MCCH change notification and using one of the multiple bits to indicate that a MBMS service has changed:

SC-MCCH change notification information may indicate more service related information by ***adopting two or more bits***. That is, ***a service type may be indicated in DCI***, and for example, two bits N are adopted for indication wherein N1 may indicate whether the SC-MCCH changes or not, and ***N2 may indicate a changing service type***, for example, N2=1

may indicate that a PS service changes, and N2=0 may indicate that an ordinary service changes. Furthermore, more than two bits in the DCI may be adopted to indicate more change information.

EX-1006, 20:9-19; EX-1003 ¶214.

Thus, Xu discloses this limitation. EX-1003 ¶215. Accordingly, for at least the foregoing reasons, Xu in view of RAN72 and Fujishiro renders obvious claim 4 of the '764 Patent. EX-1003 ¶216.

c. Claim 6

i. [6.0] A method performed by a base station comprising:

Xu discloses this limitation for the same reasons as set forth above in limitation [3.0]. VII.B.5.a.i; EX-1003 ¶217.

ii. [6.1] transmitting Single-Cell Multicast Control Channel (SC-MCCH) information;

Xu discloses this limitation for the same reasons as set forth above in limitation [3.1]. VII.B.5.a.ii; EX-1003 ¶218.

iii. [6.2] generating a second downlink control information (DCI) format indicating an SC-MCCH information change notification;

Xu, in view of RAN72, renders obvious this limitation for the same reasons as set forth above in limitation [3.2]. VII.B.5.a.iii; EX-1003 ¶219.

- iv. [6.3] transmitting, in more than one second subframe, the second DCI format carried on a second narrowband physical downlink control channel (NPDCCH);***

Xu, in view of RAN72, renders obvious this limitation for the same reasons as set forth above in limitation [3.3]. VII.B.5.a.iv; EX-1003 ¶220.

- v. [6.4] generating a first DCI format indicating a resource for a transmission of another SC-MCCH information;***

Xu, in view of RAN72, renders obvious this limitation for the same reasons as set forth above in limitation [3.4]. VII.B.5.a.v; EX-1003 ¶221.

- vi. [6.5] transmitting, in more than one first subframe, the first DCI format carried on a first NPDDCH; and***

Xu, in view of RAN72, renders obvious this limitation for the same reasons as set forth above in limitation [3.5]. VII.B.5.a.vi; EX-1003 ¶222.

- vii. [6.6] transmitting the another SC-MCCH information with use of the resource indicated by the first DCI format and in accordance with the second DCI format, wherein***

Xu, in view of RAN72, renders obvious this limitation for the same reasons as set forth above in limitation [3.7]. VII.B.5.a.viii; EX-1003 ¶223.

viii. [6.7] a period of the more than one first subframe is different from a period of the more than one second subframe.

Xu, in view of RAN72, renders obvious this limitation for the same reasons as set forth above in limitation [3.6]. VII.B.5.a.vii; EX-1003 ¶224. Therefore for at least the foregoing reasons, Xu in view of RAN72 renders obvious claim 6 of the '764 Patent. EX-1003 ¶224.

VIII. THE BOARD SHOULD NOT EXERCISE ITS DISCRETION AND DENY INSTITUTION

A. The Board Should Not Deny Institution Under 35 U.S.C. § 325(d)

When determining whether to exercise discretion under § 325(d), “the Board uses the following two-part framework: (1) whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented to the Office; and (2) if either condition of first part of the framework is satisfied, whether the petitioner has demonstrated that the Office erred in a manner material to the patentability of the challenged claims.” *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6, p. 8 (Feb. 13, 2020) (designated: March 24, 2020).

For Ground 1, Petitioners rely on Shin '094, which published in U.S. Pat. Pub. No. 2019/0174510 and is on the face of the '764 Patent, but was not applied by the examiner. Instead, the examiner cited an application that published as U.S.

Pat. App. Pub. No. 2019/0223197 and is related to Shin '094. Specifically, the examiner applied portions of the '324 Provisional written in English in rejecting as disclosing several elements of Claims 45-48 when rejecting the claims. In fact, the examiner only cited pages 10 to 13 of '324 Provisional, all of which were originally in English and only included excerpts from TS-36.213 and TS-36.331. EX-1002, 175-78.

The applicant overcame the rejections based on the '324 Provisional by amending the claims to recite multiple DCI formats and to be carried in different subframes and arguing that the '324 Provisional fails to disclose the feature of “more than one second subframe.” EX-1002, 209-13. Applicant also added Claims 49 and 50 (directed to these features). EX-1002, 211. The examiner allowed the claim in response the amendments and argument.

The present Petition relies on disclosures in the '323 Provisional that are not included in the '324 Provisional considered by the examiner. Specifically, Petitioners cite to portions of the '323 Provisional that are written in Korean and were never applied by the Office. Importantly, the '323 Provisional discloses the features that the applicant argued were missing from the '324 Provisional and were the basis for allowing the claims. Specifically, the '323 Provisional expressly discloses that the subframes carrying the first DCI format are different from the subframes carrying the second DCI format:

The MCCH changing notification is transmitted to a different SF [system frame] than the SF from which MCCH control is transmitted.

EX-1004, 24; VII.A.2.a.vii.

As discussed above, the '323 Provisional discloses applying SC-PTM to a NB-IoT system. Thus, under *Advanced Bionics*, the '323 Provisional is not substantially the same as the '324 Provisional, at least as cited by the examiner, and the arguments recited in the Petition are not substantially the same as the arguments presented during prosecution. To the extent that the Patent Owner asserts that the argument and art are substantially the same, the examiner erred by not considering the disclosure of the '323 Provisional, which discloses that the subframes carrying the first DCI format are different from the subframes carrying the second DCI format. *See* VII.A.2.vii, *supra*; EX-1003 ¶142. In other words, the examiner made a mistake by accepting Patent Owner's argument that Shin does not disclose transmitting the SC-MCCH change notification and SC-MCCH information in different subframes. *See Keysight Technologies v. Centripetal Networks*, IPR2022-01421, Paper 14 at 8 (P.T.A.B. August 24, 2023).

For Ground 2, the examiner did not consider the Xu reference used in the analysis above. The Office did consider Fujishiro, but only as a secondary reference in combination with the '324 Provisional. It is also unclear if the examiner considered the English translation of Fujishiro 919. Further, Fujishiro

was relied on in the prosecution only to disclose SC-MCCH information which included a SC-MCCH change notification:

Further, Fujishiro also discloses SC-MCCH information including (a) SC-MCCH information change notification indication and period, and (b) other information based on SC-MCCH change and radio resource and MCS information[.]

EX-1002, 178.

While portions of RAN72 (i.e., TS-36.212), were cited during prosecution, they were not explicitly relied on by the examiner in the rejection. EX-1002, at 171-181.

In this Petition, Fujishiro and RAN72 are used as secondary references in combination with Xu. This combination represents a substantially different combination of prior art with substantially different arguments than was considered by the Examiner.

Thus, the Board should not deny institution under § 325(d).

B. The Board Should Not Deny Institution Under 35 U.S.C. § 314(a)

Related to the Director's June 2022 interim guidance regarding application of the *Fintiv* factors⁶, (1) the Petition is particularly strong in the underlying merits,

⁶ Interim Procedure For Discretionary Denials In AIA Post Grant Proceedings With Parallel District Court Litigation, PTO Director's Memorandum (June 21,

and (2) Petitioners will not pursue in the Related Litigations any ground raised in this IPR. Thus, under the Interim Guidance, the Board should not deny institution.

Nevertheless, the Board’s decision in *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 (Dec. 1, 2020) instructs that a holistic view of the remaining *Fintiv* factors also weighs in favor of institution.

Factor 1 is neutral because no request for stay has been filed.

Under factor 2, the earliest scheduled trial date is March 17, 2025. A Final Written Decision is expected in the present matter around November of 2025. Considering the inherent uncertainties of litigation scheduling, this factor is neutral. Because much can change, the current trial date does not support denial. *See Dish Network v. Broadband iTV*, IPR2020-01280, Paper 17 at 16 (PTAB Feb. 4, 2021) (“We cannot ignore the fact that the currently scheduled trial date is more than nine months away and much can change during this time”).

Factor 3 favors institution. The earliest *Markman* hearing is scheduled for October 1, 2024, and the other *Markman* hearing is scheduling for March 11, 2025, which is after the time of the projected institution date. Fact discovery closes on October 11, 2024 and April 18, 2025, and expert discovery closes on December 4, 2024 and June 10, 2025. Thus, the Related Litigations are in their early stages, and

2022).

the investment in them has been minimal at this time. The district court likely will not invest significant resources or issue substantive orders related to the challenged patent prior to the issuance of an institution decision.

Under factor 4, there will not be complete overlap in the issues raised in the IPR and the Related Litigations and this favors institution. Petitioners stipulate that they will not pursue invalidity against the asserted claims in the district court using the specific combination of prior art references set forth in the grounds presented in this Petition for purposes of establishing obviousness. *See Sand Revolution II LLC v. Continental Intermodal Group-Trucking LLC*, IPR2019-01393, Paper 24 at 11-12 (PTAB June 16, 2020) (holding a similar stipulation weighs against discretionary denial).

Under factor 5, Petitioners are Defendants/Intervenors in the Related Litigations. This factor is neutral as it is “far from an unusual circumstance that a petitioner in inter partes review and a defendant in a parallel district court proceeding are the same.” *Sand*, No. IPR2019-01393, Paper 24, at 12-13.

To the extent that the Board finds Factors 1-5 favor discretionary denial, under factor 6, other circumstances weigh in favor of institution. Here, the merits of the Petition are strong. For example, Shin is directed at the same problem and discloses identical communications and the identical concepts disclosed in the ’764 Patent, demonstrating that the Petition is particularly strong in the underlying

merits. Specifically, Shin discloses the features that Patent Owner added during prosecution to get the claims allowed. This evidence, if unrebutted, shows that it is highly likely that the petitioners would succeed in demonstrating the unpatentability of at least one claim.

When viewed holistically, the timing of the present Petition is reasonable, there has been limited investment in the Related Litigations, and there is minimal overlap between the present IPR and the Related Litigations. Coupling these *Fintiv* considerations with the compelling evidence of unpatentability presented in the Petition, the efficiency and integrity of the IPR process is best served by instituting review.

IX. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8

A. Real Party-in-Interest (37 C.F.R. § 42.8(b)(1))

The real party-in-interest in this Petition is Ericsson Inc., corporate parent Telefonaktiebolaget LM Ericsson, and Nokia of America Corporation. No other parties have directed, funded, or controlled the filing of this IPR, and this IPR was not filed at the behest of any other party.

To avoid additional issues associated with real parties in interest, Petitioners likewise identify T-Mobile USA, Inc., AT&T Services Inc., AT&T Mobility LLC, AT&T Corporation, and Cellco Partnership d/b/a Verizon Wireless because Petitioners' products provided to these entities have been accused of infringement

in the Related Matters identified below.

B. Related Matters (37 C.F.R. § 42.8(b)(2))

1. Judicial Matters

As of the filing date of this Petition and to the best knowledge of Petitioners, the '764 Patent is involved in the following litigations:

- *Active Wireless Technologies LLC v. Verizon Communications Inc. et al.*, U.S.D.C. EDTX Case No. 2:23-cv-00620-JRG-RSP;
- *Active Wireless Technologies LLC v. T-Mobile USA, Inc. et al.*, U.S.D.C. EDTX Case No. 2:23-cv-00261-JRG-RSP.

These are referenced collectively herein as the “Related Litigation(s).”

2. Administrative Matters:

As of the filing date of this Petition and to the best knowledge of Petitioners, the '764 Patent was not subject to any administrative matters.

C. Related Patents

Petitioners are unaware of any related patents.

D. Lead/Back-up Counsel (37 C.F.R. § 42.8(b)(3)):

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E. Notice of Service Information (37 C.F.R. § 42.8(b)(4)):

Please direct all correspondence to lead and back-up counsel at the above addresses. Petitioners consent to electronic service at the email addresses above.

X. CONCLUSION

Petitioners request the Board institute *inter partes* review and find the Challenged Claims unpatentable.

Respectfully submitted,

DUANE MORRIS LLP

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Dated: June 4, 2024

CERTIFICATION OF SERVICE ON PATENT OWNER

Pursuant to 37 C.F.R. §§ 42.6(e), 42.8(b)(4) and 42.105, the undersigned certifies that on the 4th of June, 2024, a complete and entire copy of this Petition for *Inter Partes* Review of U.S. Patent No. 10,785,764 and all supporting exhibits were served via email and/or electronic download by agreement of Patent Owner, to the following address:

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ATTORNEY FOR PETITIONERS

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24 *et seq.*, the undersigned certifies that this document complies with the type-volume limitations. This document contains 13,484 words as calculated by the “Word Count” feature of Microsoft Word 2010, the word processing program used to create it. In addition, there were 6 words added to the annotated Figures herein as counted manually.

Dated: June 4, 2024

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