Windsor Place Consulting

Session #2:

Emerging Technologies within a Changing Telecommunications Paradigm

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Topics covered

1. Introduction
2. Facilitating eSIMs in an IoT world
3. Embracing TDD systems and synchronisation
4. The move to IP: VoLTE interconnection

1. Introduction
2. Facilitating eSIMs in an IoT world
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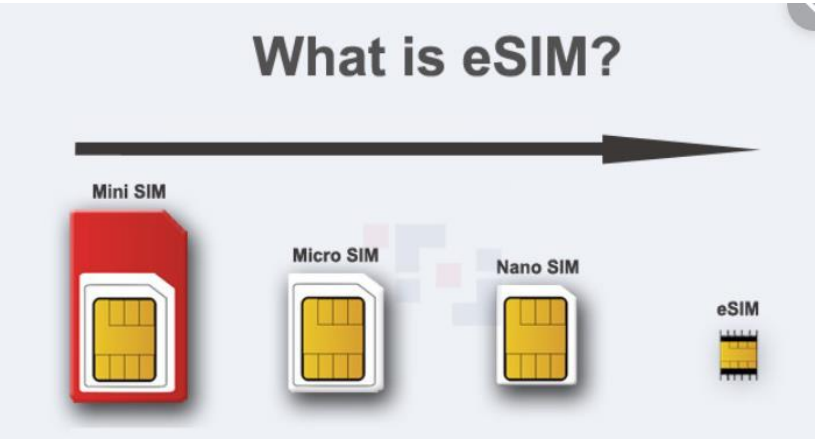
4. The move to IP: VoLTE interconnection

1. Introduction (1)

- Telecommunications sector particularly the proliferation of the mobile communication has been the catalyst for socio-economic development.
- However, the sector is also characterized by rapid changes in technology from the first-generation analogue phones to the fifth generation mobile technology.
- In addition, emergence of IoT, development of Unmanned Aerial Vehicles (UAVs), Autonomous Vehicles etc. are paving the way for emergence of new technologies.
- In this session, I will focus on eIMss, TDD synchronisation and VoLTE.



1. Introduction
2. Facilitating eSIMs in an IoT world
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2. Facilitating eSIMs in an IoT world (1)

Evolution of the SIM card

- In a competitive market, individual suppliers cannot dictate terms, but must respond to the rivalry of their competitors. Market power occurs when an industry participant can unilaterally set and maintain prices and other commercial terms.

- Since its deployment in the early 1990s, the SIM card has provided secure, identifiable and authenticated access to mobile networks

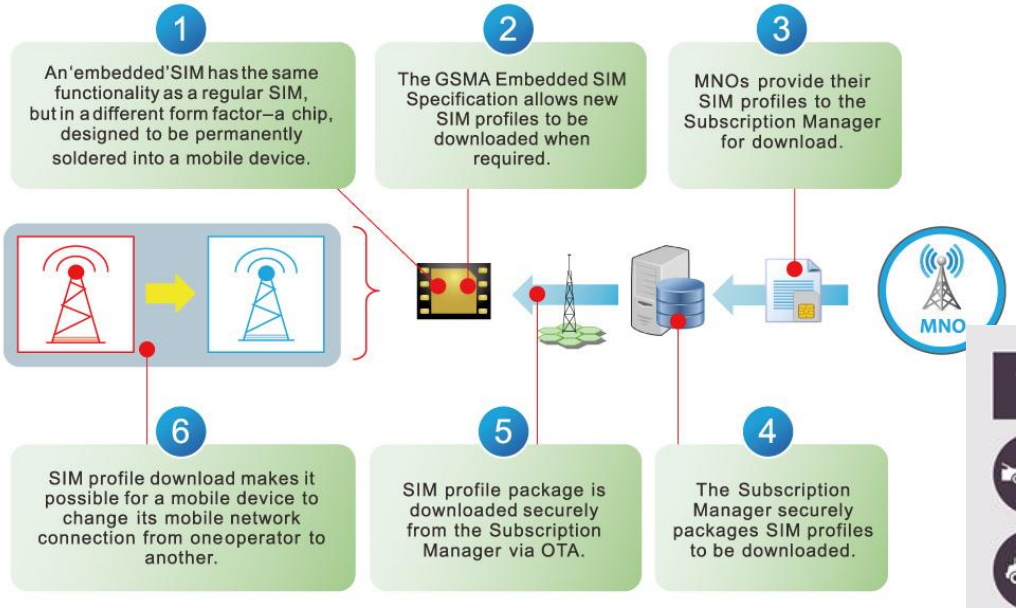
- However, the traditional form of a physical, removable SIM card has become dated as technology advances – with a range of manufacturers including Apple, Samsung and others developing a range of products which move to eSIMs (particularly wearable devices).

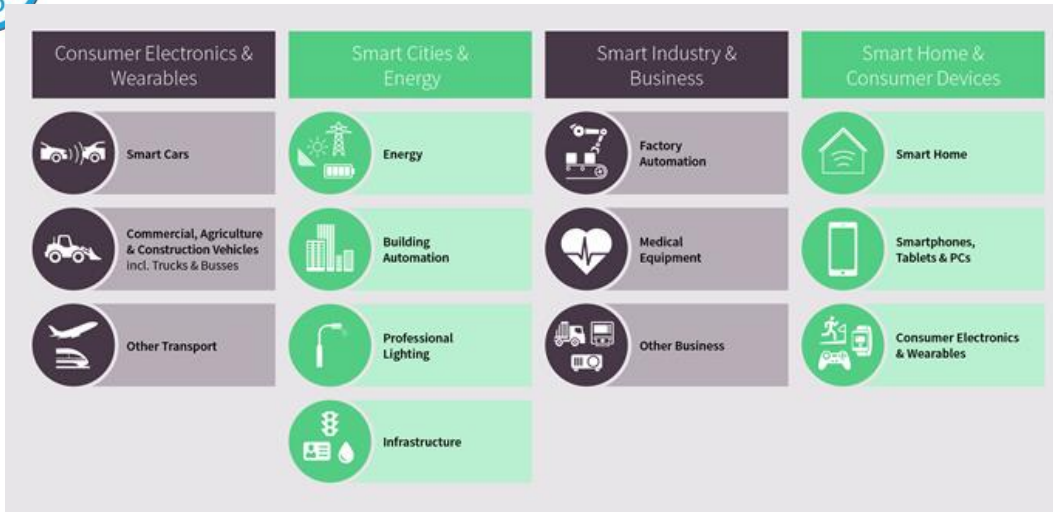
- Three types of 'new generation SIMs' have emerged in this process, namely:
    - Embedded SIM or eSIMs: a physical SIM that is permanently embedded in the device
    - Remote Provisioning 'reprogrammable' SIMs: SIM that can be removed from the device (e.g. Apple SIM)
    - Soft SIMs: collection of software applications and data that resides in the memory and processor of the device

2. Facilitating eSIMs in an IoT world (2)

Evolution of the sim card

- A critical feature of all these new generation SIMs is remote provisioning technology
- This gives the consumer and/or supplier the ability to remotely change the SIM profile without having to physically change the SIM





2. Facilitating eSIMs in an IoT world (3)

The eSIM Card

- eSIM is a global specification by the GSMA which enables remote SIM provisioning of any mobile device. eSIM allows consumers to store multiple operator profiles on a device simultaneously, and switch between them remotely, though only one can be used at a time.

- The term "eSIM" simply means an embedded SIM card. There are no physical SIM cards involved and no physical swapping over required by you. An eSIM is basically a small chip inside your phone and works in a similar way to the NFC chip that's used for payment tech

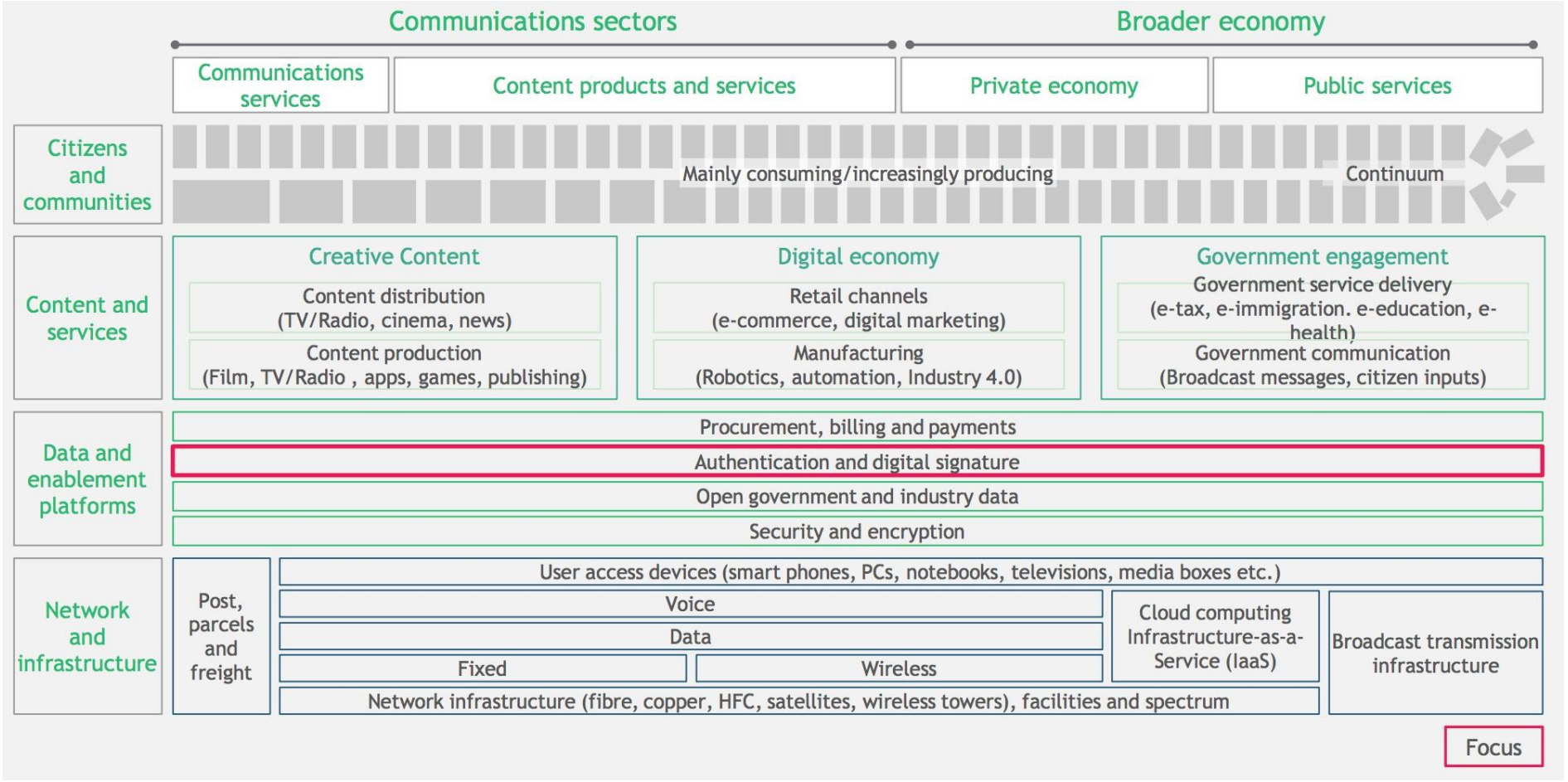
- This universal approach will grow the Internet of Things by allowing manufacturers to build a new range of products for global deployment based on this common embedded SIM architecture.

- It is increasingly found in consumer smartphones such as the iPhone 11.
  The list of eSIM supported MNOs can be found at
  https://support.apple.com/en-asia/HT209096

2. Facilitating eSIMs in an IoT world (4)

LINKAGE TO DIGITAL IDENTITY AND DIGITAL ECONOMY

- eSIMs link to the authentication and digital signature which are a foundation element of the digital economy



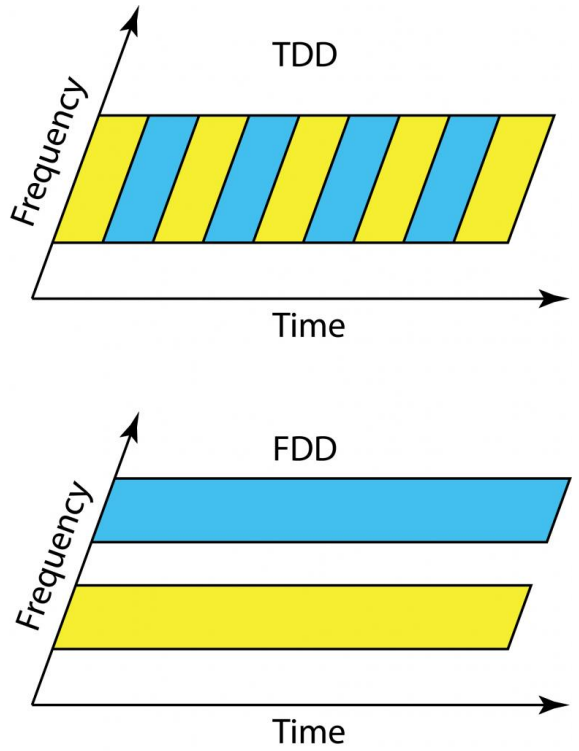
Source; BCG, 2019

3. Embracing TDD systems and synchronisation (1)

- When 4G/5G TDD systems are operating in 3.5GHz (or 2.3, 2.6 GHz), two types of synchronisation will be necessary to avoid interference:

- **Inter-operator synchronisation (within a country)**
  - Australia, China, the EU, Japan and South Korea have adopted this
  - Additional guard bands and improved filtering of transceivers can reduce interference, but limited availability of 3.5GHz spectrum in many markets makes synchronisation the better option
  - Synchronisation ensures efficient spectrum use and reduces network equipment costs

- **Cross-border synchronisation**
  - Clock Synchronisation
  - Slot Synchronisation
  - Frame Structure Synchronisation (same frame structure)



Source: Emil Björnson

3. Embracing TDD systems and synchronisation (2)

Cross-border Synchronisation

- *Clock Synchronisation*

  - Distributed synchronisation scheme based on satellite (i.e. GPS)
  - Centralised synchronisation scheme based on IEEE 1588V2 system
  - *Combination of methods* in order to improve reliability. If MNOs use the same frame structure, then frame structure is synchronised

- *Slot Synchronisation*

  - Defines the time that each slot begins
  - Full synchronisation across borders might not be feasible though it is optimal.
  - If not possible, same frame structure should be adopted by neighbouring ASEAN countries. This results in less interference and requires less regional coordination efforts.

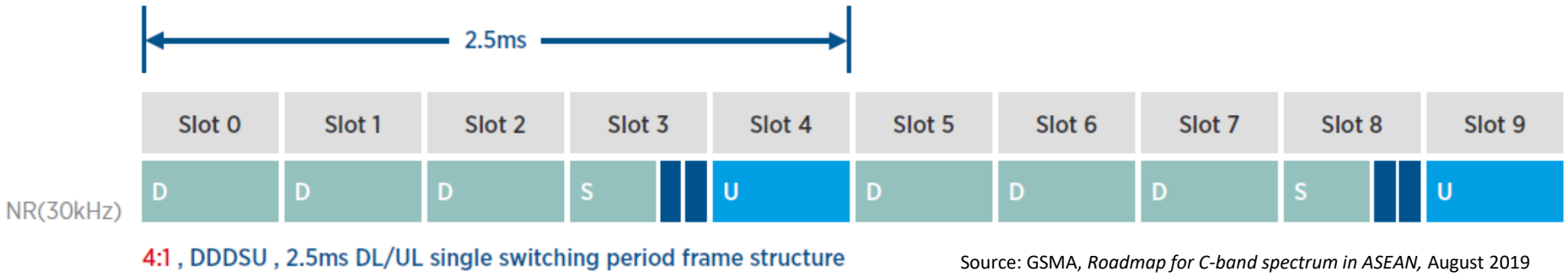
3. Embracing TDD systems and synchronisation (2)

Cross-border Synchronisation

- *Frame Structure Synchronisation*

  - DL traffic expected to continue to dominate mobile data traffic in 5G networks
  - Recommended structure (C-band 5G only microcell networks) is a **2.5 ms single DL/UL switching period frame structure (DDDSU)**
  - Has high system capacity and efficiency, and 4:1 facilitates future evolution to URLLC scenarios as it has a lower reduced round trip time (RTT)

Recommended National Frame Structure



4:1 , DDDSU , 2.5ms DL/UL single switching period frame structure

Source: GSMA, *Roadmap for C-band spectrum in ASEAN,* August 2019

3. Embracing TDD systems and synchronisation (3)

Possible Interference Paths due to Unsynchronised TDD Networks

- Base station to base station
- Base station to user terminal
- User terminal to base station
- User terminal to user terminal co-channel

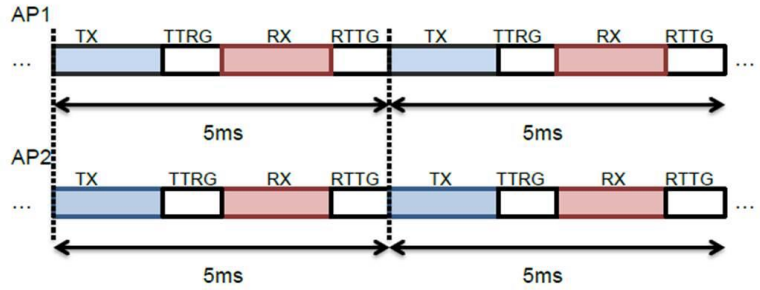


Figure 1: Synchronized APs

Minimising base station to base station interference

- Antenna shielding
- Antenna pointing away from borders
- Reducing antenna heights,
- Reducing transmitter power
- Antenna downtilting
- Use of directional, smart antennas, and
- Deployment of heterogenous networks close to the border (i.e. deploy micro and pico base stations)
- Terrain practical network planning

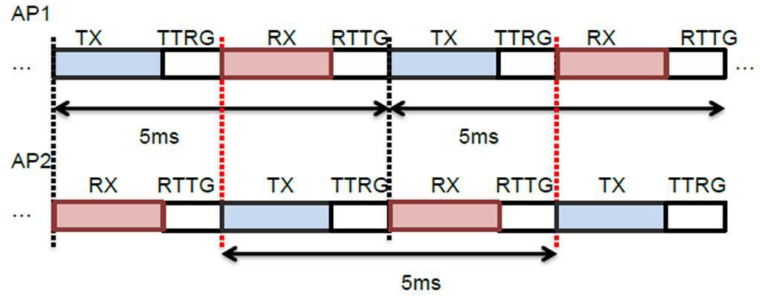


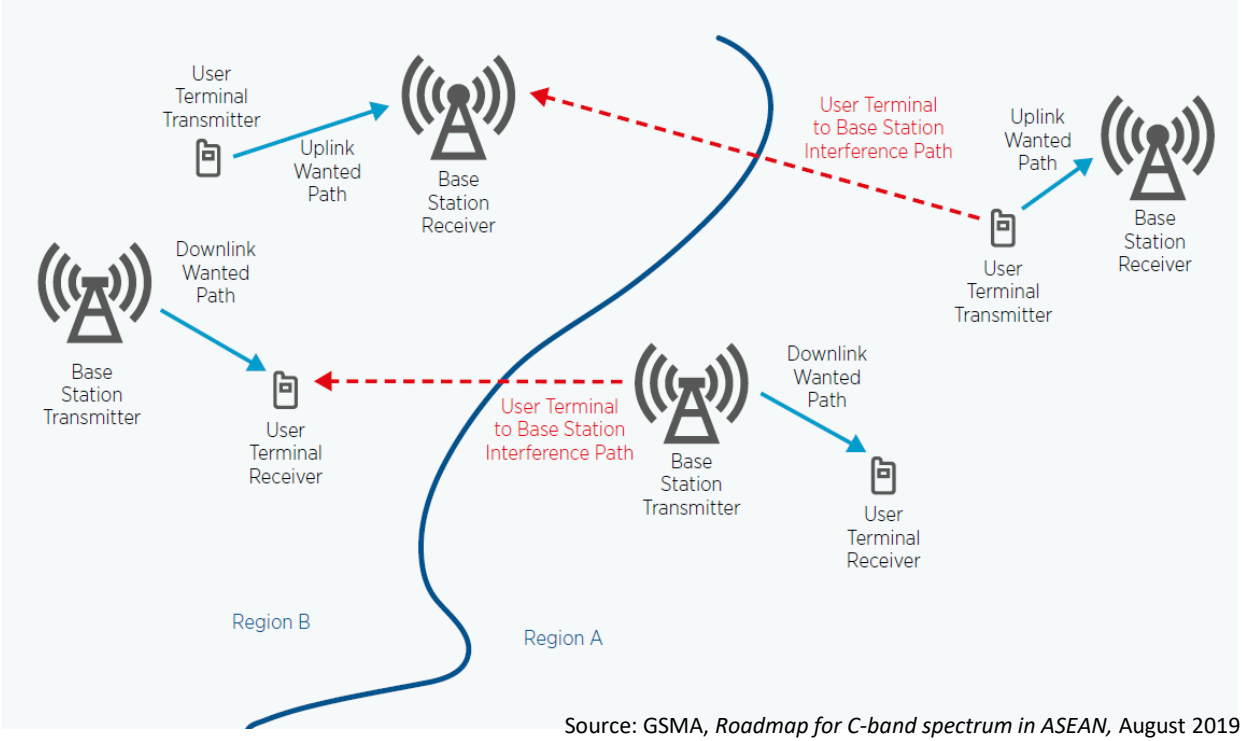
Figure 2: Unsynchronized APs

3. Embracing TDD systems and synchronisation (4)

Benefits of Synchronisation

- Synchronisation eliminates *base station to base station interference* paths and coordination threshold conditions are driven by interference paths between base stations and user terminals.

Interference from Region A into Region B when synchronised TDD networks are deployed



Source: GSMA, *Roadmap for C-band spectrum in ASEAN,* August 2019

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4. The move to IP: VoLTE interconnection (1)

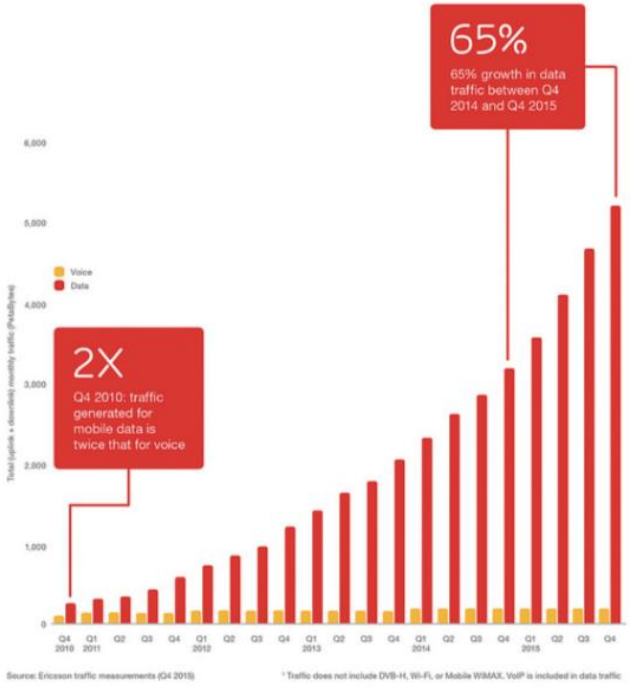
VoLTE is a real-time voice service delivered as data over LTE. As it is based on the IP Multimedia Subsystem (IMS) network, there is no dependency on the legacy circuit-switched voice network.

Why VoLTE?

- The switch to 4G (and 5G) is inevitable

VoLTE brings a host of benefits, including:

- High quality voice and video call for consumers
- Brand positioning, legacy network switch-off, greater demand for MNO core services and the possibility of greater control over other access mediums for operators



Source: Ericsson Mobility Report – Mobile World Congress Edition, February 2016

4. The move to IP: VoLTE interconnection (2)

What are the benefits of VoLTE?

- Provides a more efficient use of spectrum than traditional voice;
- Meets the rising demand for richer, more reliable services;
- Eliminates the need to have voice on one network and data on another;
- Unlocks new revenue potential, utilising IMS as the common service platform;
- Can be deployed in parallel with video calls over LTE and RCS multimedia services, including video share, multimedia messaging, chat and file transfer;
- Ensures that video services are fully interoperable across the operator community, just as voice services are, as demand for video calls grows;
- Increases handset battery life by 40 per cent (compared with VoIP);
- Delivers an unusually clear calling experience; and
- Provides rapid call establishment time.

Source: https://www.4g.co.uk/what-is-volte/

4. The move to IP: VoLTE interconnection (3)

GSMA and VoLTE

- **Promote scale**
  For VoLTE/video calls over LTE implementation to work, it's vital it's based on a single technology and not undermined by fragmentation or diversity. It must work throughout a community of 6 billion+ connections (and growing) and across all networks and devices.

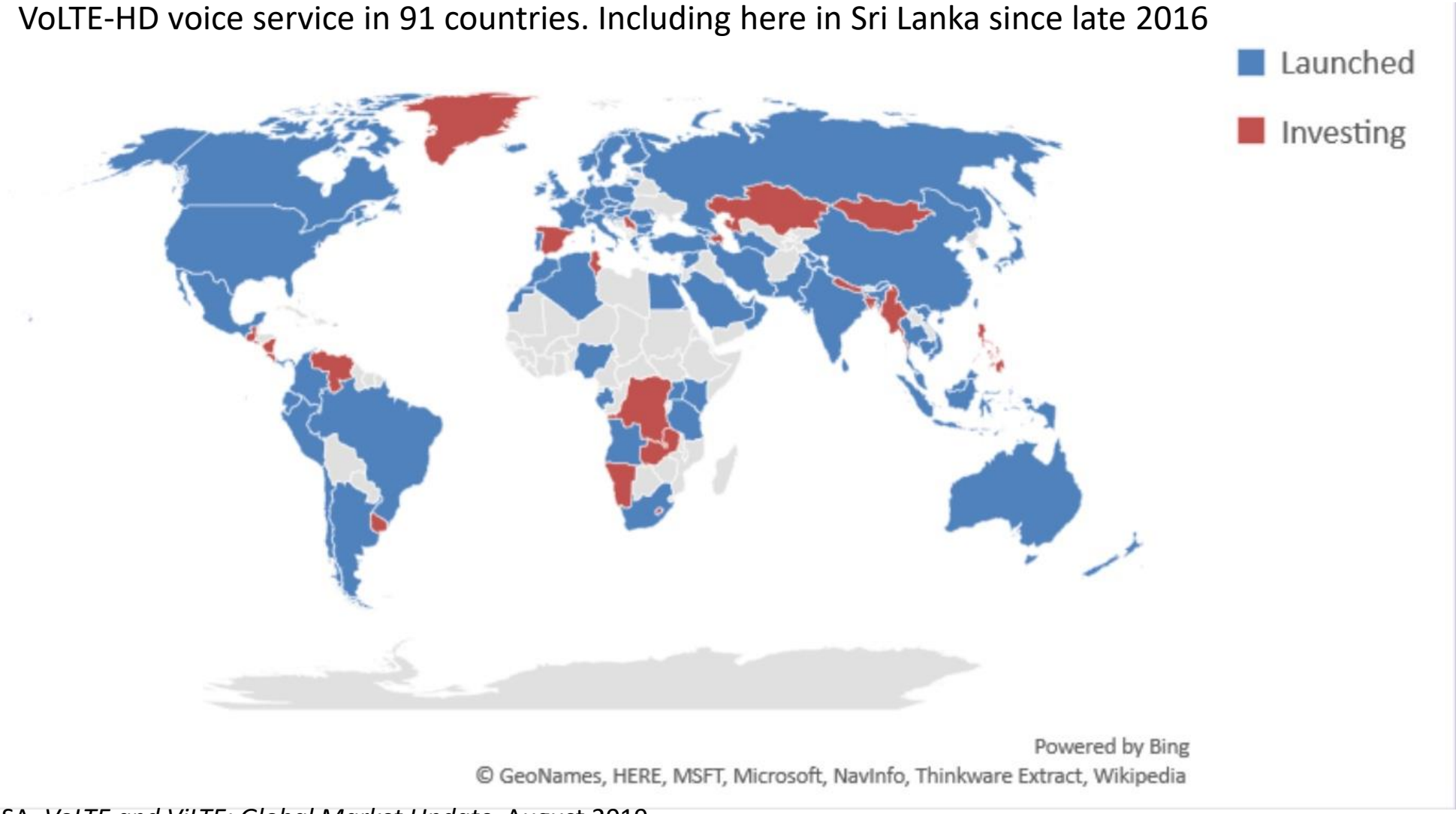
- **Reduce complexity**
  A common implementation, adhered to by all, will let messages and media be delivered in the best way. This provides consumers with the best quality experience. However, lack of common deployments between networks can detract from the overall quality of the voice/messaging service (e.g. end-to-end HD voice).

- **Enable interconnect and roaming**
  Seamless roaming can be optimised in the all-IP world. That is if all parties adhere to a single, common implementation of interfaces between every device and network.

Source: https://www.4g.co.uk/what-is-volte/

4. The move to IP: VoLTE interconnection (4)

A total of 262 operators are investing in VoLTE in 120 countries (including territories, dependencies and disputed territories), including 194 operators with commercially launched VoLTE-HD voice service in 91 countries. Including here in Sri Lanka since late 2016



GSA, *VoLTE and ViLTE: Global Market Update*, August 2019

4. The move to IP: VoLTE interconnection (5)

- IP-based communication will open a new dimension of communication: platform
  - VoLTE: provides enhanced communication quality
  - VoLTE + RCS lays a foundation for users/developers to add various services “on top”

- **Why VoLTE Interconnect**

Category	Driver	B*	R*
Revenue Growth	ARPU up with LTE		
Cost reduction	Network consolidation		
Customer benefit	Higher quality voice (HD Voice)		
	Uniform LTE experience (no CSFB)		
Promote ICT Industry	Convergence of services with communications		

* B (Business), R (Regulatory)

Source: GSMA VoLTE Interconnection Case Study

4. The move to IP: VoLTE interconnection (6)

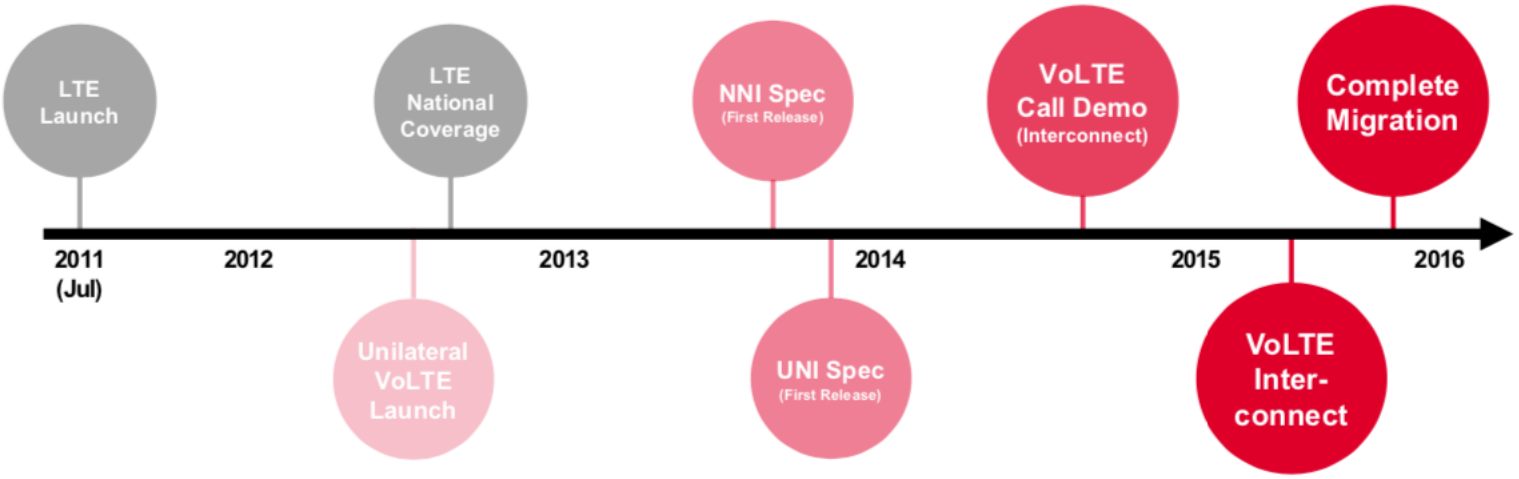
- IP-based communication will open a new dimension of communication: platform
  - VoLTE: provides enhanced communication quality
  - VoLTE + RCS lays a foundation for users/developers to add various services “on top”

- **Compliance with IR.92 UNI Specification**

  Benefits
  - Reduces time-to-market and simplifies interworking
  - Reduces possible test combinations of device & operator
  - Consistent implementations simplify interworking § E.g., DTMF in Korean case
  - With all devices complying with IR.92, it would be possible to agree on single VoLTE roaming model
  - Minimises incorrect implementation cases
  - Details that do not deviate from IR.92 guides operators and vendors to correctly implement technology for interconnect

4. The move to IP: VoLTE interconnection (7)

Case Study: South Korea



LTE
- LTE Launch (Jul 2011)
- LTE National Coverage (Sep 2012)

VoLTE
- Unilateral launches (Aug 2012)
- First release of NNI spec (Oct 2013)
- First release of UNI spec (Dec 2013)
- VoLTE Call (interconnect) demo (Oct 2014)
- VoLTE interconnect (Jun 2015)
- Complete migration (Nov 2015)

Source: GSMA VoLTE Interconnection Case Study

- Widespread deployment of VoLTE (especially using sub-1 GHz spectrum like 700 MHz) is key to the switch of legacy 2G/3G networks which is now a trend which is accelerating with the launch of 5G services. It is difficult if not impossible for MNOs to profitably deploy and operate 2G, 3G, 4G and 5G networks. See ITU, *Digital Infrastructure Policy and Regulation in Asia Pacific Region*, September 2019, page 33

Thank you

I am happy to answer any questions