BEFORE THE CANADIAN RADIO-TELEVISION

AND TELECOMMUNICATIONS COMMISSION

IN THE MATTER OF

AN APPLICATION BY TNW WIRELESS INC.

(APPLICANT)

PURSUANT TO THE PART 1 OF THE *CANADIAN RADIO-TELEVISION AND TELECOMMUNICATIONS COMMISSION* RULES OF PRACTICE AND PROCEDURE AND SECTIONS 24, 25, 32, 47, 55, AND 61 OF THE *TELECOMMUNCIAIONS ACT*

DIRECTED TO

BELL MOBILITY INC.

AND

TELUS COMMUNICATIONS COMPANY

(RESPONDENTS)

RELATING TO BELL MOBILITY INC. AND TELUS COMMUNICATIONS COMPANY REFUSAL TO PROVIDE TNW WIRELESS INC. WITH MANDATORY WHOLESALE ROAMING AGREEMENTS REQUIRED UNDER TELECOM REGULATORY POLICY CRTC 2015-177 AND AS SPECIFIED IN THEIR CARRIER ACCESS TARIFFS, CRTC 15011 ITEM 100 AND CRTC 21642, ITEM 233 RESPECTIVELY

RESPONSE TO REQUEST FOR INFORMATION OF JULY 13, 2018

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 The Response and the Confidentiality Claim

1. This response along with accompanying documentation is being submitted in response to a Request for Information received by TNW Wireless Inc. ("TNW") dated July 13, 2018 in relation to TNW's Part 1 Application of July 3, 2017, Canadian Radio-television and Telecommunications Commission ("CRTC" or the "Commission") reference 8620-R63-201705675.

   This response forms part of the collective submission to the Commission:

   - July 3, 2017 – Initial Part 1 submission
   - August 14, 2017 – Reply to Answers
   - August 21, 2017 – Reply to Procedural Request
   - April 13, 2018 – Response to Procedural Letter of March 23, 2018
   - May 14, 2018 – Reply to Answers

2. This response is being provided as two documents; responses to questions 1-11 which are being provided to the Commission on a confidential basis and responses to questions 12-15 which are being provided on a non-confidential basis.

2.0 Responses to Commission Questions of July 13, 2018

2.1 Questions 1-11

3. TNW is providing responses to questions1-11 under separate cover and provided to the Commission on a confidential basis. The company is of the view that this information is either company confidential in nature, or involves information and/or correspondence about or with third parties covered under confidentiality agreements.

2.2 Preamble to Technical Questions 12-15

As a preamble to questions 12-14, we would like to provide more detailed and specific technical information on iPCS to provide context for the answers requested by the Commission which follow. While some this information may have been provided in previous submissions in one form or another, this level of detail is provided here relates more directly to the Commission's technical questions and the rationale for the technology.

It is obvious but nevertheless important to understand that over the last 25 or so years, there have been a significant number of technological changes, upgrades, reconfigurations to wireless hardware and software. Each change and/or upgrade has been based on proprietary technology generally requiring sizable capital investments by service providers.

Generally this has not changed in the current environment however more options are becoming available in the digital world for IMS (IP Media Subsystem) clients where such clients are embedded into certain phones as well as certain specific mobile phone operating system versions (iOS, Android). Often referred to as "Wi-Fi calling" subscribers can enable this feature on their phones when available from their service provider. The UICC card containing the mobile SIM of service provider has an area in its memory specifically configured for this feature including the SIP information used when on Wi-Fi. As such a smartphone in airplane mode with Wi-Fi and Wi-Fi calling enabled and configured to point to a service provider's core network for voice and SMS, essentially becomes a VoIP device with calls being sent/received all over IP and therefor by definition, extending the Home Public Mobile Network.

All this being said, this is still a fairly expensive proprietary option for service providers and requires upgrades as respective systems evolve In addition this is only available on certain specific smartphones. iPCS using Wi-Node is a simple, less expensive and more open source solution which can work on any system and almost any iOS and Android-based smartphone with a fairly smooth integration process.

An overview of the iPCS Wi-Node is provided below. A high resolutions version is provided in **Appendix A**.

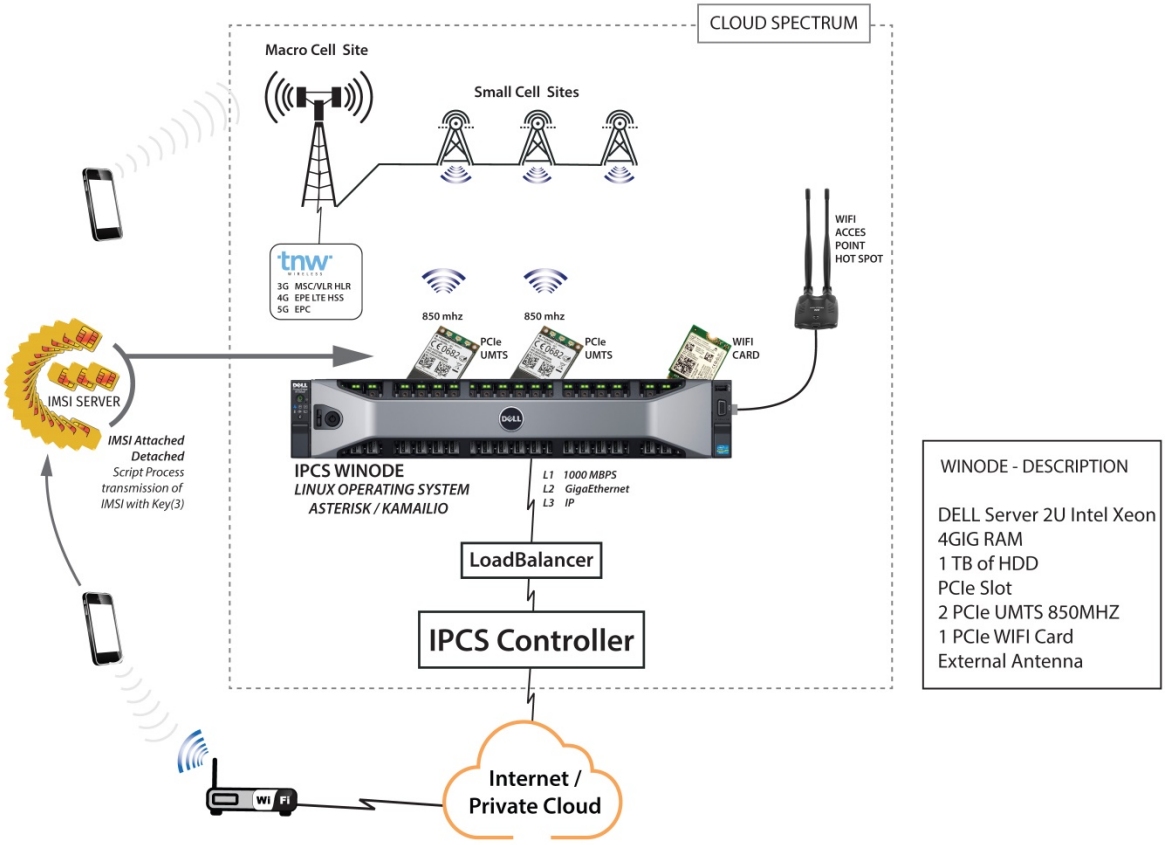

Figure 1- Wi-Node Overview

4. Attachment and Detachment from a Radio Access Network (RAN) and its Core Network

The mechanism to which GSM-based (GSM, UMTS, LTE) services work is that a Mobile Station ("MS") is either "attached" or "detached[1]" on a RAN and its core networks. In the case of iPCS, a Smartphone and a Wi-Node work in tandem to create the Mobile Station and the concept of attached or detached is fundamental to determine whether service provision to a subscriber is that of GSM services or not.

In a Wi-Fi first environment (e.g. Wi-Fi calling or over the top Wi-Fi service) the MS (or the smartphone device) remains attached at all times to a HPMN (Home Public Mobile

[1] Also referred to as "registered" or "deregistered"

Network) or VPMN (Visited Public Mobile Network) while providing voice, text and data service to the user though a Wi-Fi connection.

In the iPCS environment the Mobile Station detaches from the VPMN which necessitates the need to attach to its HPMN thought the use of the iPCS Wi-Nodes system. Without this attachment to the HPMN the devices cannot authenticate to a UMTS or LTE core network and therefore are not able to receive a phone calls or text messages or simply be registered on to the network. In other words, if the user is not remotely connected to iPCS/TNW core network, phone calls go straight to voicemail.

Technological transparency is a key component of iPCS which has been design to be completely transparent for use on any type of network core equipment regardless of manufacturer. No special core network interfaces is required. Essentially whether a device is on 3G MSC, 4G EPC or a 5G EPC/GN equipment infrastructure, any operator using iPCS can be assured of complete compatibility and seamless interface with the system.

5. iPCS and GSM Procedures

iPCS was designed to strictly follow GSM procedures as established by the European Telecommunications Standards Institute for GSM (Global System for Mobile Communications) that must performed by a GSM network and devices on it in order for the network to function. The specific iPCS procedures undertaken in order that a GSM network communicates with iPCS mobile devices are given later in this section.

The iPCS IMSI (International Mobile Subscriber Identity) attach function refers to the procedure used when an iPCS mobile device joins TNW's GSM network or when present on a Visited Public Mobile Network.

These procedures occur when a Mobile Device is turns on or when the iPCS UICC SIM provides a valid IMSI to the network and *IMSI detach* refers to the procedure used to disconnect an iPCS device when its leave its network directly or through a Wi-Node or an iPCS leave a VPMN when switching to Wi-Fi as the UICC removes the IMSI present in the SIM module or simply when the device is turned off.

6. iPCS Wi-Node IMSI General Attach Procedure

The attachment procedures are executed when an iPCS user is within TNW's GSM network and the phone is turned on or removed from Airplane mode which is prompting the IMSI to be made present in the device itself or in the Wi-Node on behalf of the remote iPCS user.

This procedure is required for TNW's Mobile Switching Center (MSC) and its Visitor Location Register (VLR) to register the smartphone on its network directly or through a

Wi-Node when on Wi-Fi or when present on a VPMN though a designated interconnection network such as Syniverse.

If the smartphone has changed Location Area (LA) while its IMSI was removed from the UICC card SIM mode or was simply powered off, then the IMSI attach procedure will lead to a Location Update (LU) procedure.

When the iPCS IMSI is being made available in the UICC SIM card module when leaving an Internet Wi-Fi connection or when the iPCS smartphone is switched on, or when connected on a Wi-Node while on Wi-Fi then the device will search for a mobile network to connect to.

Once the iPCS-enabled device identifies a desired network, it sends a message to the network to indicate that it has entered into an idle state.

TNW or a roaming partner Visitor Location Register (VLR) checks its database to determine whether there is an existing record of the specific TNW iPCS subscriber.

When an iPCS subscriber is not located directly on TNW's RAN network directly or remotely through a Wi-Node over a Wi-Fi connection, and the device attempts to attached to another network and if no record is found on the VPMN's VLR database it then communicates with TNW's Home Location Register (HLR) in order to obtains a copy of the iPCS subscription information.

The obtained information is stored in the VLR database of VPMN operator.

Then an acknowledge message is sent to the iPCS smartphone device.

7. iPCS UICC SIM IMSI attach procedure are as follows:

   i. iPCS smartphone or the Wi-Node will send a Channel Request message to the Base Station Subsystem (BSS) on the Random Access Channel (RACH) on TNW's network or on a VPMN

   ii. The BSS responds on the Access Grant Channel (AGCH) with an immediate Assignment message and assigns a Stand-alone Dedicated Control Channel (SDCCH) to the iPCS smartphone device or the Wi-Node.

   iii. The device or the Wi-Node immediately switches to the assigned SDCCH and sends a Location Update Request to the BSS. The device will send either an iPCS enable IMSI or a Temporary Mobile Subscriber Identification (TMSI) to the BSS.

iv. BSS will normally acknowledge the message and this acknowledgement simply tells the device or the Wi-Node that the Base Transceiver Station (BTS has received the message, while it does not indicate the location update has been processed yet.

v. BSS forwards the Location Update Request to TNW's or VPMN Mobile Switching Center (MSC) and it associated Visited Local Registry (VLR).

vi. MSC & VLR forwards the iPCS IMSI to TNW's Home Local Registry (HLR) if the iPCS device is present on a VPMN or on its networks directly or through a Wi-Node and requests verification of the IMSI as well as Authentication elements such as the 128-bit Random Challenge (RAND), 64-bit ciphering key (Kc) which interact with the Ki from the iPCS SIM and a 32-bit Signed Response (SRES).

vii. TNW's HLR will forward the IMSI to its Authentication Center (AuC) and request authentication the three Authentication elements.

viii. TNW iPCS Core AuC generates the Authentication elements and sends them along with the IMSI, back to the HLR.

ix. TNW's HLR validates the IMSI by ensuring it is allowed on the network and is allowed subscriber services. It then forwards the IMSI and Authentication elements to the TNW network or the VPMN MSC/VLR.

x. MSC/VLR stores the SRES and the Kc and transmits the RAND to TNW or VPMN BSS and orders the BSS to authenticate the iPCS mobile device.

xi. BSS sends the device an Authentication Request message containing the RAND information.

xii. iPCS device uses the RAND to calculate the SRES and sends the SRES back to the TNW or VPMN BSS on the SDCCH in an Authentication Response. The BSS forwards the SRES up to the TNW or VPMN MSC/VLR.

xiii. This MSC/VLR compares the SRES generated by the AuC with the SRES generated by the iPCS device. If they match, then authentication/registration is completed and successful.

xiv. MSC/VLR forwards the Kc for the iPCS device to the BSS. Importantly, the Kc is NOT sent across the 3GPP Air Interface to the iPCS device. The BSS stores the Kc and forwards the Set Cipher Mode command to the iPCS device. The Cipher Mode command only tells the iPCS device which encryption to use and no other information is included.

xv. The iPCS device or the iPCS Wi-Node immediately switches to cipher mode using the encryption algorithm. All transmissions are now "enciphered". It sends a Ciphering Mode Complete message to the BSS.

xvi. MSC/VLR sends a Location Updating Accept message to the BSS. It also generates a new TMSI for the iPCS device or Wi-Node. TMSI assignment is a function of the VLR. The BSS will either send the TMSI in the LOC_UPD_ACC message or it will send a separate TMSI Reallocation Command message. In both cases, since the Air Interface is now in cipher mode, the TMSI is not compromised.

xvii. iPCS device or the Wi-Node sends a TMSI Reallocation Complete message up to TNW's MSC/VLR or the one of the VPMN.

xviii. BSS instructs the iPCS device or the associated Wi-Node to go into idle mode by sending it a Channel Release message. The BSS then de-assigns the SDCCH.

xix. Associated MSC and its VLR send an Update Location message to TNW's HLR. The HLR records which MSC/VLR the iPCS device is currently present in, so it knows which MSC to point to when it is queried for the location of the iPCS device.

8. iPCS Device and Wi-Node IMSI Detachment

The detachment of the IMSI is the process of detaching an iPCS device from TNW's network directly or remotely on a Wi-Node or when present on a VPMN. This process happens when an iPCS UICC SIM card module is being enabled or disabled onto the device when moving from a 3GPP radio connection to Wi-Fi or vis versa.

The IMSI detach procedure informs TNW's GSM-based network that the iPCS device IMSI is no longer available on TNW network directly or through a Wi-Node and then can be switched to a VPMN or when the device is simply turn off or is unreachable by a 3GPP radio or Wi-Fi.

When an iPCS-enabled SIM device is properly power cycled down, the device requests a signaling channel. Once the signaling channel is assigned, the device sends an IMSI detach message to the TNW VLR if on direct network or on Wi-Node or on the VPMN's VLR. When the VLR receives the IMSI detach-message, the corresponding IMSI is marked as detached by setting the IMSI detach flag.

TNW's HLR is not informed of this and the VLR does not acknowledge the device about the IMSI detach.

If the radio link quality is low or interrupted when IMSI detach occurs, the VLR may not properly receive the IMSI-detach request. Since an IMSI-detach request acknowledgment message is not sent to the device, it does not make further attempts to send IMSI detach messages to the device. Therefore, the TNW or VPMN GSM network considers the device to be still attached.

9. TNW network Wi-Node Implicit IMSI detach procedures

The GSM 3GPP air-interface, designated a Layer 1 *Um* interface, transmits network-specific information on a specific broadcast channels. This information includes whether the periodic location update is enabled. If enabled, then the device must send location update requests at certain time intervals specified by the TNW network. If the device is switched off and not having properly completed the IMSI detach procedure, TNW or VPMN network will consider the device as switched off or unreachable if no location update is made.

In this situation the VLR performs an implicit IMSI detach and iPCS Wi-Node issue the same state of Wi-Fi connectivity is lost between the iPCS client and the Wi-Node

10. Cancel Location

When an iPCS device registers to a different VLR (TNW or VPMN), the subscriber's data is deleted from the previous VLR in a cancel location procedure. TNW's HLR initiates the procedure when it receives an update location message from a VLR other than the one in which the device was located at the time when its location information was last updated in TNW's HLR database.

The cancel location procedure can also be initiated with automatic Man-Machine Language (MML) commands that is used for changing the location area or deleting the iPCS device temporally from TNW's HLR.

11. iPCS/GSM Location Update Procedure Function with the Wi-Node

TNW's GSM-based (UMTS, HSPA+) network is a radio network of individual macro cells or small cells, known as base stations which can have cluster of individual Wi-Node in a load balancing mode. Each base station covers a small geographical area of few kilometre radius and some will be covering smaller area of few hundred meters which is part of a uniquely identified location area. By integrating the coverage of each of these base stations, TNW provides radio coverage over wider area. In iPCS terminology, a group of macro and small base stations is named a "location area", or a "routing area". Wi-Node servers are therefore to be spread to different location areas to assure balance in network cell capacity as well as preparing the decentralization GSM access in preparation for a 5G network topology deployment on New Radio systems.

The location update procedure allows the iPCS device or its correspondent remote Wi-Node to inform TNW GSM-based network, whenever it moves from one location area to the next to maintain balance network capacity or when moving onto different location on a VPMN roaming partner.

Just like any mobile station an iPCS subscriber device equipped with a iPCS proprietary UICC SIM are responsible for detecting location area codes (LAC) while directly on a 3GPP GSM Radio connection or through a Wi-Node while on Wi-Fi.

When the device finds that the location area code is different from its last update, per example moving from a VPMN to HPMN thought a Wi-Fi connection back to remote TNW's GSM network over a Wi-Node, it performs another update by sending to the network, a location update request, together with its previous location, and its Temporary Mobile Subscriber Identity (TMSI).

The mobile station device also stores the current Location Area Code in the iPCS UICC SIM card and including it as well to a list of recently used Location Area Codes.

This is done to avoid unnecessary IMSI attachment procedures in case the iPCS SIM IMSI has been temporarily removed from the iPCS SIM without having a chance to notify the network with an IMSI detach and then switched on right after the IMSI is being replaced in the UICC SIM module of the iPCS device.

While the iPCS device is still associated with TNW's Mobile Switching Center/Visitor Location Register (MSC/VLR) of the current location area, there is no need for any kind of IMSI attachment procedures to be performed if the iPCS device will stay remotely connected to TNW's core network remotely thought the Wi-Node.

There are several reasons why an iPCS user connected on Wi-Fi remotely though a Wi-Node gateway needs to provide updated location information to the network. Whenever an iPCS user located anywhere in Canada or anywhere else in the world is connected on Wi-Fi and is switched ON or OFF, the remote Wi-Node may require it to perform an IMSI attach or IMSI detach location update procedure to maintain registration on GSM-based service. In addition, each iPCS device is required to regularly report its location at a set time interval using a periodic location update procedure.

Whenever an iPCS user moves from one location area to the next within its network directly, remotely though a Wi-Node over Wi-Fi or on a VPMN while not on a call, a random location update is required to maintain registration to the GSM-based service. Otherwise, if an iPCS device is not registered on a VPMN and temporarily loses Wi-Fi connectivity, the remote Wi-Node is needed to reattach the IMSI to TNW's MSC to maintain service. Otherwise the iPCS user's phone call will not reach user's device and will go straight to voicemail.

When a iPCS subscriber is "paged" by the network in an attempt to deliver a call or SMS and the subscriber does not reply to that page directly or through a Wi-Node then the subscriber is marked as absent in both the MSC/VLR and the Home Location Register (HLR) (Mobile not reachable flag MNRF is set) and call will go again, straight to voicemail. The next time the iPCS device will performs a location update if the IMSI is

present in the UICC SIM or though Wi-Fi on the Wi-Node, TNW GSM-based core HLR (or associated HSS) is updated and the mobile not reachable flag is cleared and MSC/VLR dedicated SIP gateway will then send an invite message to the iPCS VoIP user's interface.

12. TNW's iPCS Roaming Service

Like in any other traditional GSM-based network, the iPCS network roaming capability is one of the fundamental mobility management procedures of all cellular networks and as set by the GSMA.

Roaming is defined as the ability for a mobile user to automatically make and receive voice calls, send and receive data, or access other services, including home data services, when moving from its home network directly or on Wi-Node over Wi-Fi and outside of that coverage area of the home network, by using a visited network as the iPCS device IMSI is moved temporarily from the Wi-Node to the iPCS UICC SIM.

13. Wi-Node Location Area

TNW's current "location area" is a set of base stations that are grouped together to optimize signaling. Currently TNW network has 3 main location areas. The first one is on the island of Haida Gwaii BC, the second is on the beginning of the Alaska Highway north of Dawson Creek and Fort Nelson, BC and the third is located in Whitehorse, YK area.

All base stations currently share a Radio Network Controller (HnodeB GateWay) which voice Circuit Switched (CS) and Data Packet Switched (PS) for the base stations. TNW HnodeB GW handles allocation of radio channels, receives measurements from the mobile phones, and controls handovers from base station to base station. To each location area, a unique number called a "location area code" is assigned. Wi-Node essentially assure that remote iPCS users on their behalf have the location area code broadcasted by each base station to NodeB radio connected to TNW's core at regular intervals.

Where the location areas are very large in footprint, Wi-Node Gateway density will be increased and associated with new small cell sites to be added and therefore permitting many remote iPCS users to be able to operate simultaneously over Wi-Node. To reduce "paging" traffic, since as every paging request has to be broadcast to every base station in the location area, TNW will divide location area by adding small cell site with Wi-Node gateway service. This will prevent wastes of bandwidth by requiring it to listen for less broadcast messages the time. As Wi-Node gateways are not moving and in static position having many small location areas, the remote iPCS user over Wi-Fi does need to contact the network often as there are virtually no changes of location. This means that a iPCS users located anywhere in the world and remotely connected to TNW GSM-based network will be associated in a load balance mode at a static Wi-Node gateway within

TNW's network to be registered to its core transparently and will not move from location area until there is a reconnection over Wi-Fi.

14. iPCS VPM Licenced Spectrum, 3GPP Radios and GSMA procedure

The main difference between the use of Wi-Fi service by an wireless service provide and iPCS is that at all time while an iPCS user is on Wi-Fi, its SIM module has no valid IMSI present therefore the device is detached from the VPMN, unregistered on the VPMN core network, not using the 3GPP radio during that time while smartphone operating system disable that radio. This has the added benefit of increasing battery life.

What the CRTC had to take in consideration in its 2017-56 decision and 2017-259 public notice were scenarios where a smartphone device was using an *over-the-top* VoIP application or a form of IMS client while on Wi-Fi and at the same time using licensed radio spectrum, maintaining device attached to a VPMN Radio Access Network and using network resource while effectively the wireless provider users were not connected to their own core network but instead registered to a traditional VoIP server - as such using the terms and definitions of ***Extending the HPMN***.

An iPCS user has remote access to its Home Network which is materially different from a Wi-Fi-first over the top service. At all times, a Mobile Station (MS) as defined in the GSMA standards[2] and into telecom regulations is considered to be within an operator Licensed Spectrum Area when the device is **actually using license spectrum and at the same time is located within that territory**. When a device loses all its abilities to use a 3GPP radio and loses abilities to be attached directly to a RAN using licensed spectrum because the IMSI is not present into the SIM module of the smartphone device, **then that device is not within a licenced operator territory**. An iPCS user smartphone device on Wi-Fi is not in a "nowhere position", but rather at home on a Wi-Node through a Wi-Fi connection without being attached or using spectrum resources of any VPMN RANs.

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[2] Permanent Reference Document of the GSM Association Official Document IR.92 - IMS Profile for Voice and SMS Version 12.0 dated 02 May 2018 https://www.gsma.com/newsroom/wp-content/uploads//IR.92-v12.0.pdf

Permanent Reference Document of the GSM Association Official Document IR.61 - Wi-Fi Roaming Guidelines v11.0 (Version 12.0) dated 27 September 2017 https://www.gsma.com/newsroom/wp-content/uploads/IR.61-v12.0.pdf

Permanent Reference Document of the GSM Association Official Document N2020.01 - VoLTE Service Description and Implementation Guidelines Version 1.0 dated 18 December 2014 https://www.gsma.com/futurenetworks/wp-content/uploads/2015/03/N2020.01-v1.0.pdf

The questions one obviously would pose are; On which operator RAN an iPCS users without an IMSI would be deemed roaming on when the 3GPP radio is turned off? and; Which wholesale roaming service agreement would be breached, still, if such user would be considered to be "permanently roaming" while not attached directly to any VPMN RAN?

(Note that the Permanent Reference Document of the GSM Association Official Document IR.92, IR.61 and N2020.01 describes:

- *Wi-Fi Access to the Evolved 3GPP Packet Switched domain also known as the Evolved Packet Core (EPC) as defined in the 3GPP specifications TS 23.402 and TS 24.302, e.g. for devices based on GSMA PRD IR.51 and based on 3GPP Release 11 and later*

- *Roaming scenarios but also includes some non-roaming scenarios to give the full picture, including mobility between E-UTRAN and pre-E-UTRAN 3GPP radio access technologies, policy control and charging, and authentication*

- *EPC integrated Wi-Fi roaming common guidelines*

- *IP Multimedia Subsystem (IMS) Profile for Voice and SMS, documented in this Permanent Reference Document (PRD), defines a profile that identifies a minimum mandatory set of features which are defined in 3GPP specifications that a wireless device (the User Equipment (UE)) and network are required to implement in order to guarantee an interoperable, high quality IMS-based telephony service and IMS-based and SGs-based Short Message Service (SMS) over Long Term Evolution (LTE) radio access*

- *Voice over LTE, or VoLTE is a GSMA profile of the standards definition for the delivery of services currently provided via Circuit Switch networks - mainly voice and SMS - over the Packet Switched only network of LTE, leveraging the core network IP Multimedia SubSystem (IMS)*

- *When mobile networks deploy LTE radio access technology, conformity to the VoLTE profile provides operators with assurance of interworking between their LTE network and the devices that connect to it, as well as providing for the expected user experience of voice Multi-Media Telephony service and SMS.*

- *Policy Control, IMS provides for the required QoS appropriate for voice service using LTE radio access technology, thereby providing the user experience of voice calls that subscribers expect.*

- *VoLTE integration with the existing user experience that is currently implemented with circuit switched voice devices, and therefore whether the call*

is a circuit switched call or a VoLTE call is transparent to the end user (including when moving in and out of LTE coverage) and is dependent only on which radio access technology to which the user is attached

- *VoLTE is in accordance with 3GPP specifications and additional profiling is defined within GSMA Permanent Reference Documents.)*

2.3 Responses to Technical Questions 12-15

15. Below are responses to technical questions 12-15. Where appropriate reference is made to more technical details provided in section 2.2

16. ***Question 12:*** *Provide details of how the Wi-Node interfaces with TNW Wireless Radio Access Network (RAN). Specifically, identify the number of Wi-Nodes in your network, their locations, the frequencies used as well as their capacity (number of simultaneous calls supported per Wi-Node).*

    As described more completely in the previous section, the iPCS Mobile Station ("MS") consists of a Wi-Node and a smartphone and these operate in tandem. As soon as a smartphone enters and connects to a Wi-Fi zone, the iPCS UICC module which contains the SIM module disables the IMSI in the smartphone device. The device then detaches from the VPMN. The device then informs the iPCS controller that it is on Wi-Fi. The controller then informs the Wi-Node to begin the process of attachment to the HPMN and the device becomes registered to the HPMN. The load balancing process algorithm ultimately determines which site is used and the IMSI is transferred to that site.

    This is a highly cost-effective process versus alternatives such as Voice Over LTE (VoLTE) as it very inexpensive to set up and operate and works cross platform – i.e. on any IOS or Android phone and any Core network manufacture. Most alternative systems will only work where the proprietary technology (e.g. Wi-Fi calling) is embedded in the phone operating system.

    Wi-Node uses SIP signalization and a voice media light Codecs such as G.729 and are therefore an overall very light platform in terms of data bandwidth. As such there are no real world limitations on its capacity and each Wi-Node can handle over 1,000 simultaneous calls.

    At present there is only one Wi-Node active in a controlled environment which uses TNW licensed spectrum exact frequencies. The full deployment is awaiting the Commission decision.

17. ***Question 13:*** *Explain the relationship of Cloud Spectrum to Wi-Node Gateways and the relationship of Cloud Spectrum to the company's radio base stations (e.g. Base Transceiver Station (BTS)/eNodeB). Provide a detailed diagram showing all interfaces.*

    The term "Cloud Spectrum" is iPCS terminology for the collective system which provides the ability to deliver GSM-based services over the Internet in compliance with Canadian Telecommunication regulations as well as GSMA standard and policies.

    As shown in Figure 2 below (a high resolution version is provided in **Appendix B** – see also Figure 1 provided earlier), the Cloud Spectrum consists of small cell sites connect to the Wi-Node gateway which is in turn is connected to the load balancing system (which determines which Wi-Node is to be utilized). This is part of the iPCS network overview.

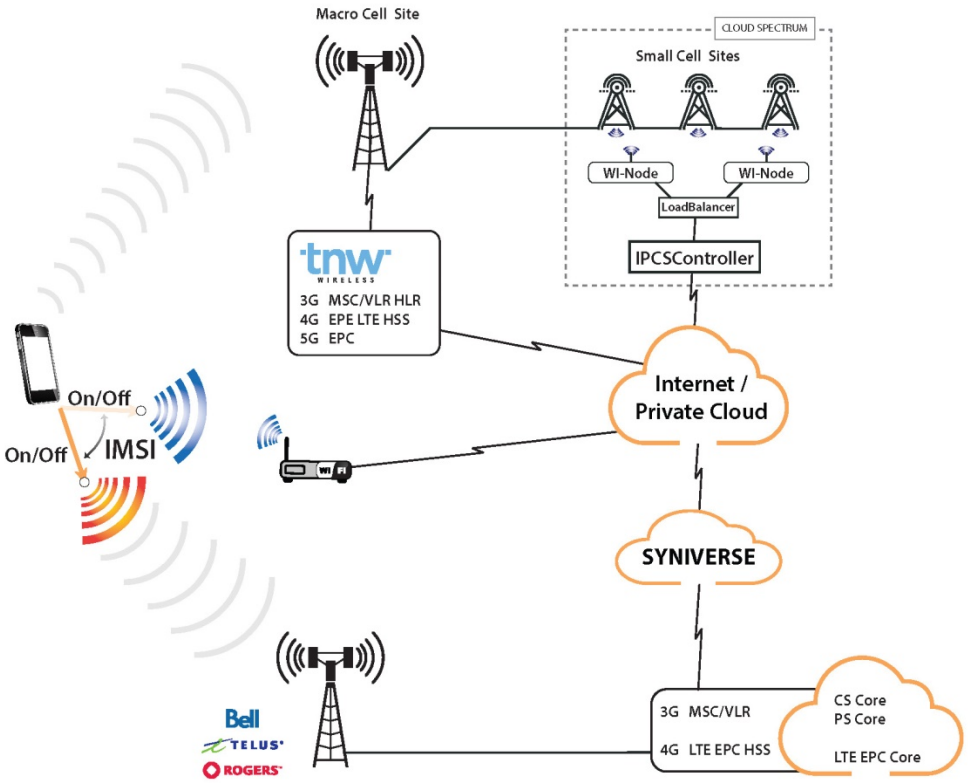


Figure 2 - Cloud Spectrum Ecosystem as part of the Network Overview

18. ***Question 14:***

a. Explain the rationale for connecting to your core network via BTS and licensed spectrum rather than via direct IP connectivity to your core.

This question again relates to the systems "keep alive" protocol which provides iPCS with an open source, cross platform option versus the direct IP option which requires users to use proprietary and more costly systems. The BTS and licensed spectrum connections are inexpensive with no license fees and universal (independent of phone device). It operates transparently over smartphones and core networks while respecting GSM standards. Furthermore the system does not and will not require updating and upgrading over time even as telecommunications systems will soon evolve to 5G standards.

b. Provide details on the benefits of this approach. For example, are there services that can only be provided using the company's approach?

There is no other way to provide the services offered without a specialized and expensive core network. We reiterate that it is also the only way to provide services on **virtually all** iOS and Android based smartphones

c. Explain in detail how the traffic from remote customers is retransmitted over TNW Wireless' RAN. How does this affect the capacity on the company's RAN when multiple remote users are connected?

One Wi-Node can supply multiple remote iPCS users. The main task of the Wi-Node is to *attach* or *detach* an IMSI from the TNW's core network, process voice signalization and media and maintain user registration onto the network. As the Wi-Node uses SIP signalization with a very light code, there is no issue with capacity. We can implement multiple small cell sites as necessary to maximize spectrum density (see more detailed description in section 2.2).

It is important to emphasize here that iPCS does not use any voice channels, using packet switching versus circuit switching. As such, call capacity is not an issue as traditional CS voice channels are not being used.

d. Explain whether remote customers connect to the same cellular network used by TNW Wireless cellular subscribers in TNW Wireless Home Network footprint or whether they are connected at specific towers.

iPCS utilizes load balancing in its three primary regions for every session. Each Wi-Node is attached to a specific tower however subscribers attach to different Wi-Nodes according to the load balancing algorithm.

19. ***Question 15:*** *At paragraph 79 of the Application, TNW Wireless describes how iPCS supports 911/E911 when subscribers are on the TNW Wireless network and also when they are on a roaming partner's network. Explain in detail how a 911 call is processed when the iPCS user is using Wi-Fi and their phone is unregistered from any cellular network.*

TNW Wireless uses an Enhanced 911 system for all its emergency call originated from its subscriber. When call is initiated from the 3GPP GSM/UMTS Circuit Switch, calls are router to TNW current Voice over Internet Protocol (VoIP) Public Safety service provider. All 911 calls are directed to the Emergency Response Center (ERC) as the primary Public Safety Answering Point (PSAP). Location information is retrieve from TNW's real-time Automatic Location Information (ALI) database. Once the physical location is verified the call is transferred to the appropriate PSAP within seconds.

TNW logs in real time, the geolocation position of the NodeB that it is connected to from the originating a 911 call and updates the ALI database while the call is being transmitted to the PSAP. If at least two NodeB radio was receiving registration signal form the user handset IMEI code, then the HNodeB gateway provides our ALI immediately through the angle of arrival (AOA), the estimated GPS coordinates of the position of the device. Furthermore, if a network based location triangulation is available while three NodeBs are receiving same registration signal then TNW's HNodeB Gateways, through the radio resource location services protocol (LCS) provides an estimated geolocation position of the handset under Time Difference of Arrival (TDOA) with Multi-Lateration calculation conversation system and permits the networks to determinate the time difference and therefore distance from each NodeB radio to determine geo-position via triangulation. In all cases TNW's permanent GPS coordinate conversation data system converts the estimate GPS coordinates into the closest street address and updates the ALI data base as the call in connected to TNW's primary PSAP. The average process from retrieving the NodeB position or by AOA or TDOA then converting into GPS coordinates and then converting in the closes street address by using TNW real-time synchronizes MSAG (Master Street Address Guide) is less than 4 seconds and happens before the ALI database is required by the PSAP provider. Our third party PSAP emergency dispatch centers are now equipped with computer-assisted dispatch (CAD) system and have already implemented real-time onscreen Enhanced 911 street map display with graphic user interfaces (GUI) to highlight the caller's handset position.

If a 911 call is placed over the iPCS interface while the device is connected on a Wi-Fi network which backhauls the connectivity to the TNW HPMN, remote access, calls placed to PSAP will be routed as described as follows.

TNW supports both Handset Based and Network Based location system. As a standard, all geolocation Global Positioning System (GPS) function on smartphone must be turned on while using iPCS service. As such, GPS coordinates are maintained in real time in the iPCS backend servers and any calls place to 911 or by pressing and holding the default 911 button on iPCS, will be sent to TNW's PSAP service provider while the GPS

coordinates are being converted into the closed street address by using TNW real-time synchronized MSAG (Master Street Address Guide) and updating in real time the ALI database accordantly. Should the GPS location system not be activated or not properly function while a call is placed to the PSAP service, TNW's real time fall back system is activated as already described.

Furthermore, as explained previously, when iPCS is connected to TNW's HPMN through a Wi-Fi connection, the device is deregistered from VPMN core network and is no longer using licensed bandwidth of the roaming partner network. Even if the phone is not using iPCS 911 access occurs via 3GPP and the call is routed to the closest PMN by default.

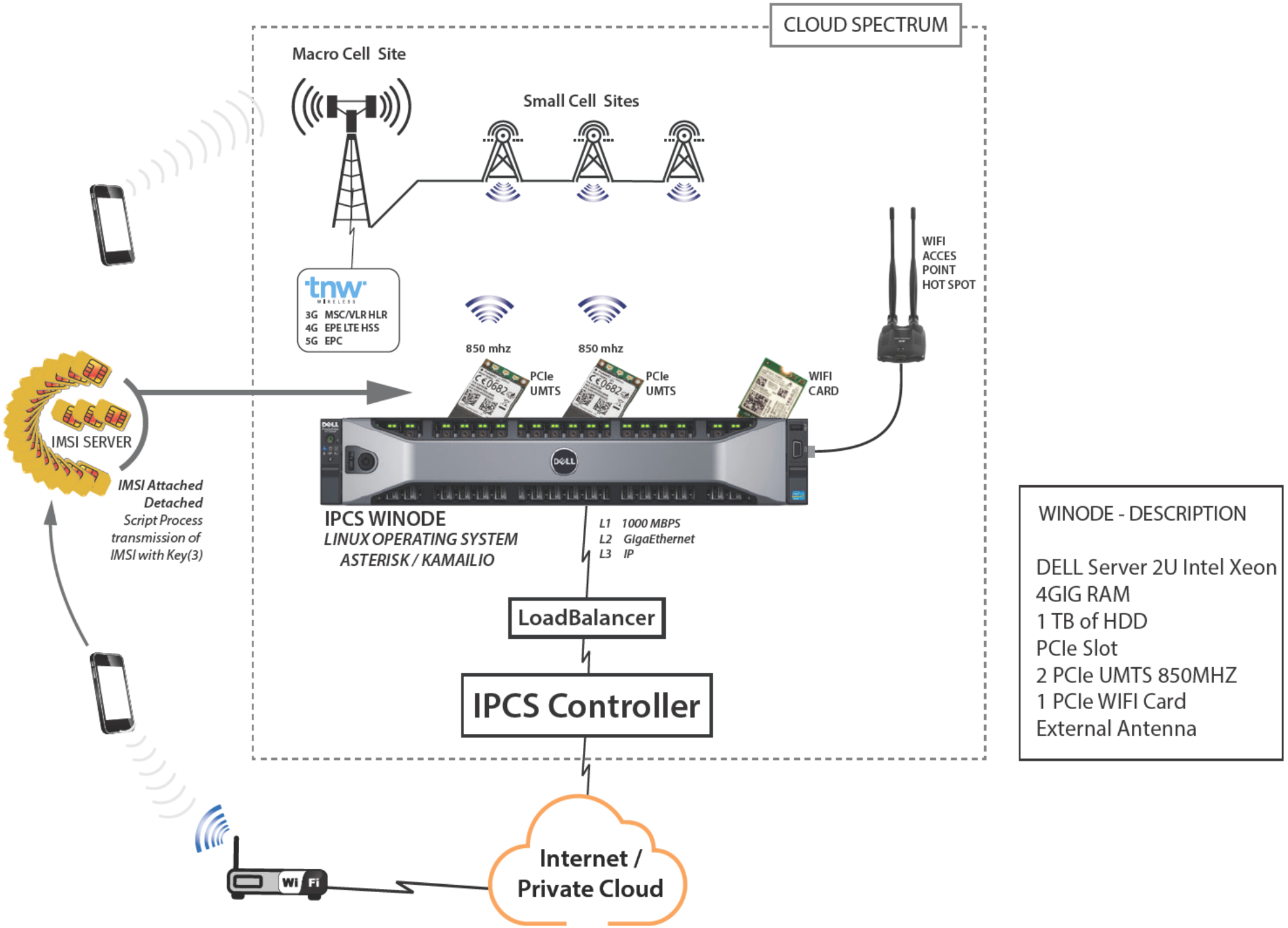
3.0 NOTICE

20. This response is made by TNW Wireless Inc., c/o Lawry Trevor-Deutsch, 468 Pleasant Park Road, Ottawa ON K1H 5N1 [email: regulatory@tnwcorp.com]

    A copy of this response may be obtained by sending a request to regulatory@tnwcorp.com .

    TAKE NOTICE that pursuant to section 25, and, as applicable section 26 of the Canadian Radio-television and Telecommunications Commission Rules of Practice and Procedure, any respondent or intervener is required to mail or deliver or transmit by electronic mail its answer to this application to the Secretary General of the Canadian Radio-television and Telecommunications Commission ("Commission"), Central Building, 1 Promenade du Portage, Gatineau (Québec) J8X 4B1, and to serve a copy of the answer on the applicant within 30 days of the date that this application is posted on the Commission's website or by such other date as the Commission may specify. Service of the copy of the answer on the applicant may be effected by personal delivery, by electronic mail, or by ordinary mail. In the case of service by personal delivery, it may be effected at the address set out above.

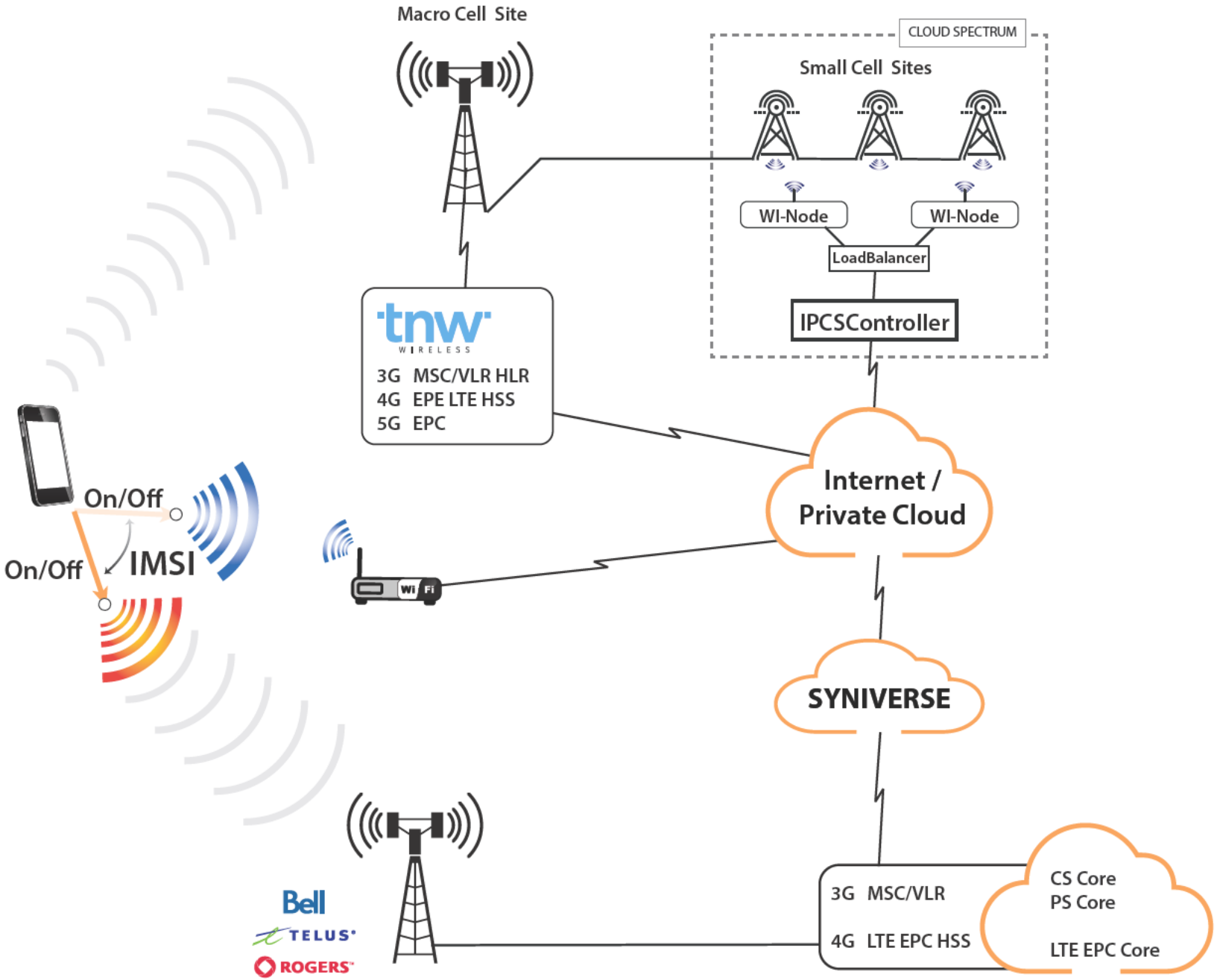
APPENDIX A



WINODE - DESCRIPTION

DELL Server 2U Intel Xeon
4GIG RAM
1 TB of HDD
PCIe Slot
2 PCIe UMTS 850MHZ
1 PCIe WIFI Card
External Antenna

APPENDIX B


Macro Cell Site
CLOUD SPECTRUM
Small Cell Sites
WI-Node
WI-Node
LoadBalancer
IPCSController
tnw
WIRELESS
3G MSC/VLR HLR
4G EPE LTE HSS
5G EPC
On/Off
On/Off
IMSI
Internet /
Private Cloud
SYNIVERSE
Bell
TELUS
ROGERS
3G MSC/VLR
4G LTE EPC HSS
CS Core
PS Core
LTE EPC Core

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