19 JAN - 8 FEB, 2021

ASIA TELECOM SUMMIT

Wi-Fi & 5G
The Path to Convergence

Steve Andrews

2nd Feb 2021

08:00GMT / 16:00 SGT

#WGC | #wifirevolution | #lovewifi | #openroaming

WIRELESS GLOBAL CONGRESS
WIRELESS BROADBAND ALLIANCE

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Moderator Introduction & Welcome

STEVE ANDREWS

CHAIRMAN LUMINET, NED EDGEWATER WIRELESS & WBA BOARD ADVISOR

WIRELESS GLOBAL CONGRESS
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ASIA TELECOM SUMMIT

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Asia Telecom Summit

Full Program Agenda

3rd – 4th February – WBA Members Only Working Sessions
Start time: 10:00 ET; 07:00 PT; 23:00 Singapore; 15:00 GMT

4th February – WBA Members Only Working Sessions: **Briefing for Asia-based members**
Start Time: 16:30 Singapore; 08:30 BST – 09:30 CET

ASIA TELECOM SUMMIT OPEN CONFERENCE: Start time 16:00 Singapore; 08:00 GMT; 03:00 ET; 00:00 PT

Tuesday 19th January	Wednesday 27th January	Thursday 28th January	Tuesday 2nd February	Monday 8th February
WBA Executive Plenary	OpenRoaming™: Transforming Public & Guest Wi-Fi	Next Generation of Wi-Fi	Wi-Fi & 5G: The Path To Convergence 16:00PM Singapore Wi-Fi & 5G: The Path To Convergence 12:30 AM Singapore	Next Gen Wi-Fi & IoT

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Wi-Fi & 5G: The Path to Convergence

Steve Andrews

Chairman Luminet,
NED Edgewater Wireless &
WBA Board Advisor

Dr. Stan Wong

Asst. Vice President,
Strategic Design & Planning
HKT

Jonas Björklund

CTO
Aptilo Networks

Nigel Bird

NGN Standardization Manager
Orange

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Wi-Fi & 5G: The Path to Convergence

Binita Gupta

Sr. Staff Systems Architect

Intel Corporation

Florin Baboescu

Senior Principal Scientist

Broadcom

Mark Grayson

Distinguished Consulting Engineer

Cisco

Bruno Tomás

Director of Programs

Wireless Broadband Alliance

Wi-Fi & 5G: The Path To Convergence

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TODAY'S AGENDA	
08:00am (GMT)	**Moderator Introduction & Welcome** Steve Andrews, Chairman Luminet, NED Edgewater Wireless & WBA Board Advisor
08:05am (GMT)	**Delivering new architecture for 5G over Wi-Fi: RAN Convergence** Dr. Stan Wong, Asst. Vice President, Strategic Design & Planning, HKT
08:25am (GMT)	**Maximizing Wi-Fi Opportunities in the 5G Era** Jonas Björklund, CTO, Aptilo Networks.
08:45am (GMT)	**Overview: WBA's 5G Workgroup program** Nigel Bird, NGN Standardization Manager, Orange
08:55am (GMT)	**Overview of WBA's Latest White Paper: 5G & Wi-Fi RAN Convergence. Aligning the Industry on Opportunities & Challenges** Binita Gupta, Senior Systems Architect, Intel; Florin Baboescu, Senior Principal Scientist, Broadcom; Mark Grayson, Distinguished Consulting Engineer, Cisco
09:35am (GMT)	**Moderated Q & A** All
09:45am (GMT)	**WBA 5G Program: What next?** Bruno Tomás, Director of Programs, Wireless Broadband Alliance
10:00am (GMT)	**Close** Steve Andrews, Chairman Luminet, NED Edgewater Wireless & WBA Board Advisor

Delivering new architecture for 5G over Wi-Fi: RAN Convergence

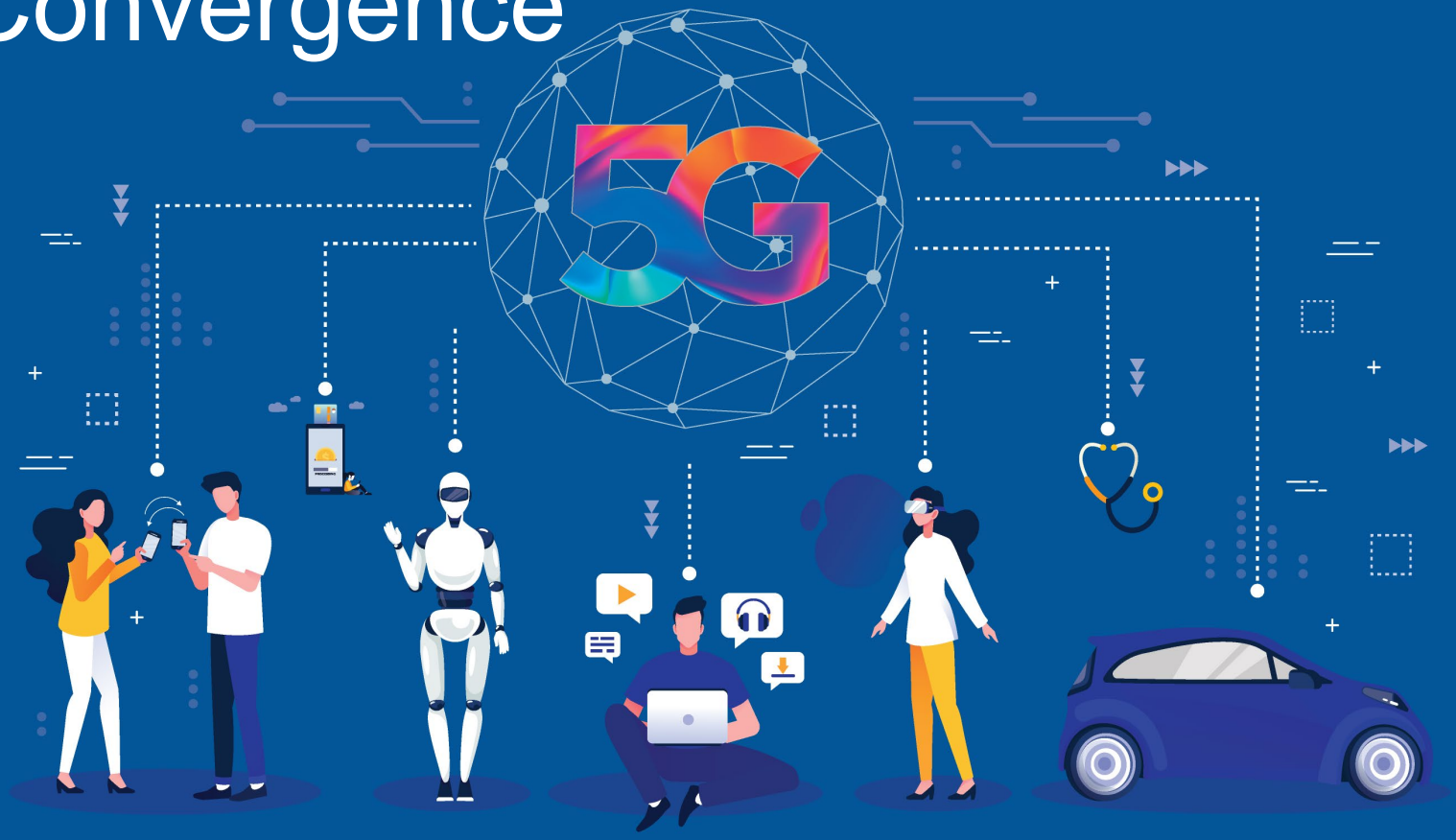
DR. STAN WONG

ASST. VICE PRESIDENT, STRATEGIC DESIGN AND PLANNING, HKT

HKT®

Delivering New Architecture for 5G over Wi-Fi: RAN Convergence

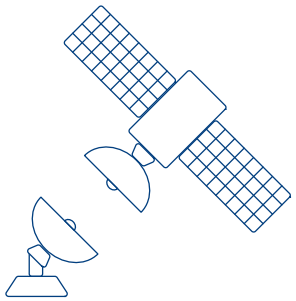
Dr. Stan Wong
Assistant Vice President
Email: stan.ws.wong@pccw.com



Wireless Broadband Alliance
WBA Asia Telecom Summit 2nd Feb 2021

WIRELESS BROADBAND ALLIANCE
DRIVING NEXT WIRELESS EXPERIENCE

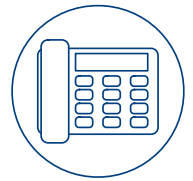
HKT Quadruple-Play Experience



Satellite Transmission

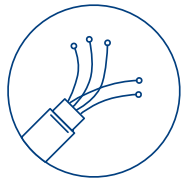
International Telephony

Local Telephony



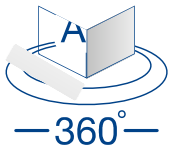
Ip telephone

ADSL



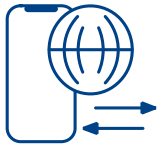
Fiber-to-the-Home

Quadruple-play Experience in One Network

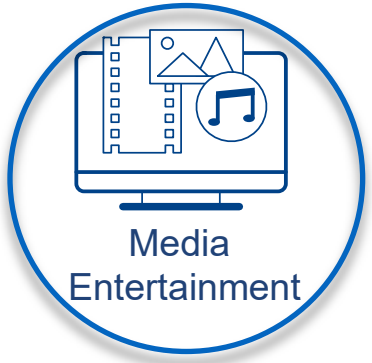


AR and eSport

360 video streaming



Enhanced MBB



IP TV

Music Streaming

Over-The-Top-Service

Video on Demand

csl. Wi-Fi Hotspots Partnership

Shopping Malls

STM Shopping Center · Plaza Ascot · PMQ · Telford Plaza · Popcorn mtrmalls · Paradise Mall · Maritime Square · Luk Yeung Galleria · Yuen Long Plaza · the lane · citylink · Ocean Walk · 朗豪坊 Langham Place · The Edge

Food & Beverages

Starbucks · Pacific Coffee · Pizza Hut · 翠餅博士 PHD · KFC · MX · 稻香集團 · Joyous One · wildfire pizzabar & grill · alfafa · 牛角 日本燒肉專門店

Commercial Buildings

中国建设银行大厦
CCB TOWER
28 HENNESSY ROAD

Universities and Tertiary Institutions

香港大學 The University of Hong Kong · 香港中文大學 The Chinese University of Hong Kong · The Hong Kong Polytechnic University 香港理工大學 · 香港科技大學 The Hong Kong University of Science and Technology · 香港公開大學 The Open University of Hong Kong · Lingnan 嶺南大學 University 香港嶺南大學 · 香港教育大學 The Education University of Hong Kong · CityU 香港城市大學 City University of Hong Kong · 香港浸會大學 Hong Kong Baptist University

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7-Eleven · 759 阿信屋 · Circle K · VanGO

Phone Booths

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香港賽馬會 The Hong Kong Jockey Club · westKowloon 西九文化區 · 伊利沙伯醫院 Queen Elizabeth Hospital · Discovery Bay Golf Club Hong Kong · club siena Discovery Bay · AsiaWorld-Expo 亞洲國際博覽館 · 屯門公路轉車站 Tuen Mun Road Interchange · Discovery 愉景灣 Bay FERRY

HKT Here To Serve http://www.cslwifi.com/index.html

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5G Coverage by End 2020

Full 5G Coverage in Hong Kong

- 5G Cell Site
- 5G coverage by 1 Apr 2020
- 5G Coverage by End 2020

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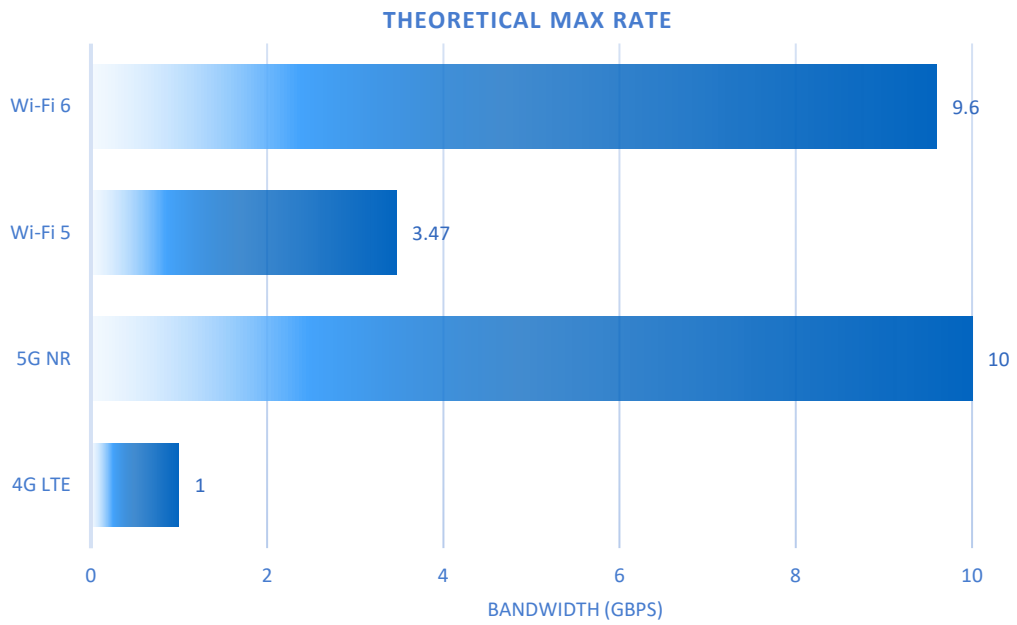
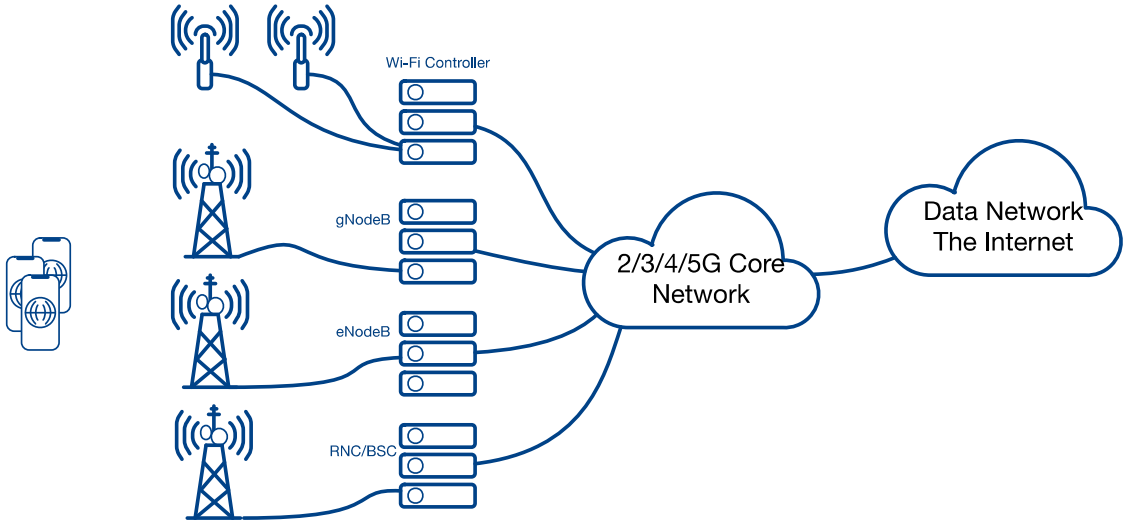
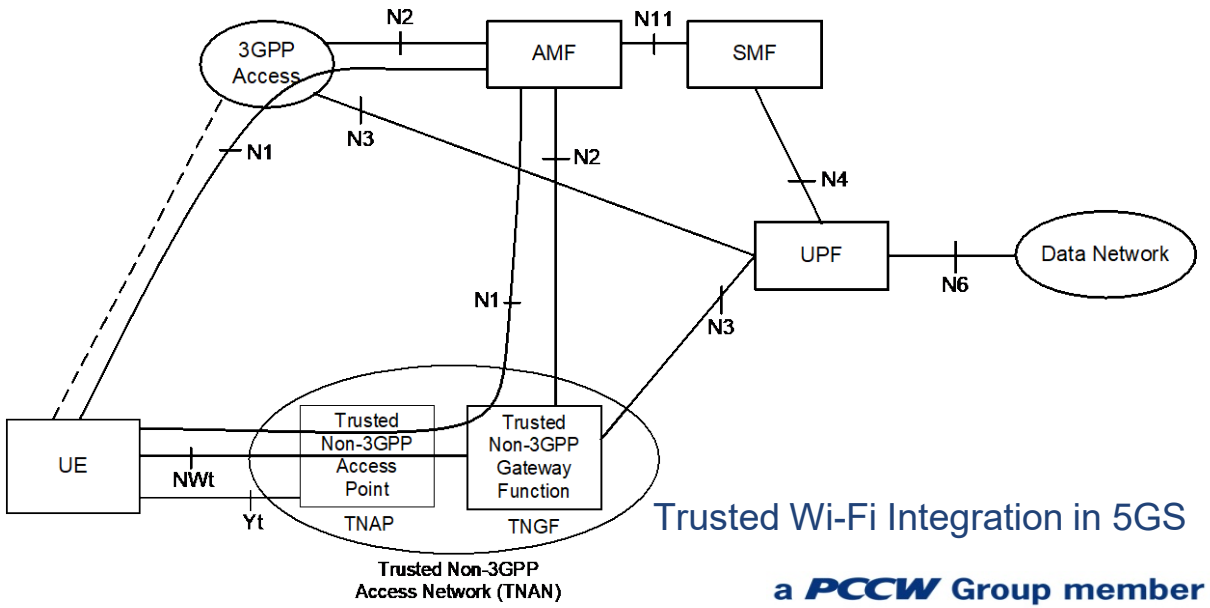
5G Integration with Wi-Fi





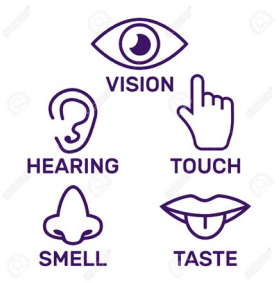
Technical Expectation cannot use to evaluate Subscriber/Customer/End-User Experience.



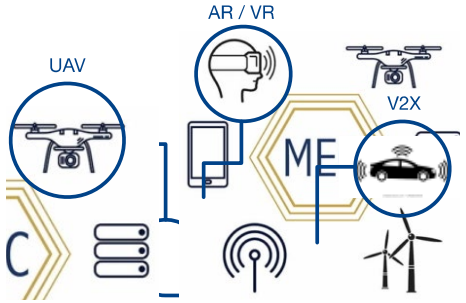
Trusted Wi-Fi Integration in 5GS

5G Innovation

The 5G innovation also include the following technologies and services ownership

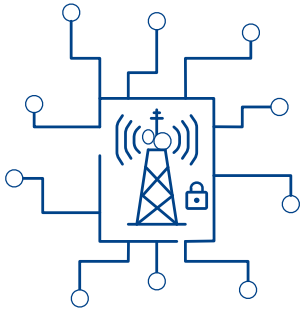


Tactile Internet

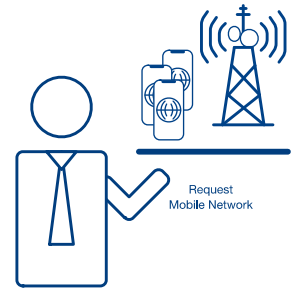


Multi-Access Edge Computing

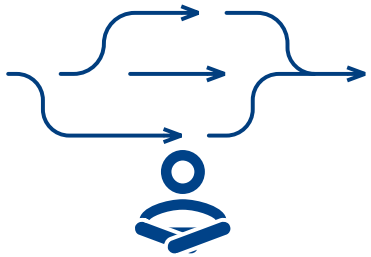
Network Slicing



Non-public Network



Mobile Network On-demand



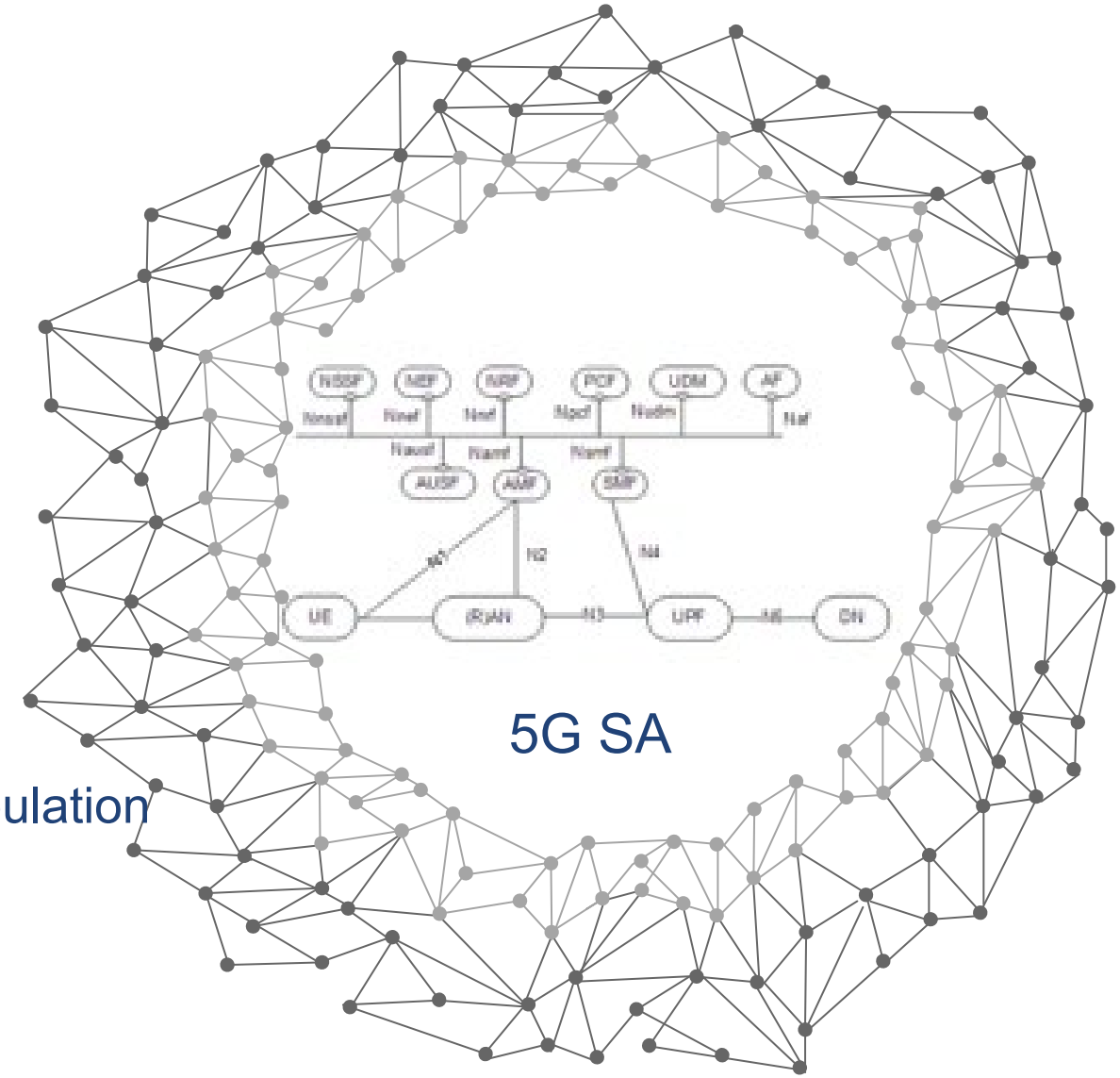
Network Infrastructure Flexibility

Enterprise Network Service Agility

With 5G Network Infrastructure Flexibility and Enterprise Network Service Agility, would gain the market competence, and velocity of services delivery.

5G Innovation & Wi-Fi Convergence Architecture

- Network Visibility
- Manageability
- Policy Control
- Tight integration with Wi-Fi
- Network Intelligence
- Network Resource Flexibility and Manipulation
- User Experience Continuity



Convergence Challenges

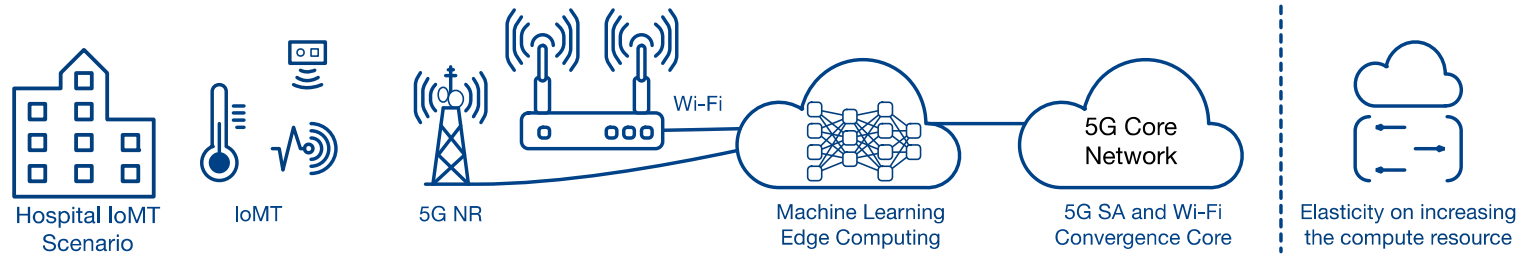
Technical Challenges

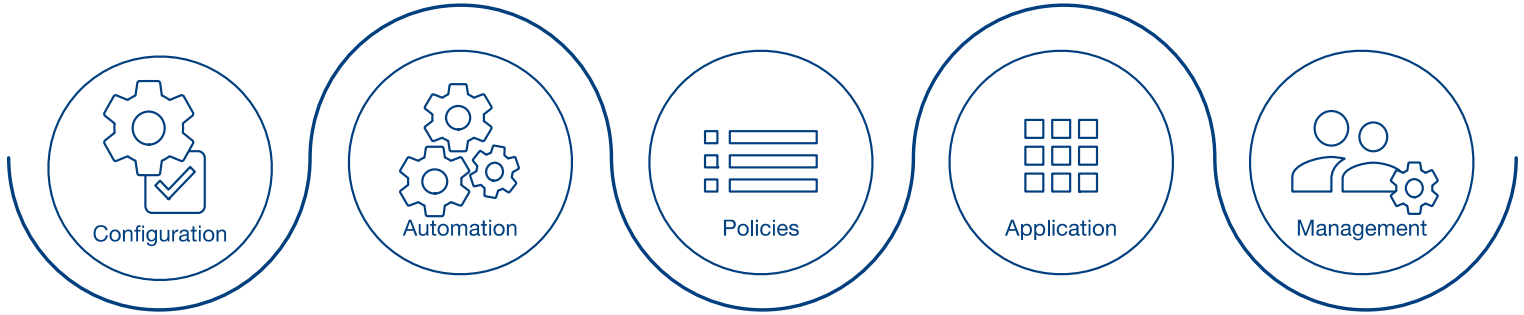
- **Resolving Ping / Pong Effects**
  - When subscriber on the edge of the Wi-Fi cell and overlapping with 5G cell.
- **Various user network registration methods can be deployed but which one is the most suitable for subscribers.**
- **Network Elasticity of Resource in Orchestrations**

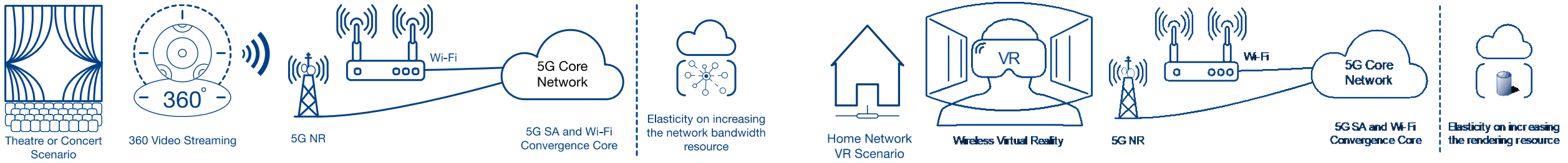
Business Challenges

- **The Public Expectation Free Internet Access over Wi-Fi**
- **The Convenience of Network Access**
- **The Cost per Registration via Wi-Fi vs Cellular**
- **The Cost of Deployment of Wi-Fi Infrastructure**

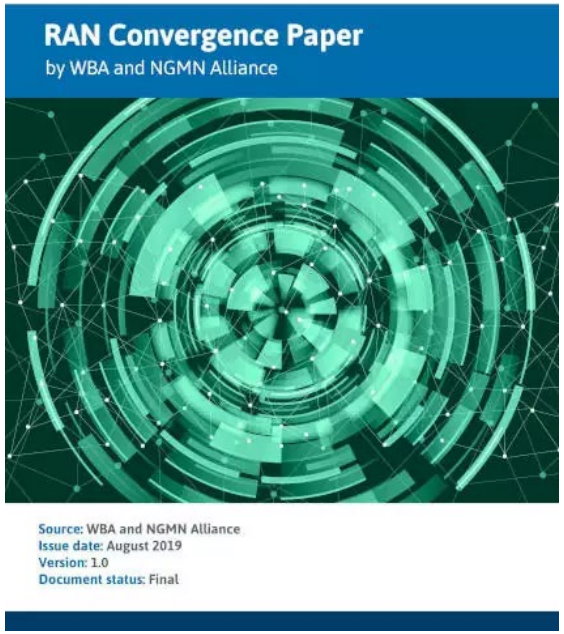
Network Elasticity with Convergence







Useful Convergence Material



https://wballiance.com/ran-convergence-paper-by-wba-and-ngmn-alliance/

WBA OpenRoaming™ creates the framework to connect billions of users and things to millions of Wi-Fi networks globally

WBA OpenRoaming™ is a roaming federation service enabling an automatic and secure Wi-Fi experience globally. With WBA OpenRoaming™, we are creating an open connectivity framework for all organizations in the wireless ecosystem to power new opportunities in the 5G era.

www.openroaming.org

a PCCW Group member

HKT Here To Serve

Thank you!

Dr. Stan Wong

Assistant Vice President

Strategic Planning and Design

HKT Limited

Email: stan.ws.wong@pccw.com

Maximizing Wi-Fi opportunities in the 5G era

JONAS BJÖRKLUND

CTO, APTILO NETWORKS

aptilo
an Enea company

MAXIMIZING WI-FI OPPORTUNITIES IN THE 5G ERA

JONAS BJÖRKLUND, CTO

APTILO NETWORKS [EST. 2001]

WORLDS #1

PROVIDER OF WI-FI SERVICE MANAGEMENT
FOR LARGE SCALE WI-FI DEPLOYMENTS

+200 MILLION
PEOPLE POWERED WITH WI-FI

+100
CARRIER WI-FI CUSTOMERS

+75
COUNTRIES

MNOs MUST RENEW THEIR WI-FI STRATEGIES

THE PROMISES OF 5G

But there are some challenges!

5G: ~100X HARDER TO PENETRATE WALLS

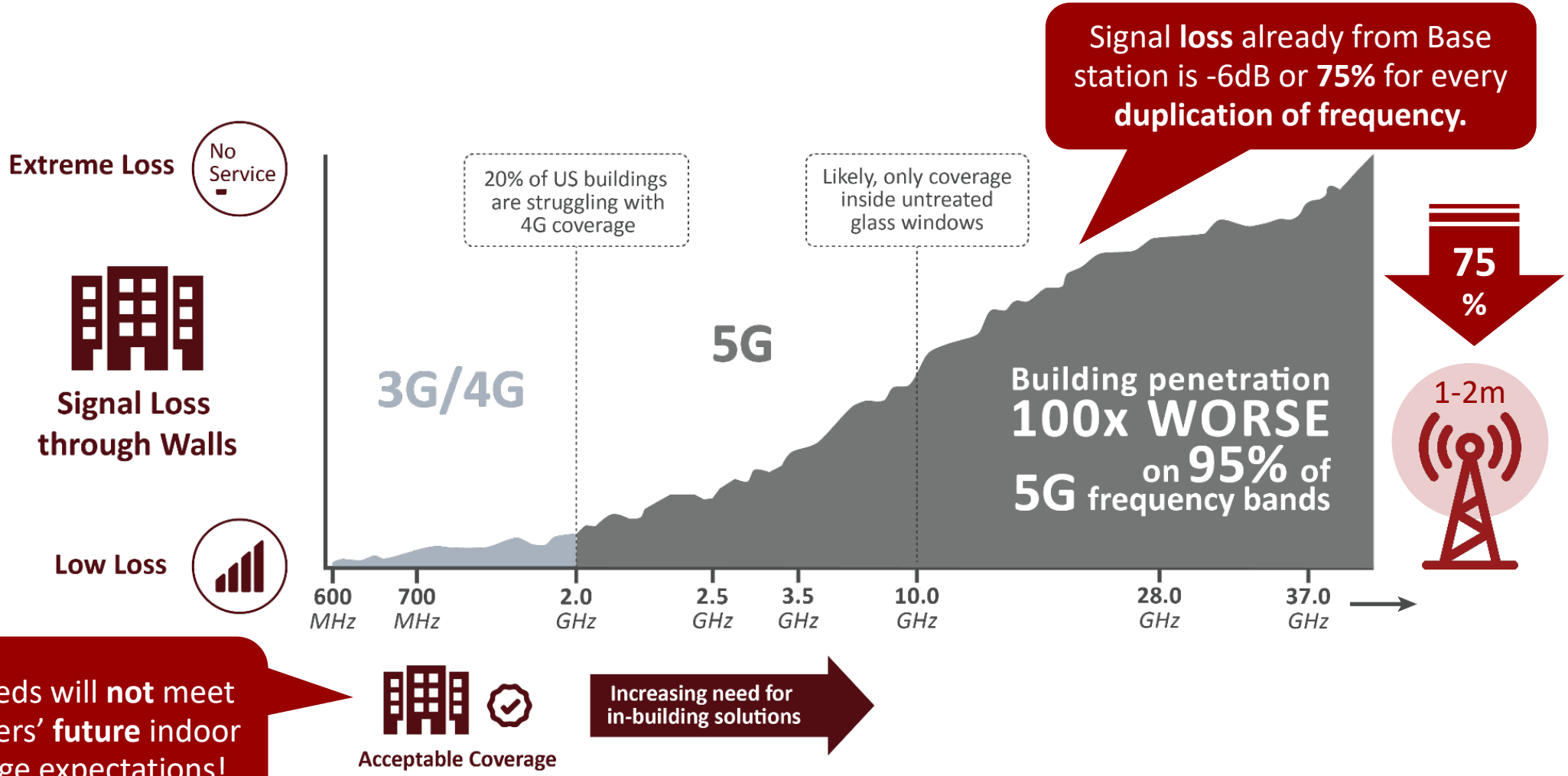
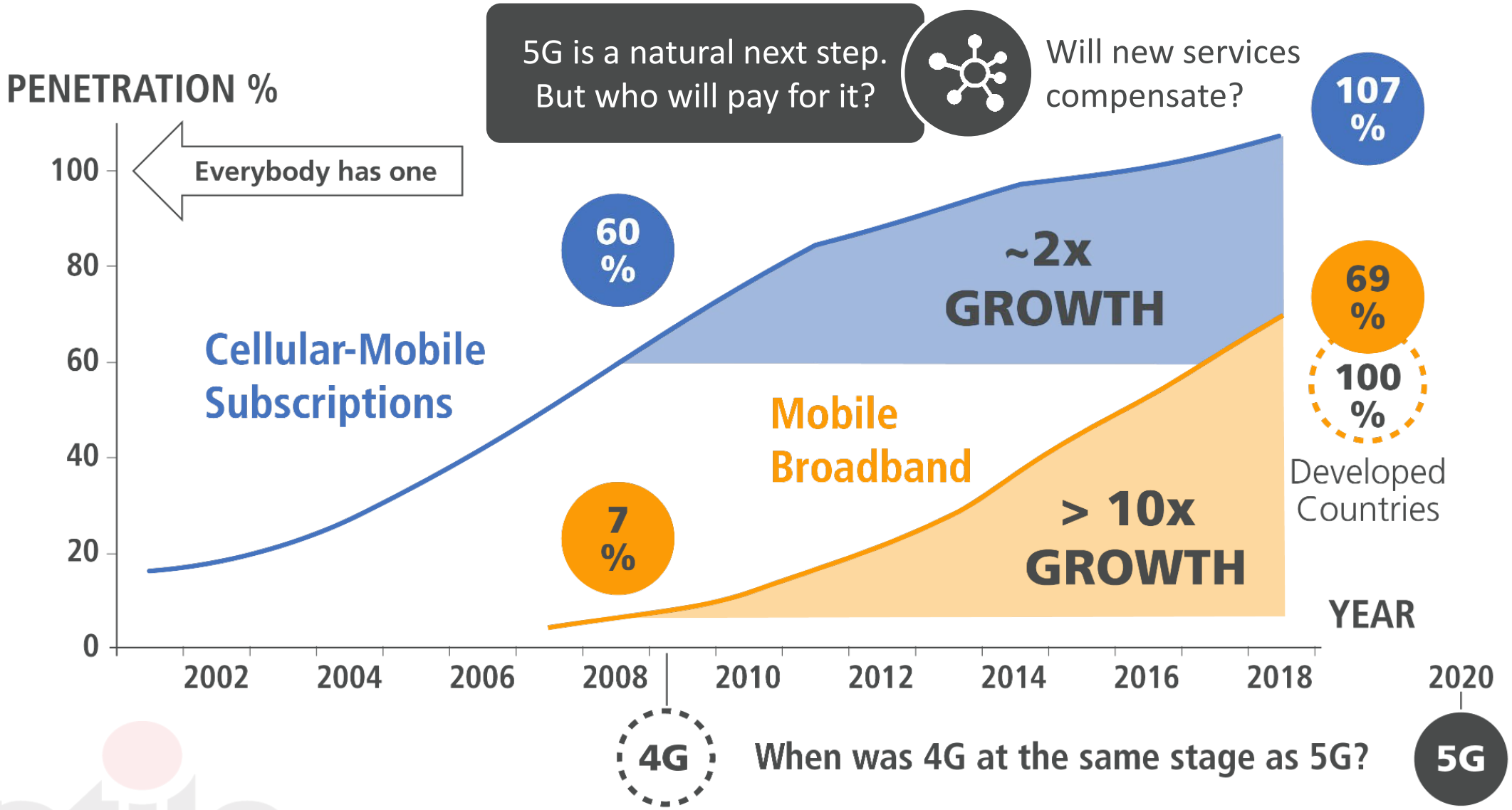


Diagram source: SureCall (https://blog.surecall.com/what-is-5g-frequencies-faults/)

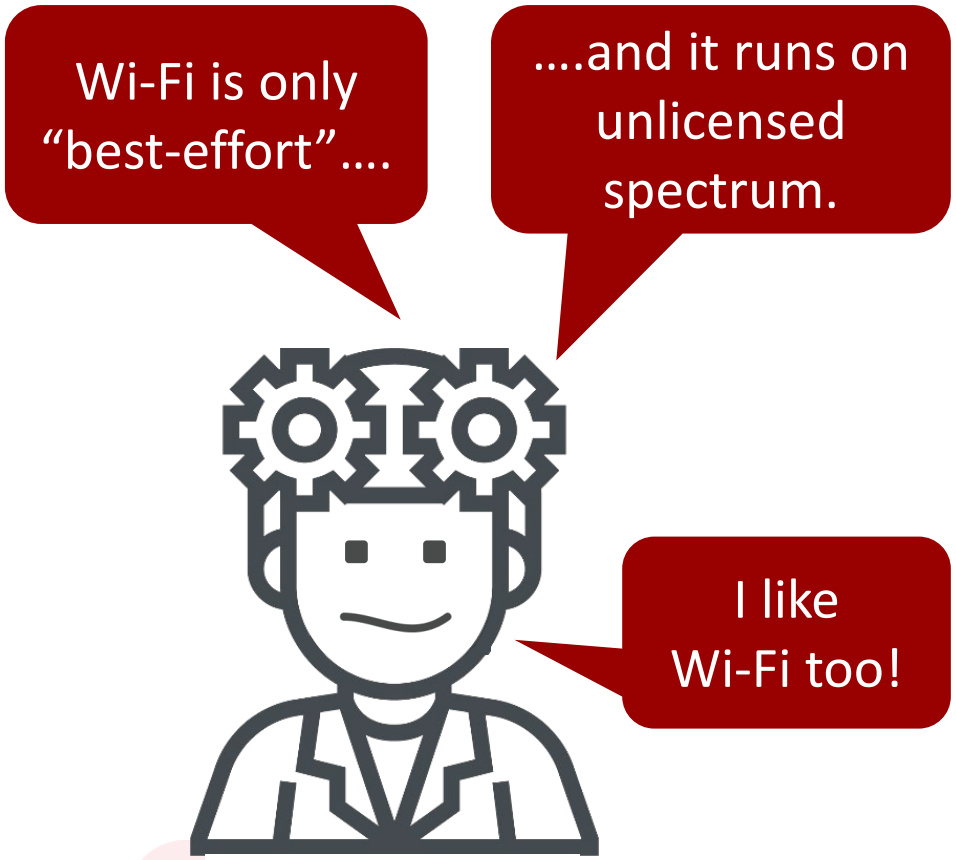
PREDICTING THE FUTURE LOOKING AT THE PAST



Source: ITU World Telecommunication/ICT Indicators database

THINGS HAVE CHANGED WI-FI IS NOT THE FOE!

MNO's traditional perspective



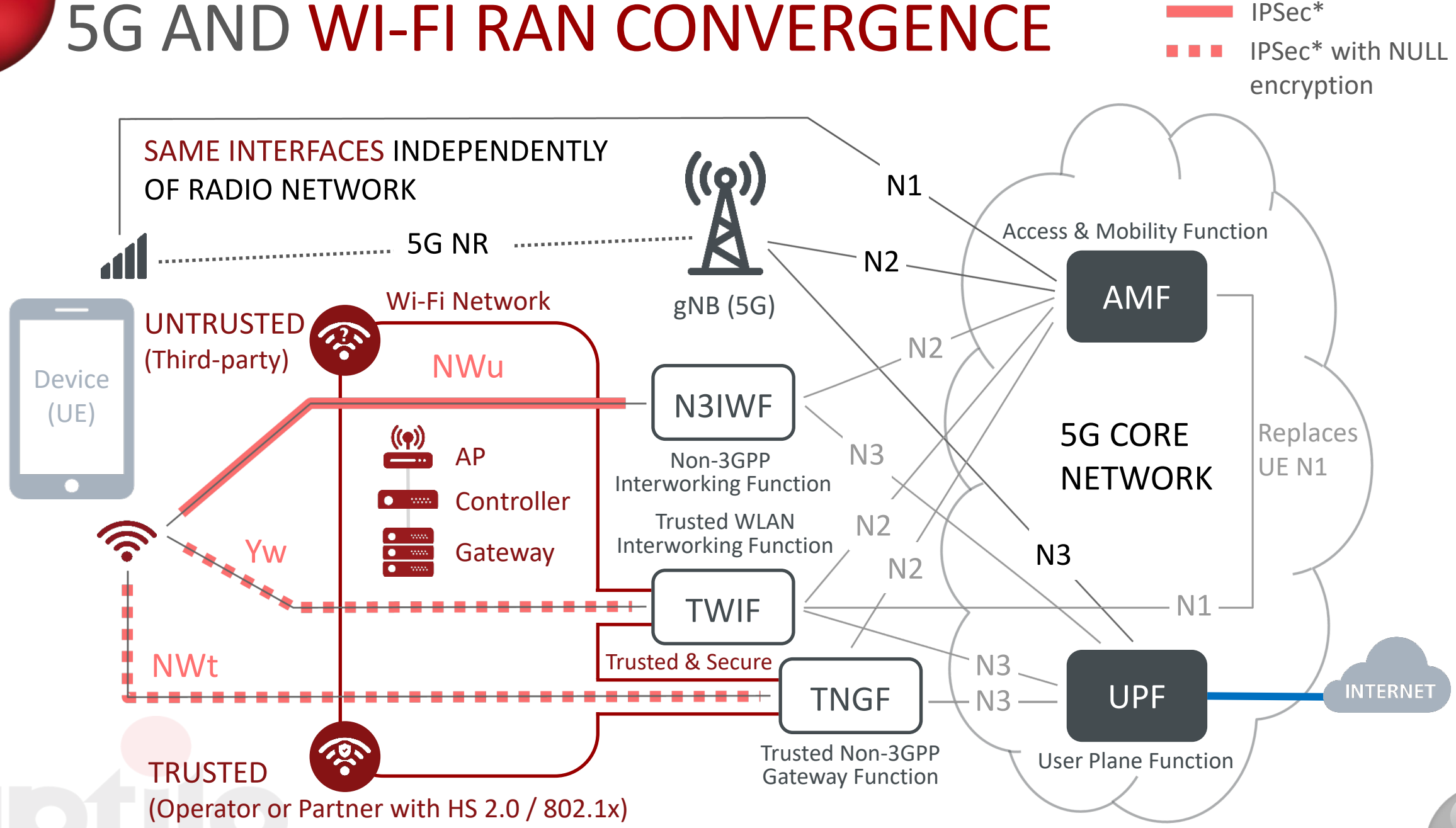
Reality check 2021

Wi-Fi 6 has OFDMA

- Wi-Fi 6 has scheduling similar to LTE
- 6 GHz: The Wi-Fi spectrum will triple!
- Wi-Fi for indoor coverage
- Wi-Fi for additional capacity

*) One tunnel for signaling + one or more for data

5G AND WI-FI RAN CONVERGENCE



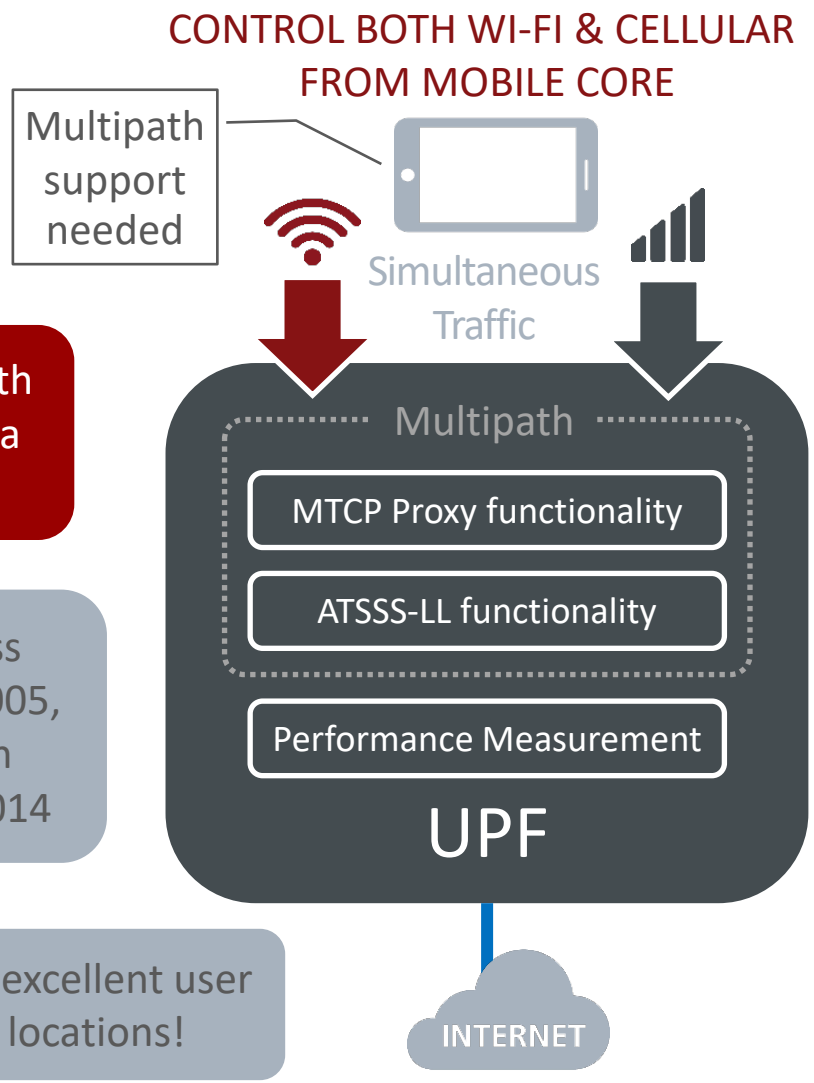
ATSSS ACCESS TRAFFIC STEERING, SWITCHING & SPLITTING

- The holy grail of 3GPP integration
- Rely on multipath technology
- Rely on device support
- Still very early days!
- No reason to wait!

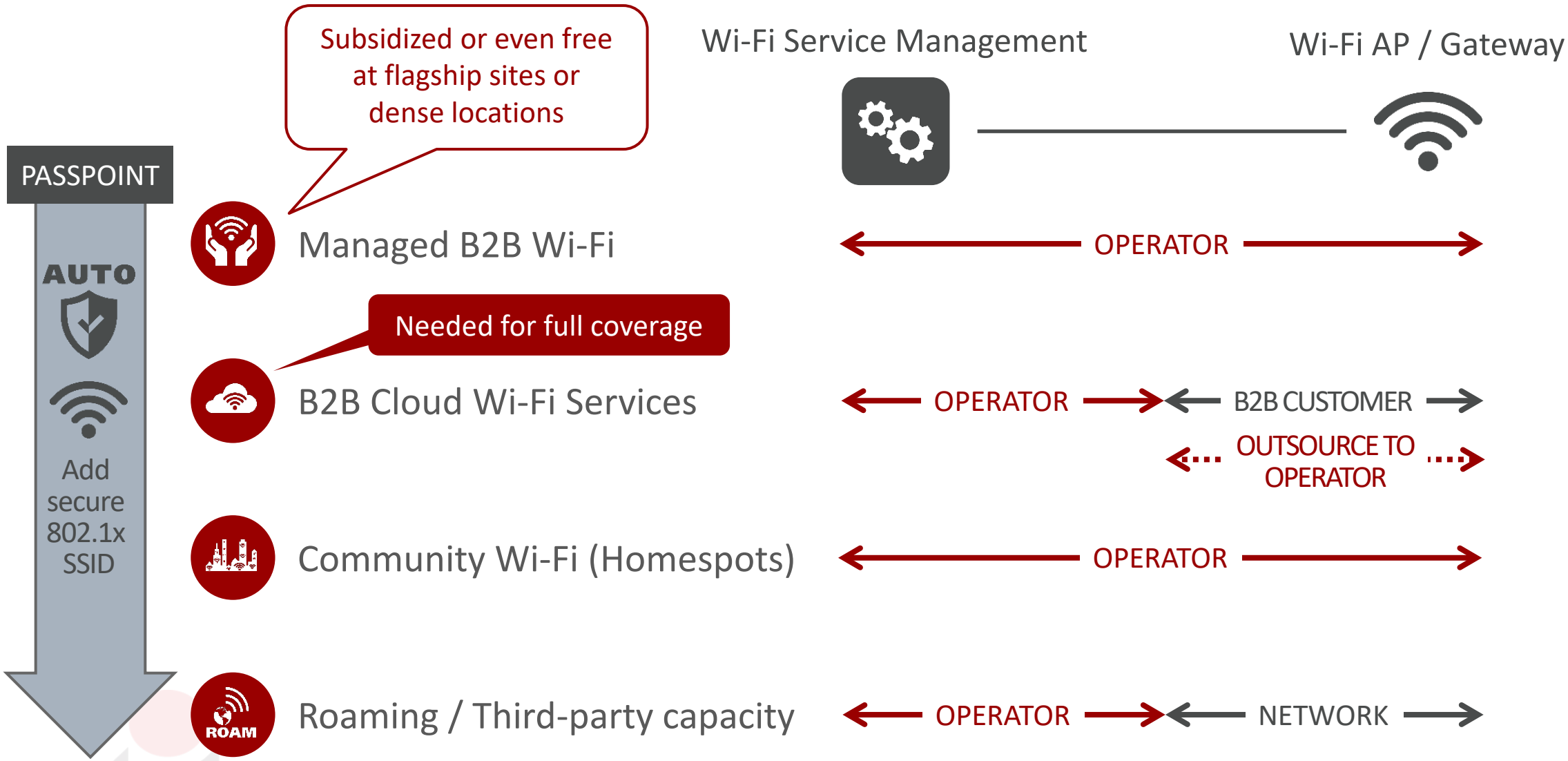
Apple use multipath for e.g Siri, but in a proprietary way

Untrusted access standardized in 2005, but took of with Wi-Fi Calling in 2014

Wi-Fi 6 is already delivering an excellent user experience in dense indoor locations!



HOW TO BUILD WI-FI INDOOR FOOTPRINT?



THE FIXED & MOBILE CONVERGENCE TREND

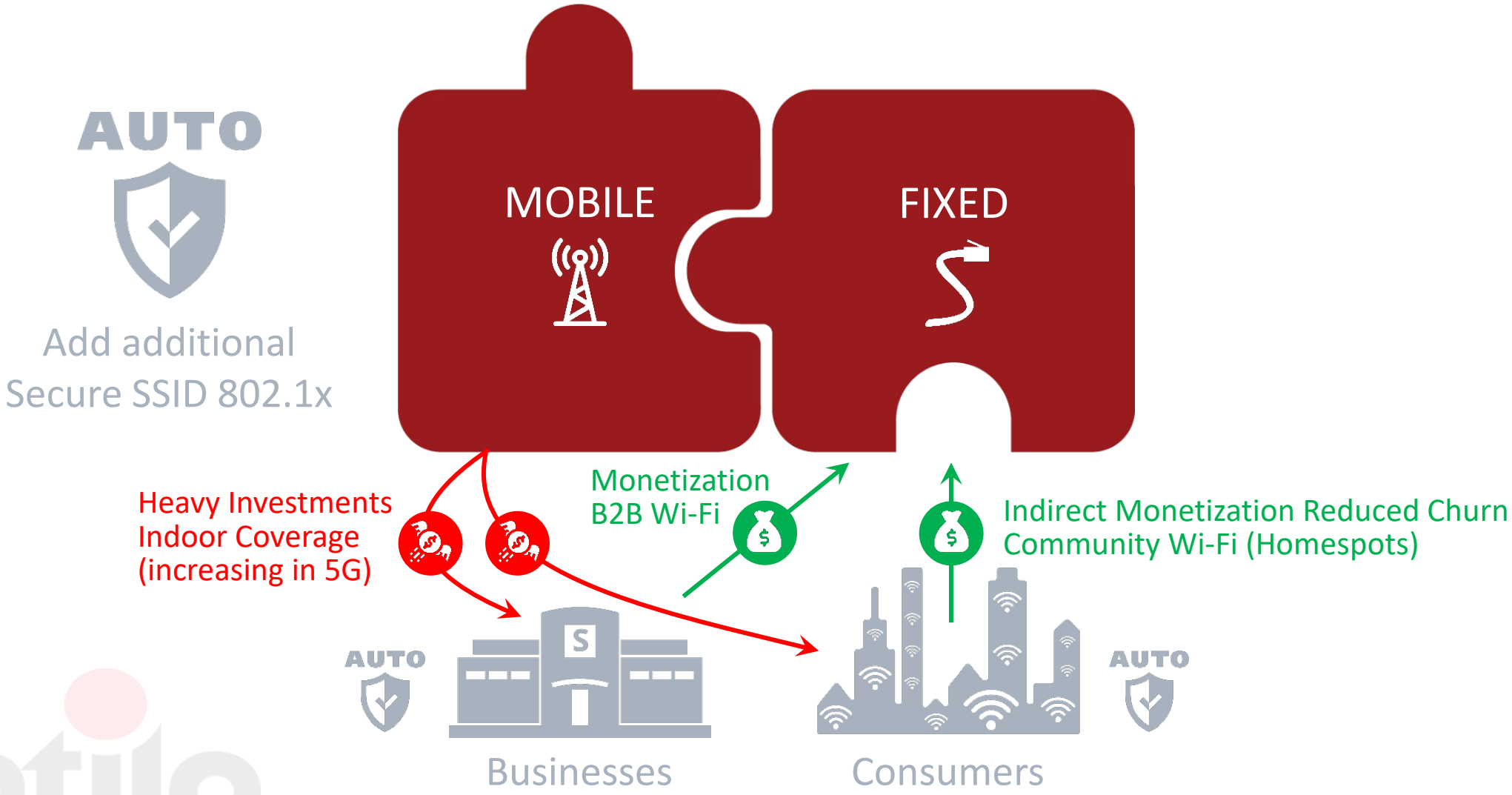
Acquisitions and mergers globally

"Europe is a success story and convergence is the jewel in our crown," said Ramon Fernandez, Orange CFO and Head of Europe.

telecoms.com January 2020

THE FIXED & MOBILE CONVERGENCE TREND

IS STRONG, BUT OPERATORS MUST BREAK DEPARTMENTAL SILOS TO MAXIMIZE THE VALUE



B2B WI-FI IT'S A WIN ✕ 5

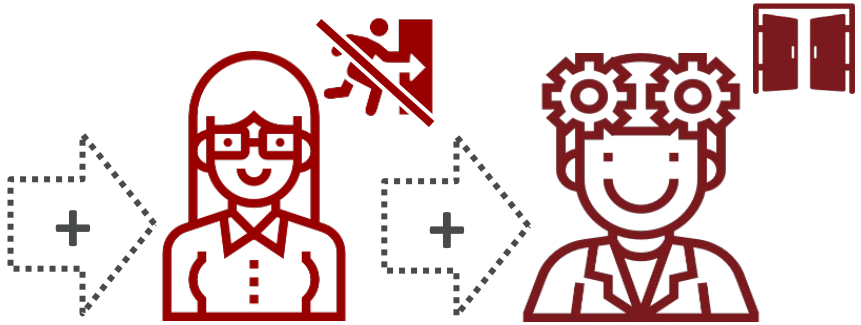
END-USERS
WIN

BUSINESS CUSTOMERS
WIN

BUSINESS TO BUSINESS (B2B)
WIN

CONSUMER BUSINESSES
WIN

NETWORK OPERATIONS
WIN



SERVICE PROVIDER DEPARTMENTS

Step Up Your Wi-Fi and IoT.

Thank-you!

https://www.aptilo.com

Overview: WBA's 5G Work Group program

NIGEL BIRD

NGN STANDARDIZATION MANAGER, ORANGE

WIRELESS BROADBAND ALLIANCE

DRIVING NEXT WIRELESS EXPERIENCE

5G WORKGROUP OVERVIEW

2 February 2021

5G Workgroup – Story So Far

5G Work Group 2017 <> 2020 Deliveries

WBA storyline since 2017 work inception:

1. 5G Networks – The Role of Wi-Fi and Unlicensed Technologies
2. Network Slicing for 5G – Wi-Fi Capabilities
3. Unlicensed Integration with 5G Networks
4. WBA & NGMN RAN Convergence paper
5. NEW - 5G and Wi-Fi RAN Convergence

Next Steps:

Next project –

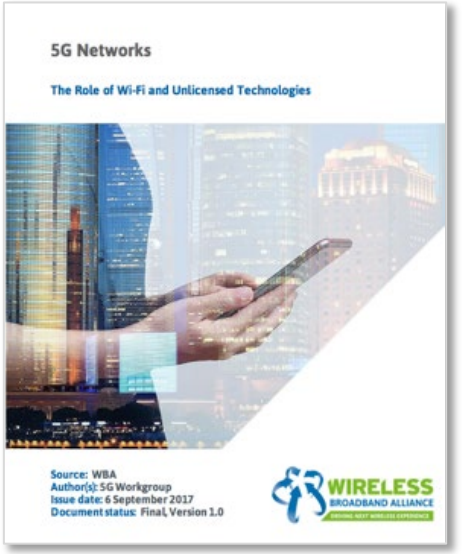
5G and Wi-Fi Convergence in Private 5G Networks

1. 5G Networks – The Role of Wi-Fi and Unlicensed Technologies

The next generation of mobile technology, 5G, is beginning to take shape. 5G intends to enable a seamless society connection, bringing people together along with things, data, applications, transport systems and cities in a ‘smarter’ networked communication environment.

This whitepaper provides initial assessment on how Wi-Fi and other unlicensed technologies will contribute to the 5G framework definition.

The whitepaper also explores the opinions of more than 65 companies across the globe.



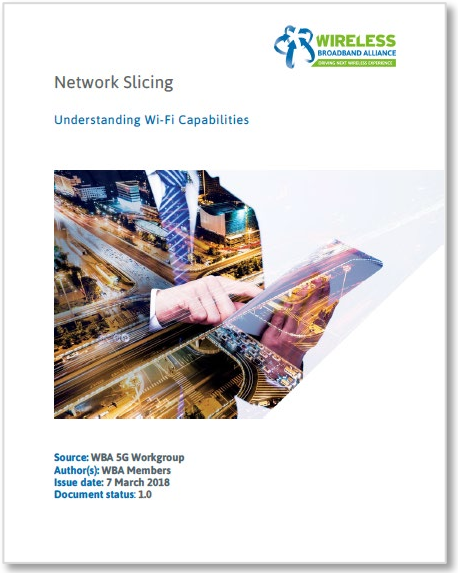
5G Workgroup – Story So Far

5G Work Group 2017 <> 2021 Deliveries

2. Network Slicing for 5G – Wi-Fi Capabilities

In this paper, the WBA explains how Wi-Fi operators can embrace the slicing concepts being defined by 3GPP and leverage the already existing capabilities to deliver sliced Wi-Fi networks today.

It also demonstrates how the key network slicing requirements associated with the access network can be addressed using commercial Wi-Fi capabilities



5G Workgroup – Story So Far

5G Work Group 2017 <> 2021 Deliveries

3. Unlicensed Integration with 5G Networks

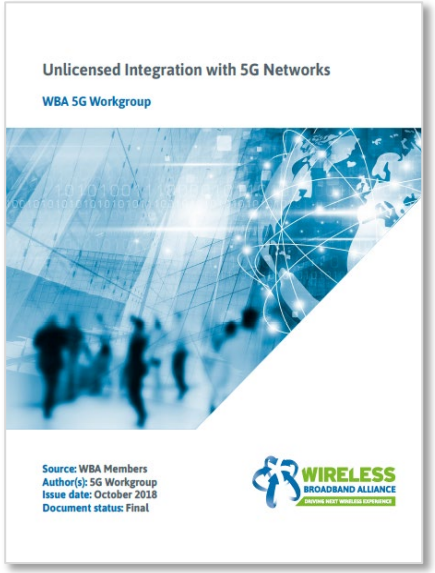
This whitepaper outlines the options and alternative approaches available for combining access over Wi-Fi and cellular based networks in the run up to 5G.

The report builds on the WBA's previous report, to provide an analysis of the varied approaches for integrating cellular and Wi-Fi networks and defines three alternative approaches to integration describing key requirements for each approach:

- Access Centric Solutions integrate Wi-Fi into the cellular access-stratum.

- Core Centric Solutions integrate Wi-Fi into the cellular non-access stratum core network.

- Above-the-core Centric Solutions integrate Wi-Fi above-the-core network using IETF defined multi-path protocols.



5G Workgroup – Story So Far

5G Work Group 2017 <> 2021 Deliveries

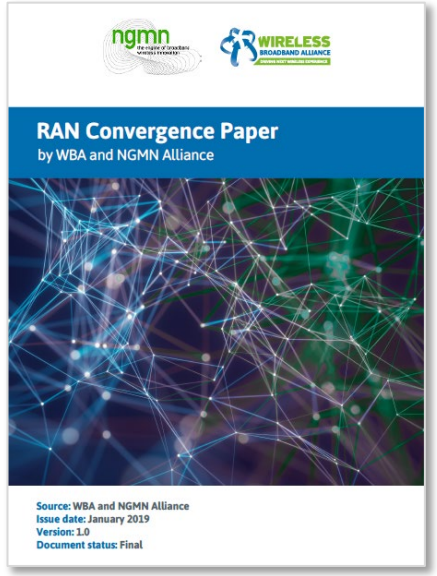
4. WBA & NGMN RAN Convergence paper

This White Paper, explores the importance of existing and future Wi-Fi and cellular convergence, highlighting techniques that enable convergence and identifying solutions to bridge technology gaps – critically this is a major step towards realizing the full benefits of the 5G vision enabled by Wi-Fi.

The paper outlines how mobile operators will benefit from the convergence of Wi-Fi and 5G by gaining improved visibility into Wi-Fi networks, affording them the ability to control customer experience, deliver better services to customers and provide enterprise Wi-Fi network management solutions to enterprise customers.

Wi-Fi operators will benefit from convergence by gaining improved visibility and transition management as they operate overlapping cellular and Wi-Fi networks, ultimately resulting in an improved user experience.

Additionally, enterprise Wi-Fi networks will gain the ability to access operator-provided 5G services.



5G Workgroup – Story Today

5G Work Group 2017 <> 2021 Deliveries

5. NEW - 5G and Wi-Fi RAN Convergence

This paper enhances on the previous work done in WBA and NGMN on RAN Convergence and continues to explore the topic of Cellular and Wi-Fi convergence with in-depth look at 3GPP defined solutions to support integration of WLAN with the 5G system and identifies some key challenges and gaps in current solutions which the industry needs to address.

With continued development of 5G networks in 3GPP and continued evolution of Wi-Fi technology with Wi-Fi 6/6E and Wi-Fi 7, the industry stands to benefit a great deal from the continued convergence of Wi-Fi and 3GPP systems.

This convergence can enable leveraging capabilities of both access networks to provide seamless and interoperable services to the end-users across a variety of use cases and verticals.

5G Workgroup – Next Step

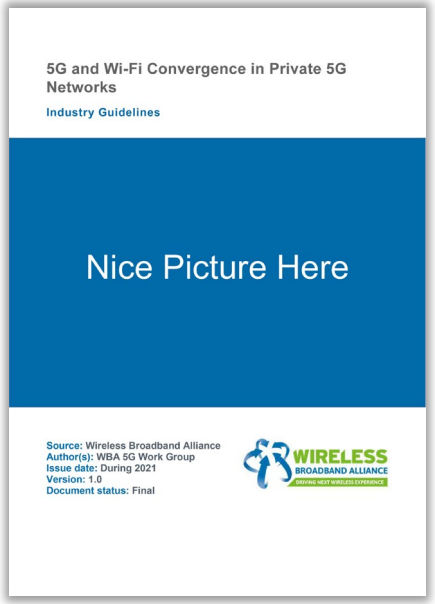
5G Work Group 2017 <> 2021 Deliveries

6. NEXT - 5G and Wi-Fi Convergence in Private 5G Networks

Scope of the project will be to further study, analyse and propose some high-level solutions and guidelines following key challenges and gaps identified to enable the Wi-Fi and 5G convergence in private 5G networks.

The main objectives of the project will be:

- Capture business opportunities for Wi-Fi and 5G convergence in private 5G networks
- Document analysis, approaches and potential solutions related to identified challenges of convergence in private 5G networks
- Deployment guidelines for converged Wi-Fi and 5G private networks
- Potential trials for Wi-Fi and 5G convergence in private 5G networks.



5G and Wi-Fi RAN Convergence: Section Description

Three Main Parts:

Part I (Chapter 2):

- 3GPP state-of-the-art of integrating WLAN with the 3GPP 5G system Release 15 and 16.
- WLAN integration architecture, related features, functions, policies and associated procedures.

Part II (Chapter 3):

- Identifies key challenges and gaps in current 3GPP-defined solutions to support interworking between WLAN and 3GPP 5G system
- Suggests high-level solutions to address some of the identified gap items.

Part III (Chapter 4 & 5):

- Provides recommendations and next steps for the industry and the relevant standard bodies to address the key challenges and gaps related to the 5G and Wi-Fi convergence.

5G and Wi-Fi RAN Convergence: Summary and Recommendati

Key Messages Cover:

- 5G and Wi-Fi Convergence Architecture
- ATSSS Multi-Access Steering Functionality
- End-to-end QoS Support
- Policy Interworking and Enhancements across 5G and Wi-Fi
- Support for Wi-Fi only devices

5G RAN Convergence Presenters

Our three presenters, and paper contributors, will cover the technical areas as follows:

Co-leader & Editor: Binita Gupta (Intel)
Integration Architecture, Wi-Fi Only Devices, End-to-end QoS

Co-Chair: Florin Baboescu (Broadcom)
3GPP ATSSS Multi-Access Functionality

Co-Chair: Mark Grayson (Cisco)
Enhancing Experiences using Wi-Fi and 5G

THANK YOU

5G AND WI-FI CONVERGENCE

INTEGRATION ARCHITECTURE, MVNO ONLY DEVICES, END-TO-END QoS

BINITA GUPTA

SENIOR STAFF SYSTEMS ARCHITECT, INTEL CORP.

5G and Wi-Fi Convergence

Integration Architecture, Wi-Fi Only Devices, End-to-end QoS

Binita Gupta
Sr. Staff Systems Architect, Intel Corporation

5G and Wi-Fi Convergence Opportunities

Business Drivers

- Ubiquitous Wi-Fi devices
- Significant Wi-Fi Advancements
- Lower TCO
- Higher Network Capacity
- Improved Reliability
- Seamless Mobility

Applications and Verticals

Enterprise/Retail

Healthcare

Smart Cities

Industry 4.0

AR/VR

Logistics/Supply Chain

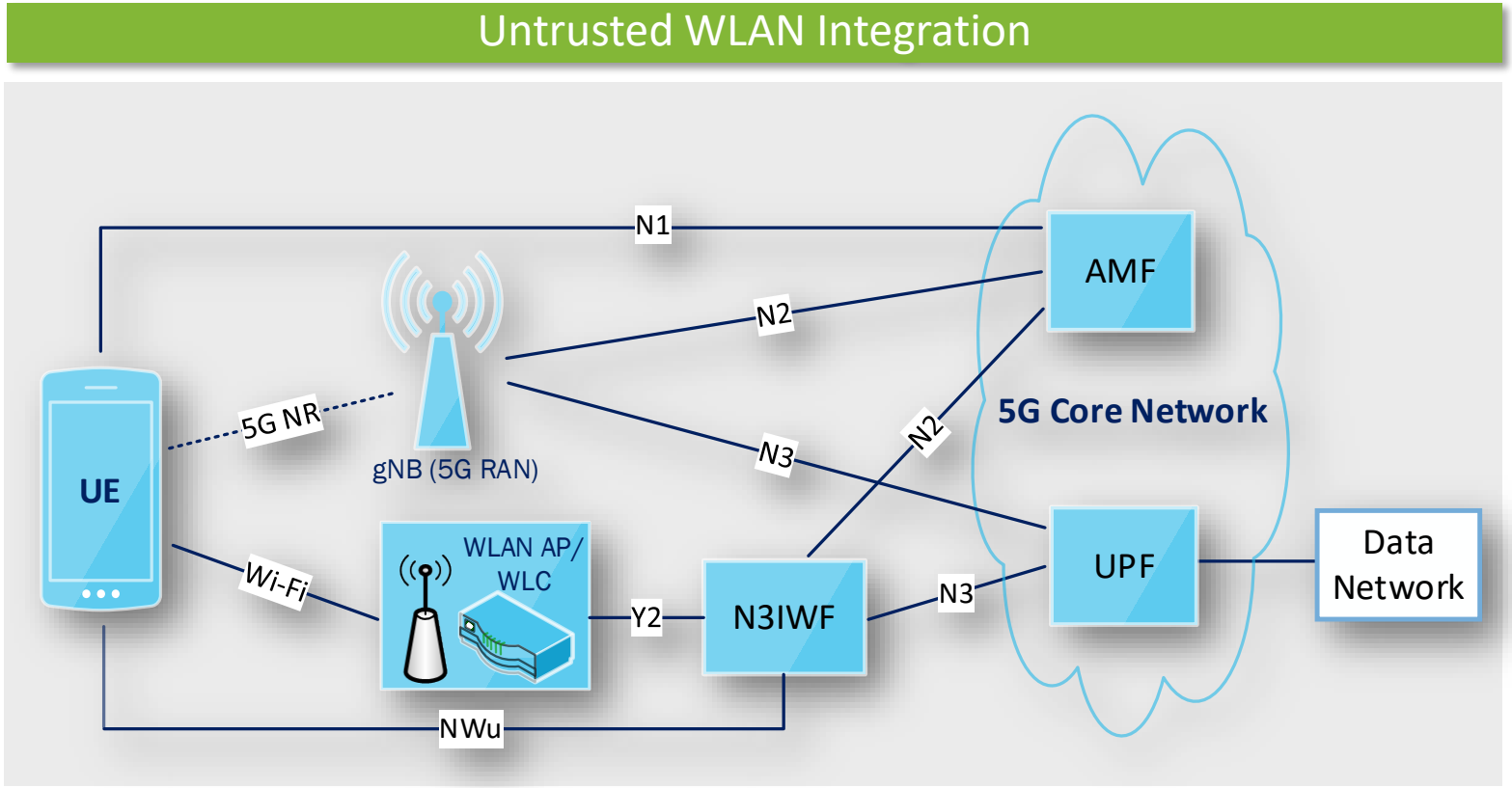
WBA 5G and Wi-Fi convergence work aims to educate the industry on convergence architecture and solutions and highlights associated challenges for the industry to address

5G and Wi-Fi Integration Architecture

3GPP 5G architecture supports UEs connecting to 5G core over WLAN access, without requiring primary connectivity over cellular access

Untrusted WLAN integration:

- Loose coupling over generic IP (Y2) between untrusted WLAN access and N3IWF
- IPsec tunnel between UE and N3IWF (NWu) – applies encryption for secure transport of signaling & data
- Wi-Fi Only UEs need to be 5G capable (support 5G NAS)



N3IWF: Non-3GPP Interworking Function
AMF: Access and Mobility Management Function
UPF: User Plane Function
NAS: Non-Access Stratum

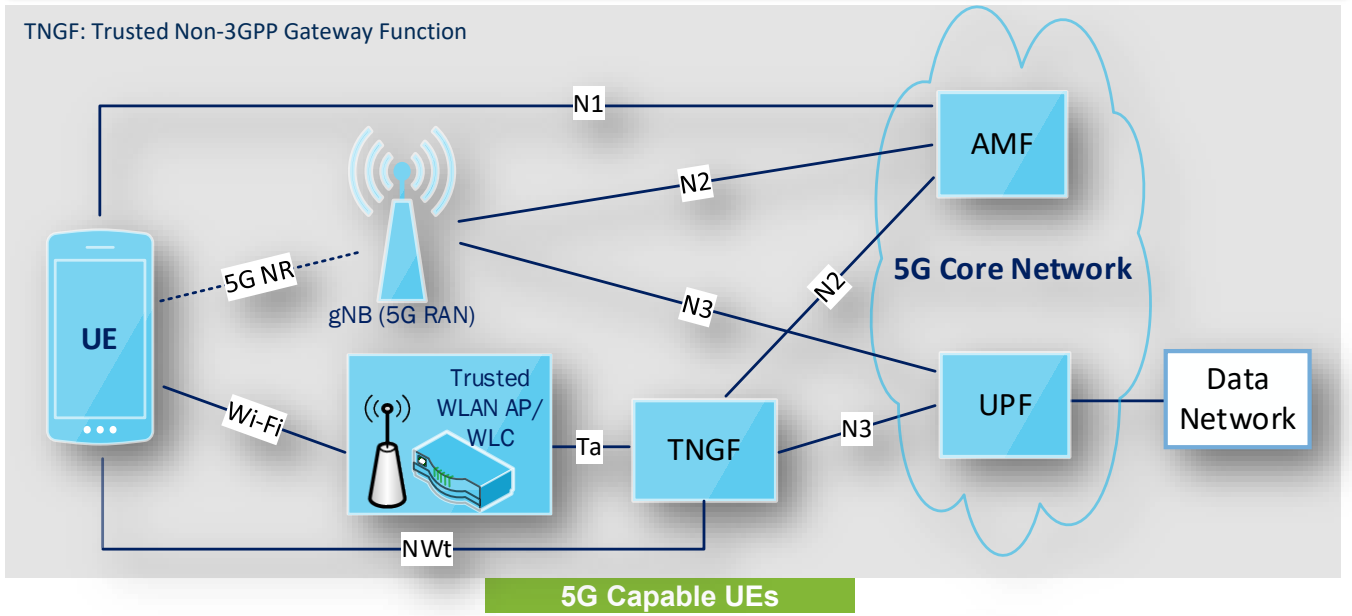
5G and Wi-Fi Integration Architecture

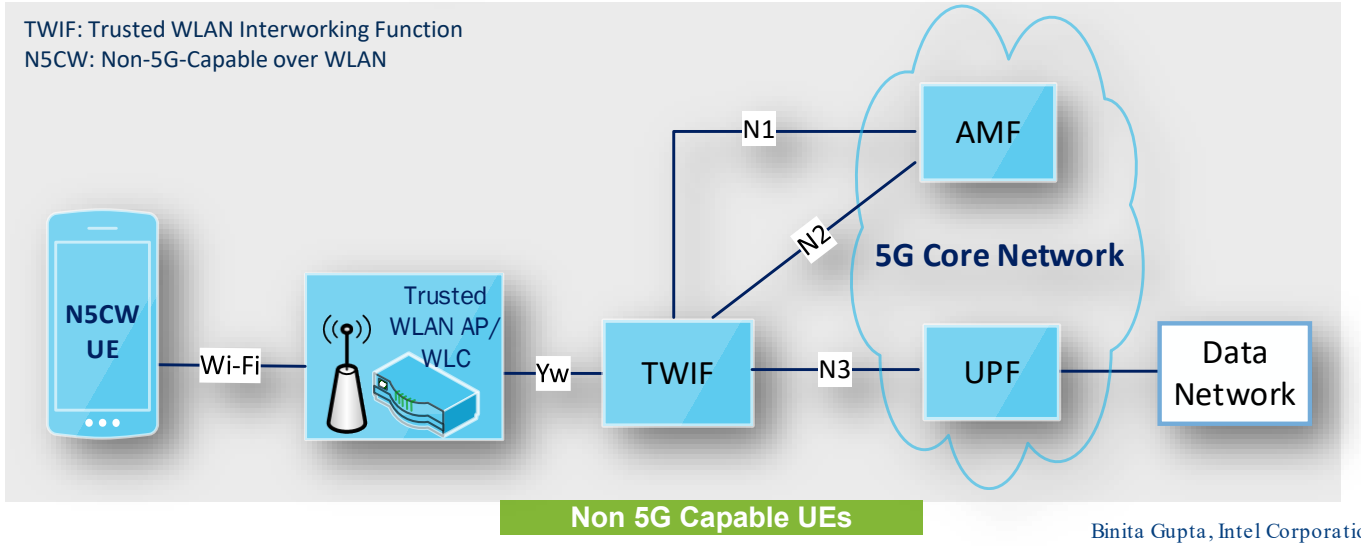
Trusted WLAN integration:

- Tight coupling between trusted WLAN access and gateway functions TNGF & TWIF
- WLAN layer-2 authentication gets tied to a key derived from UE 5G core authentication
- IPsec tunnel between UE and TNGF with NULL encryption applied (NWt), avoiding double encryption
- Non 5G Capable UEs supported via TWIF
- AAA-based interfaces Ta and Yw between WLAN access and gateway functions
- Trusted WLAN discovery can be done over 802.11 ANQP - advertise list of PLMNs with which trusted 5G connectivity is supported

ANQP: Access Network Query Protocol

Trusted WLAN Integration



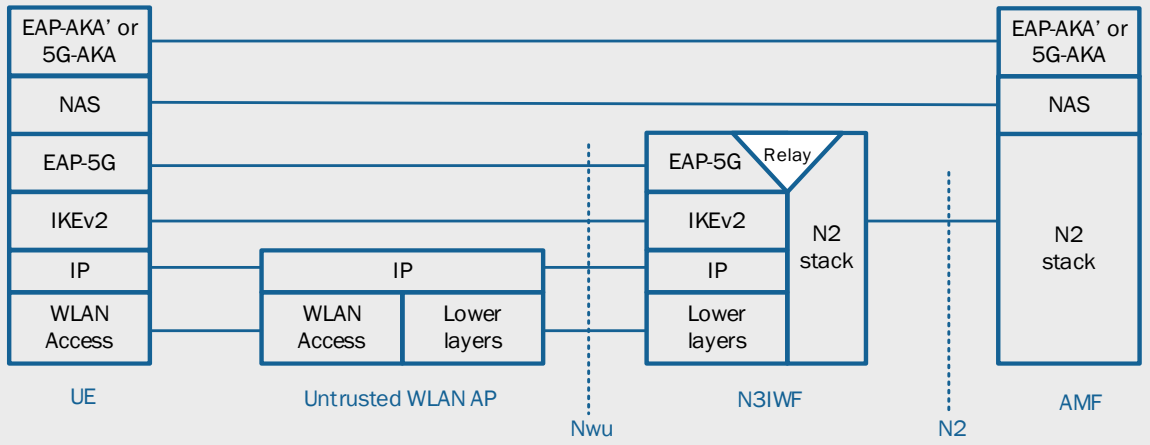


WLAN Access Integration – Control Plane

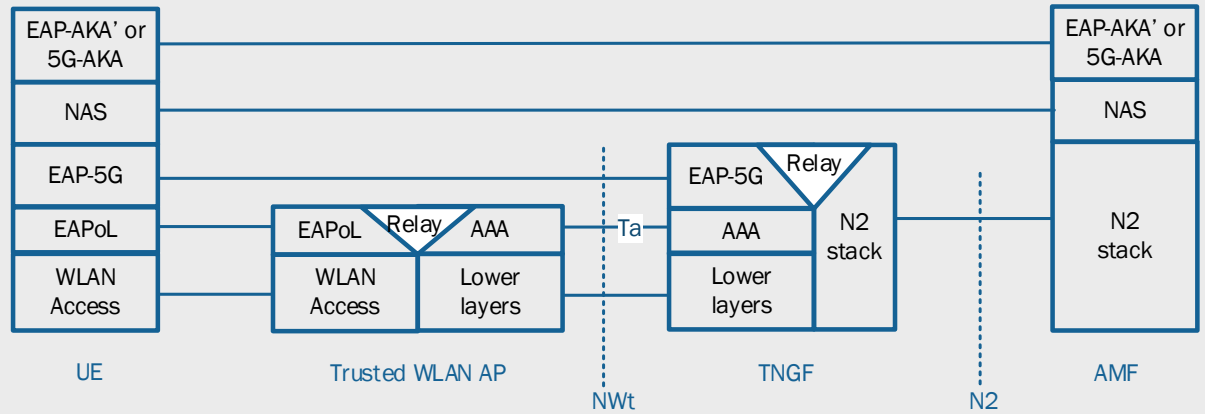
Signaling IPsec SA for control plane:

- Signaling IPsec SA created between UE and N3IWF/TNGF
- Vendor specific EAP-5G method defined for encapsulating 5G NAS messages
- For trusted WLAN, a key from TNGF/TWIF used as PMK for the 802.11 4-way handshake for WLAN security

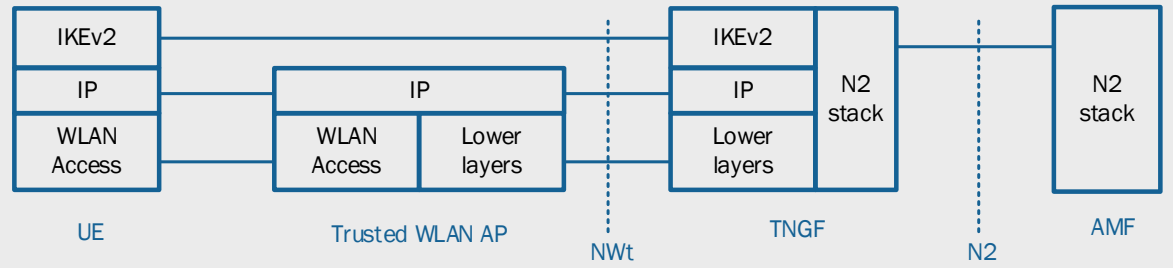
Control plane for Signaling IPsec SA for Untrusted WLAN



Control plane for Signaling IPsec SA for Trusted WLAN



Control plane over Trusted WLAN before UE is assigned IP address



Control plane over Trusted WLAN after UE is assigned IP address

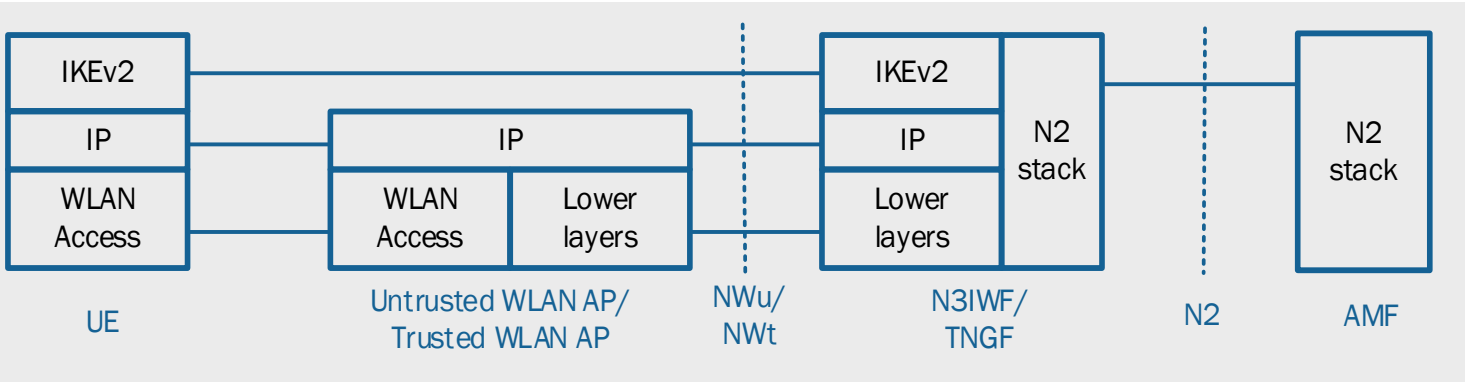
IKEv2: Internet Key Exchange Version 2
SA: Security Association

WLAN Access Integration – User Plane

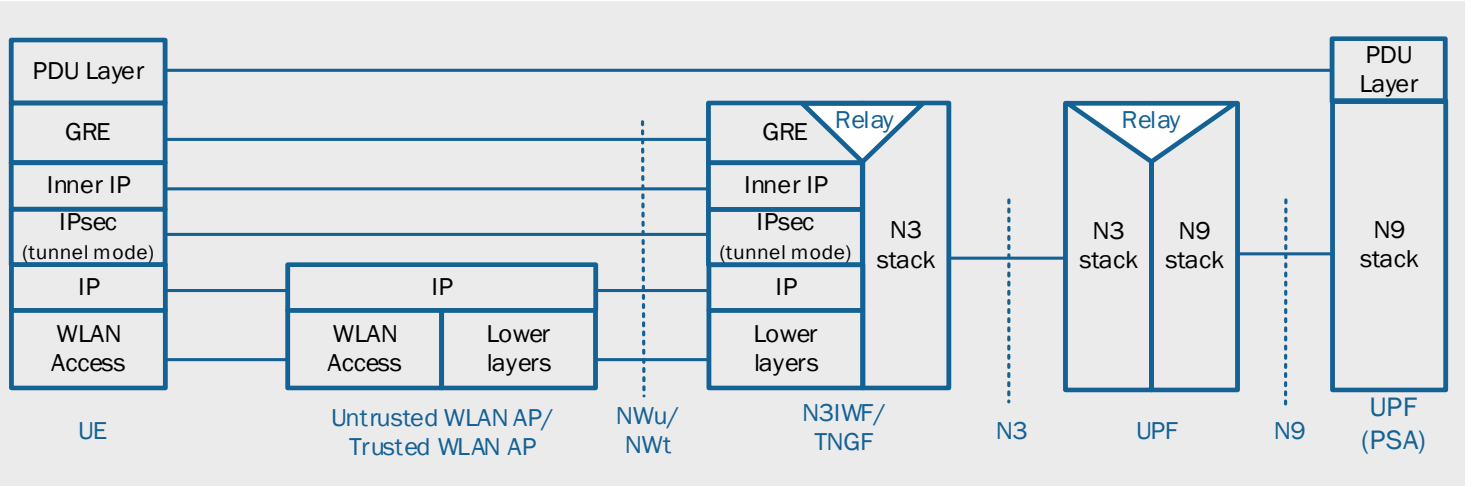
IPsec child SAs for user plane:

- PDU session establishment over WLAN access is based on procedure defined over 3GPP access
- Multi-access PDU session to carry user data over both 3GPP and WLAN access
- One or more IPsec child SAs created between N3IWF/TNGF and UE to carry user data over WLAN
- N3IWF/TNGF determine how to map 5G QoS flow(s) to IPsec child SAs
- User data packets get encapsulated in GRE packets

Establishment of User Plane IPsec child SA



User plane for transport of data over WLAN Access



GRE: Generic Routing Encapsulation

Enhancements for Trusted WLAN Integration

Trusted WLAN Access Selection	New Capabilities on WLAN AP/WLC	New Capabilities on WLAN STA
Advertise list of 5G PLMNs over ANQP with which trusted 5G connectivity supported by WLAN	Support for Ta and Yw AAA-based Interfaces on WLAN AP/WLC*	Support filtering for EAP-5G protocol messages
UE to discover (over ANQP) and select a preferred WLAN network providing trusted 5G connectivity	Support filtering for EAP-5G protocol messages	Provide 3GPP specific NAI for UE for connectivity via TNGF/TWIF "<any_non_null_string>@nai.5gc.mnc<MNC>.mcc<MCC>.3gppnetwork.org"
	Support for using TNAP key from TNGF/TWIF as the PMK for 802.11 4-way handshake	

TNAP: Trusted Non-3GPP Access Point
PMK: Pairwise Master Key
NAI: Network Address Identifier

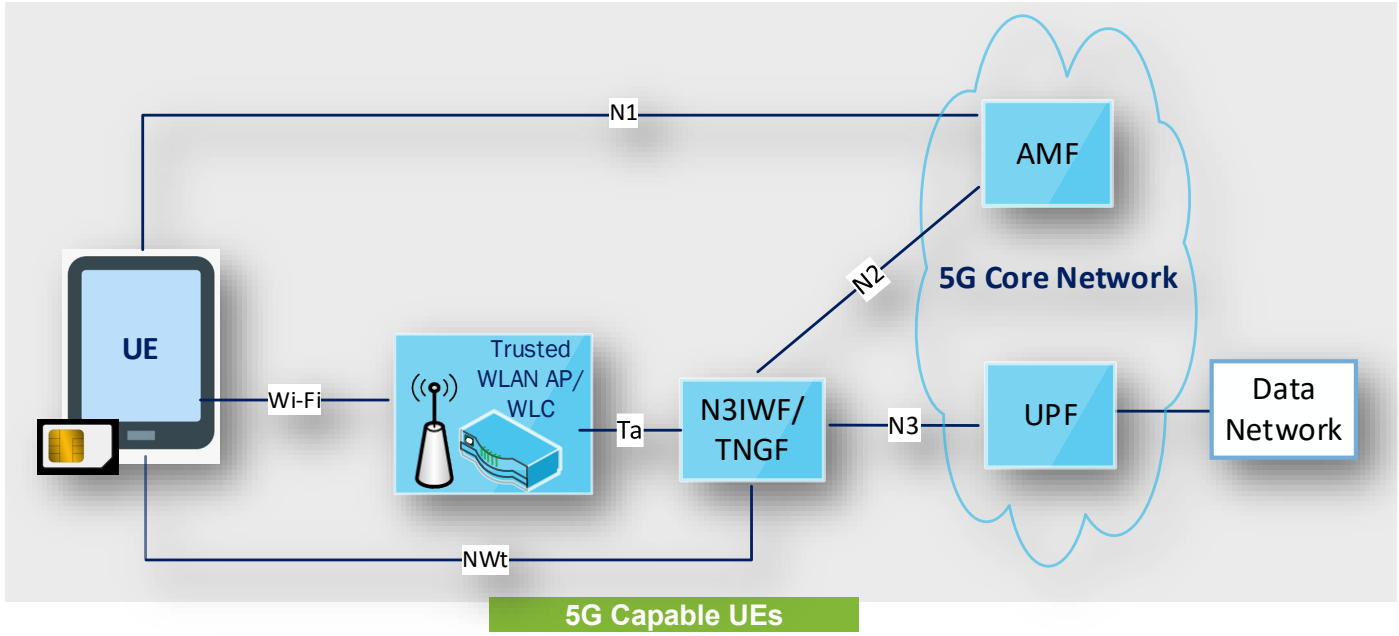
***Standardization of Ta and Yw interfaces can provide improved integration of WLAN access within the 5G System**

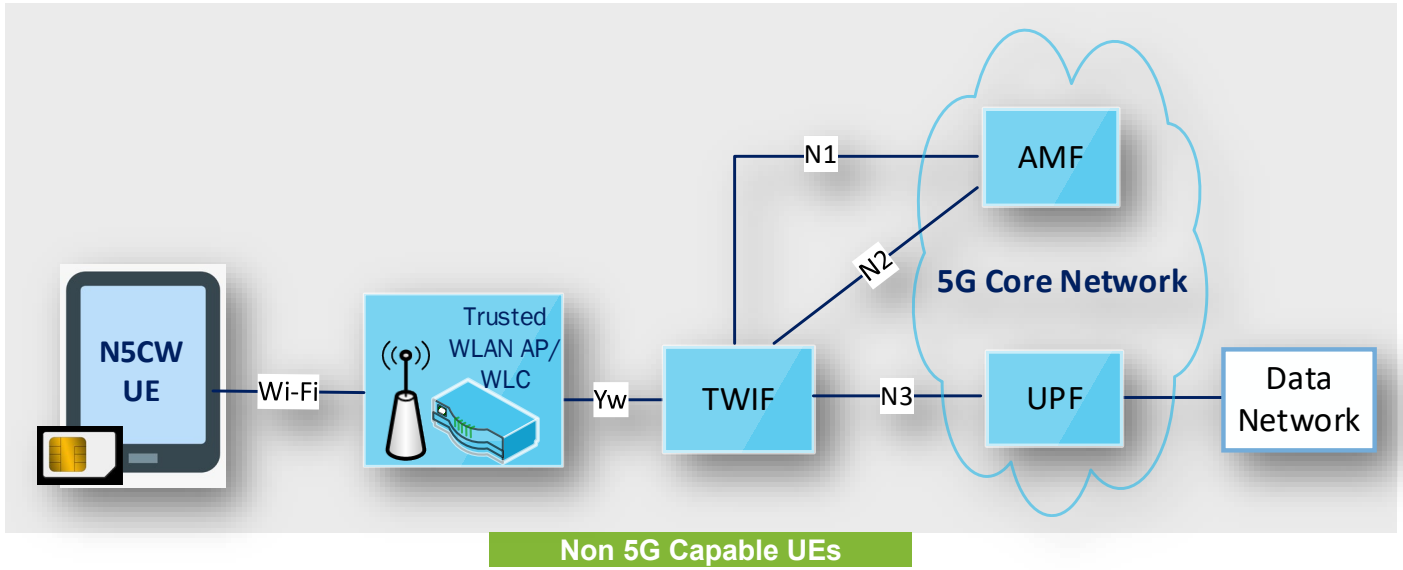
Support for Wi-Fi Only Devices

Wi-Fi Only devices with USIM capability:

- Such devices supported by the 5G Core
- Authenticated using SIM-credential based auth. methods EAP-AKA' or 5G-AKA
- Both 5G Capable and Non-5G-Capable Wi-Fi Only UEs with SIM are supported

Most Wi-Fi only devices do not include USIM – need support for non-SIM devices





Support for Wi-Fi Only Devices w/o USIM

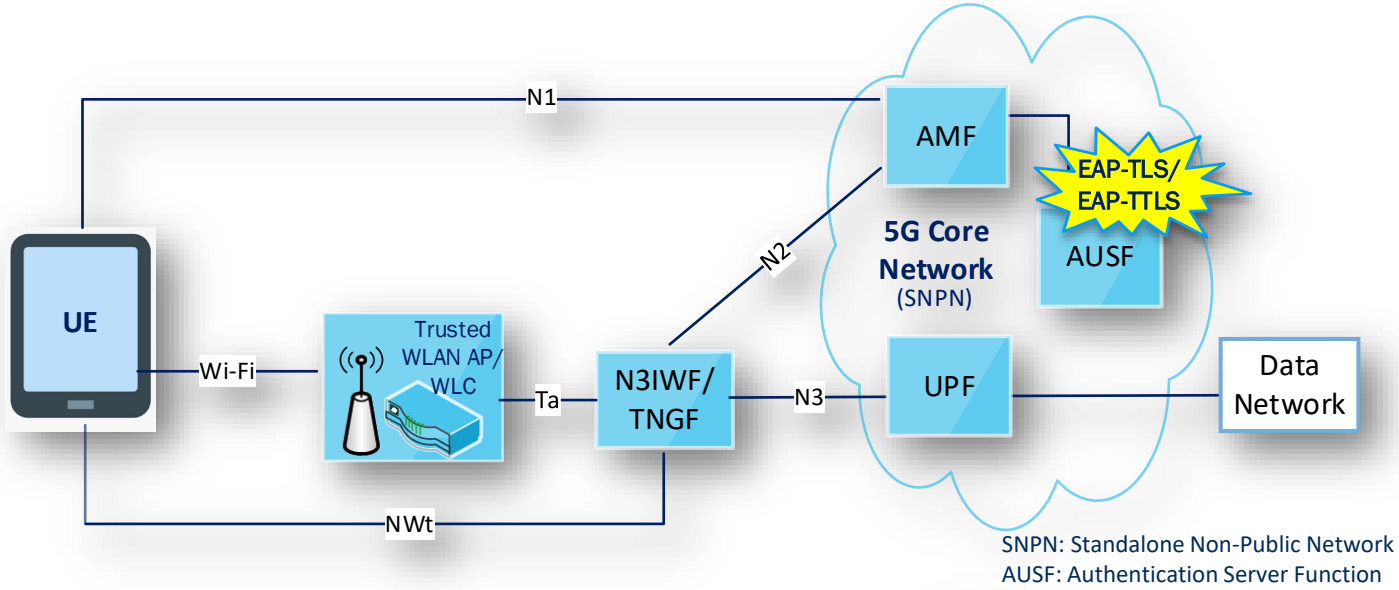
Requires support for EAP-TLS/EAP-TTLS

- Support for non-IMSI based identity and certificate based auth methods EAP-TLS/EAP-TTLS
- Current 3GPP specs define EAP-TLS/EAP-TTLS for private networks (SNPN) over 3GPP access only

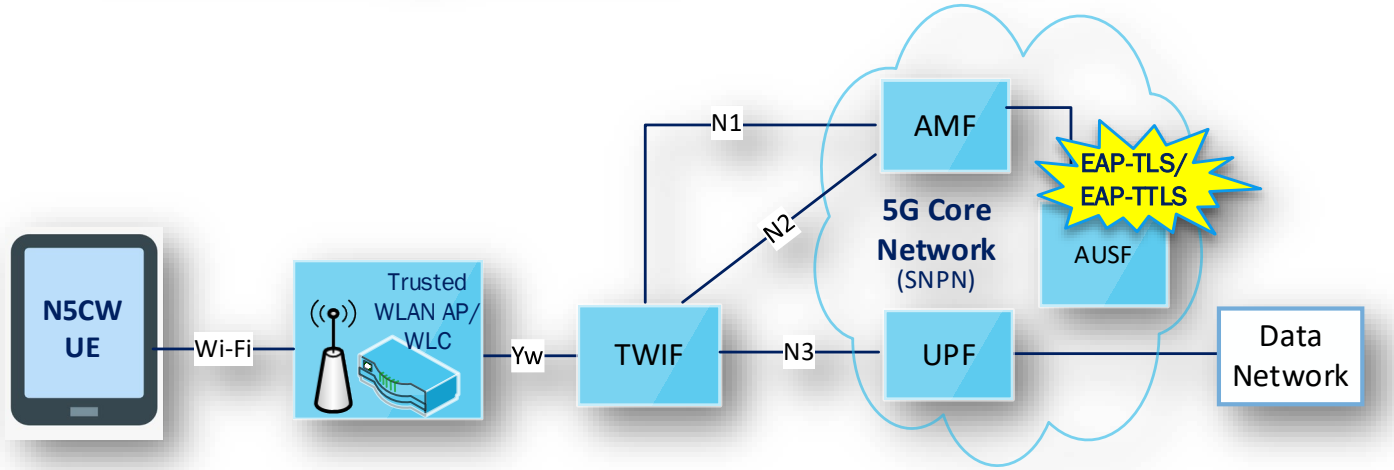
3GPP support for SNPN over WLAN access

- 3GPP specs need to define access to SNPN over WLAN access via N3IWF/TNGF/TWIF
- Define EAP-TLS/EAP-TTLS procedure for SNPN over WLAN access

Operator's considerations for EAP-TLS/EAP-TTLS support over PLMNs for Wi-Fi only devices



SNPN: Standalone Non-Public Network
AUSF: Authentication Server Function



Enabling Wi-Fi only devices w/o USIM can expand reach of 5G services and applications to many more devices across enterprises and verticals

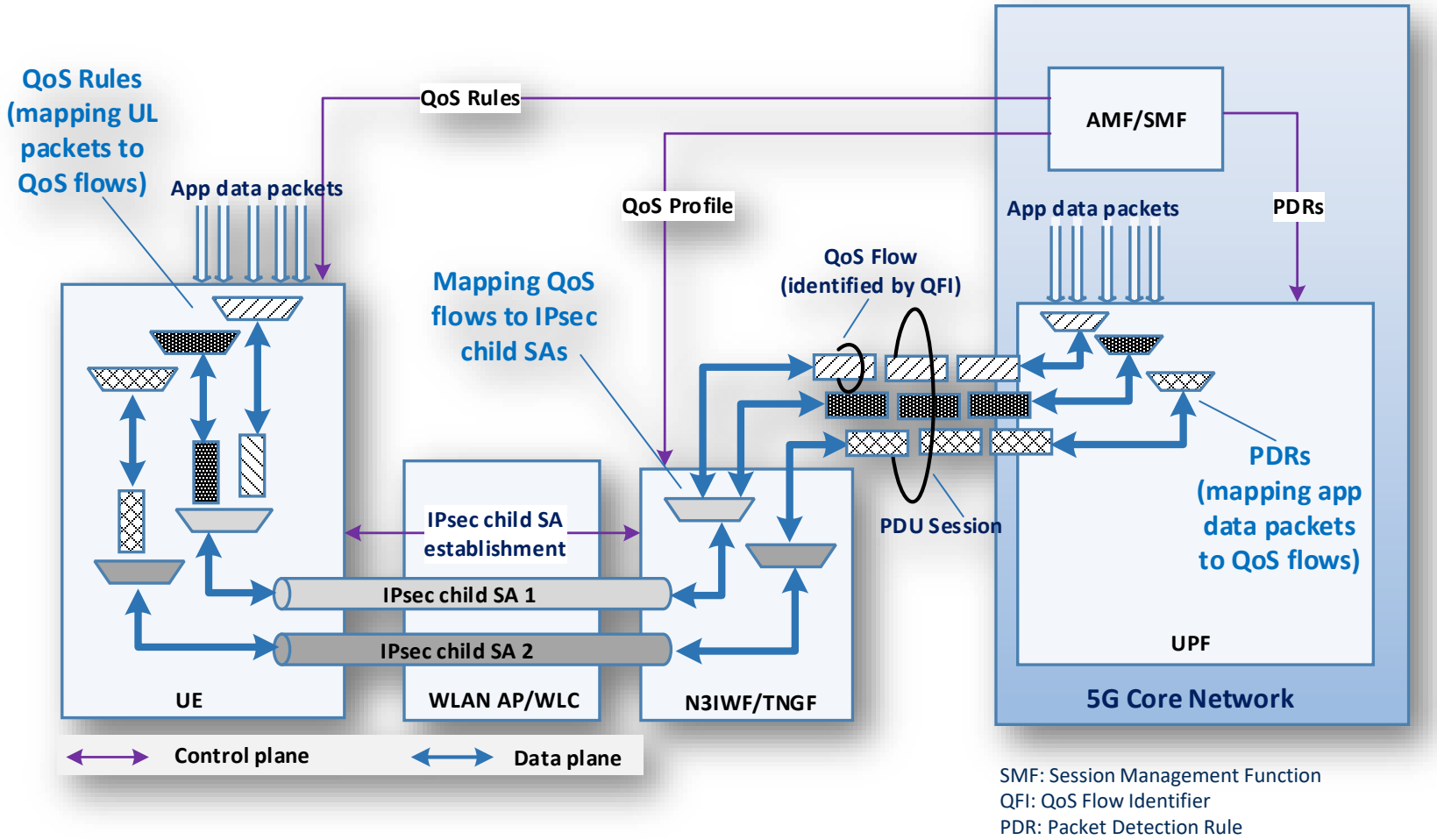
Binita Gupta, Intel Corporation

End-to-end QoS over WLAN Access

5G QoS model over WLAN access:

- 3GPP 5G QoS model is also applied when traffic is carried over WLAN access
- QoS Flow (identified by QFI) is the finest granularity of QoS differentiation
- 5QI (5G QoS Identifier) value identifies QoS characteristics for a QoS flow
  - Standardized 5QI values defined for frequently used services
- 5G QoS flows get mapped to IPsec child SAs when carried over WLAN access

5G QoS Model Applied over WLAN Access



SMF: Session Management Function
QFI: QoS Flow Identifier
PDR: Packet Detection Rule

Binita Gupta, Intel Corporation

QoS Differentiation over WLAN Access

- To support end-to-end QoS, need QoS differentiation for 5G flows over WLAN access per 5G QoS characteristics and parameters
- Two approaches to provide QoS management for 5G flows within WLAN access:

1) DSCP based QoS Mapping

- ❑ QoS differentiation done based on DSCP marking in the IP header for UL and DL data packets
- ❑ Applicable across all types of WLAN integration architecture (via N3IWF, TNGF and TWIF)

2) IPsec SA based QoS Management

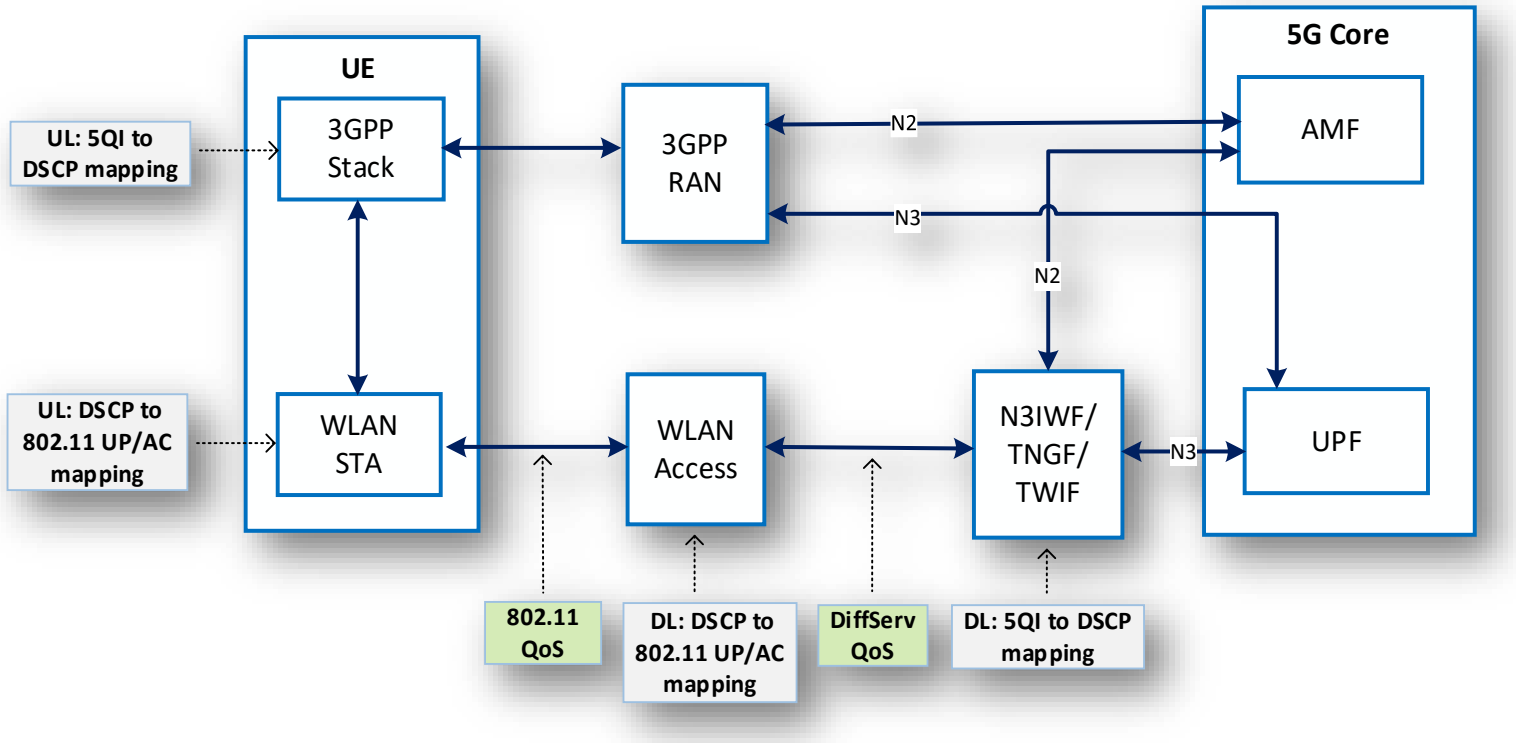
- ❑ QoS differentiation done based on identifying and prioritizing IPsec child SAs carrying 5G flows
- ❑ WLAN STA initiates QoS Traffic Stream setup for IPsec child SAs using EDCA admission control
- ❑ Applicable for WLAN integration architecture via N3IWF and TNGF

DSCP based QoS Mapping

- 5QI to DSCP mapping done at the N3IWF/TNGF (for DL) and at the UE (for UL)
- DSCP markings get mapped to 802.11 UP/AC on WLAN AP (for DL) and STA (for UL)

Gaps and enhancements needed:

- ❑ Standardized 5QI values to DSCP mapping not defined
  - IETF **draft-henry-tsvwg-diffserv-to-qci-04** defines a mapping but it has expired
- ❑ Support for tagging 5G data packets with appropriate DSCP for UL/DL
- ❑ Define mapping between updated set of DSCP values to 802.11 UP/AC



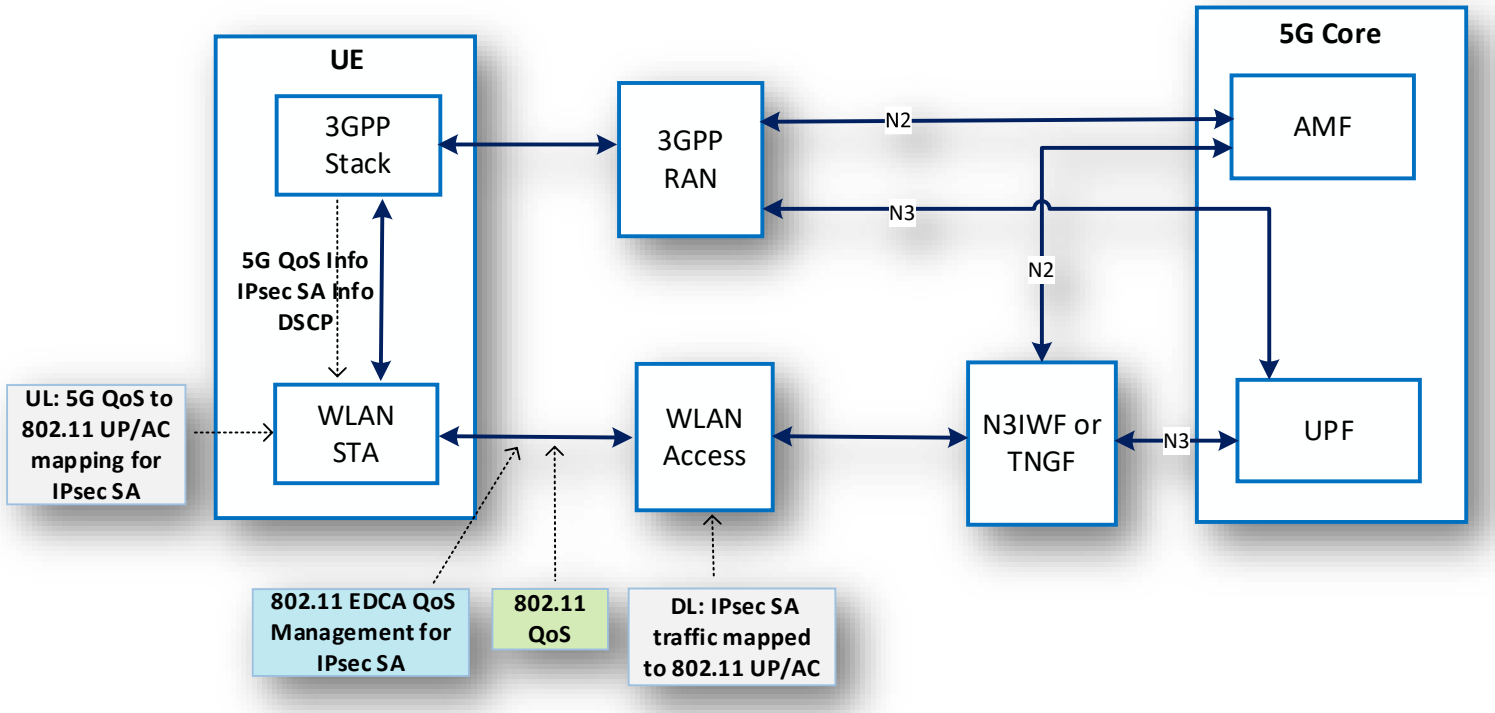
Simpler implementation, no 3GPP/WLAN integration needed on UE for QoS mapping

IPsec SA based QoS Management

- 5G QoS parameters and IPsec SA info for child SAs sent to WLAN STA on the UE
- WLAN STA maps 5G QoS parameters to 802.11 TSPEC, UP/AC and creates TCLAS from IPsec SA info
- **WFA OCE** project is addressing IPsec SA based QoS management within WLAN

Gaps and enhancements needed:

- ❑ Mapping of 5G QoS parameters to 802.11 TSPEC parameters for WLAN QoS Traffic Stream setup
- ❑ Determine 802.11 UP/AC based on 5G QoS parameters (or DSCP)
- ❑ TCLAS element to specify filtering for IPsec SA traffic



More involved approach, with challenges around tighter 3GPP/WLAN integration on the UE and addressing 5G to WLAN QoS parameters mapping

Addressing QoS Differentiation in Wi-Fi 7

- Wi-Fi 7 includes features like Multi-link operation, Multi-AP and 320 MHz which can provide further lower latency than Wi-Fi 6
- IEEE 802.11be is also considering enhancements to provide **Deterministic Low Latency** for TSN support
  - New Access Category for TSN
  - TSPEC enhancements
- Wi-Fi 7 QoS enhancements should also consider providing fine grain QoS differentiation (throughput, latency, PER, data burst) for 5G flows

Wi-Fi 7
Based on IEEE 802.11be

Key features**

- 320 MHz channels
- 4096-QAM
- 16 spatial streams
- Multi-RU (puncturing)
- Multi-link operation
- Multi-AP operation
- Deterministic low latency

It is timely for IEEE 802.11be QoS enhancements to consider how fine grain QoS can be provided for 5G flows based on 5G QoS characteristics (5QI) and parameters

Road Ahead to Converged Networks

Convergence enables new business opportunities

Better together for new breed of applications and services such as Industry 4.0, AR/VR, Connected Cities & Edge Computing benefiting operators and vendors to provide seamless end-user experiences

Convergence architecture defined in current 3GPP specifications

3GPP Release 15/16 defines WLAN integration architecture for untrusted and trusted WLAN, support for Wi-Fi Only devices with USIM and QoS model applicable over WLAN

Convergence related challenges and enhancements are highlighted in three key areas

- Support for trusted WLAN integration
- Support for Wi-Fi Only devices w/o USIM for private 5G networks
- Enabling QoS mapping and differentiation for 5G flows over the WLAN access

Addressing identified challenges can provide improved integration and facilitate converged network deployments

5G AND WiFi CONVERGENCE

Hybrid Access

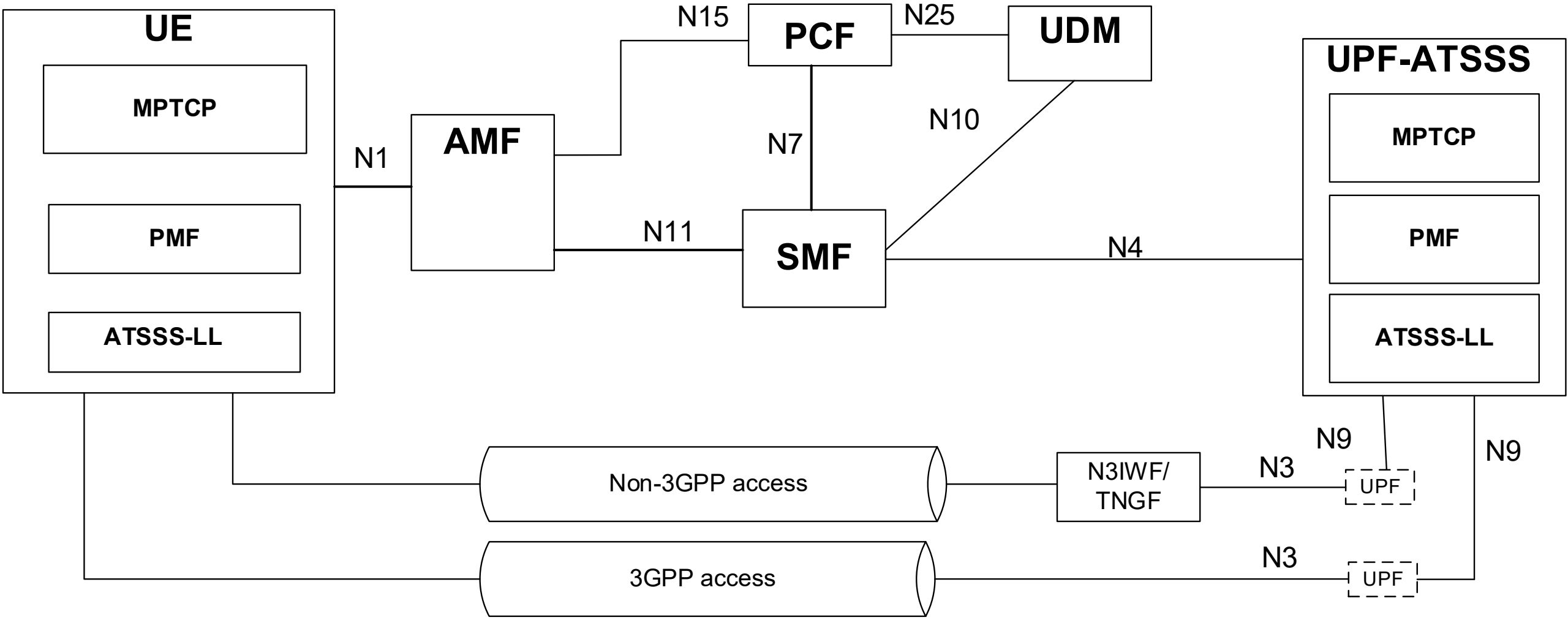
Florin Baboescu

Senior Principal Scientist, Broadcom

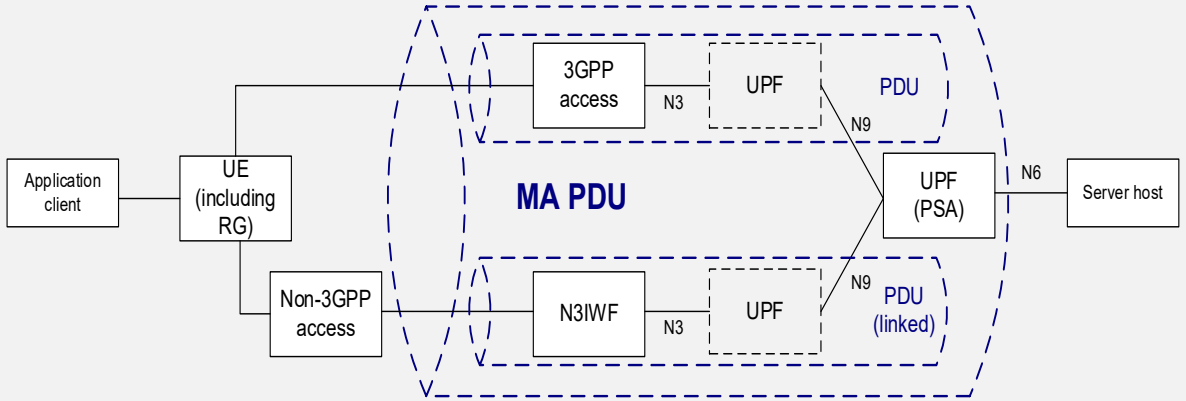
Hybrid Access – Why is it needed?

- Campus/Enterprise Use Case:
  - A subscriber is simultaneously using both cellular and WLAN connectivity to access the same service
  - This use case provides:
    - For the user: 1) Increased capacity, 2) Increased coverage and 3) Increased reliability
    - For the access provider: 1) Increased capacity, 2) Increased coverage, 3) Increased reliability and 4) Minimized cost
- End to end server access:
  - An end user may access end to end services using multiple thin bi-directional pipes using multiple links to the server
  - This use case provides(on top of the previous use case):
    - For end user: 1) Minimized latency, 2) reduced playback stalls and reduced stall duration (Apple music, youtube, etc.)

3GPP Release 16 ATSSS Architecture



3GPP ATSSS User Plane

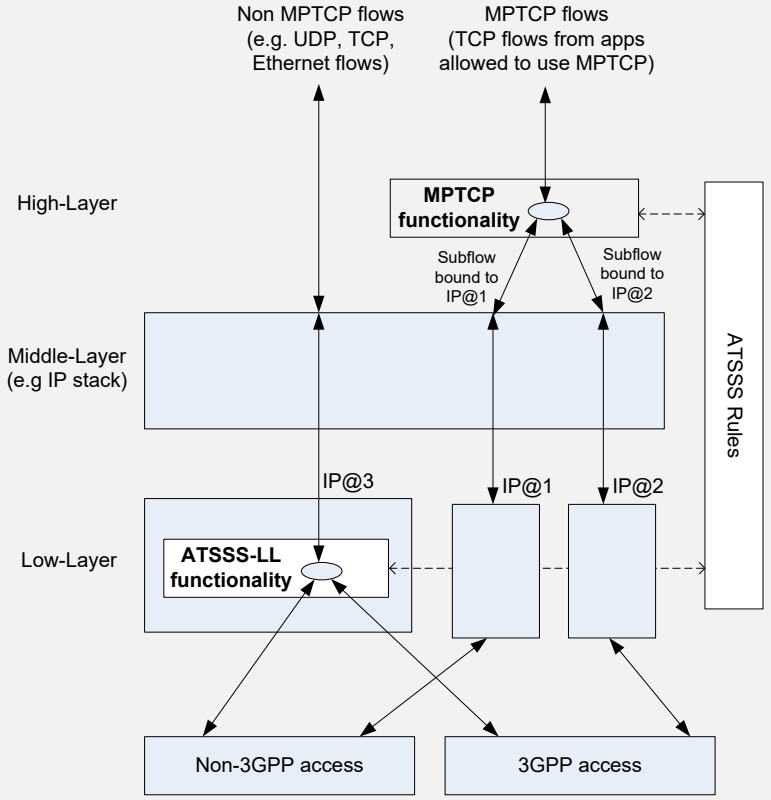


It supports Multi-Access (MA PDU). A MA PDU is a type of PDU session that may have user-plane resources on two access networks.

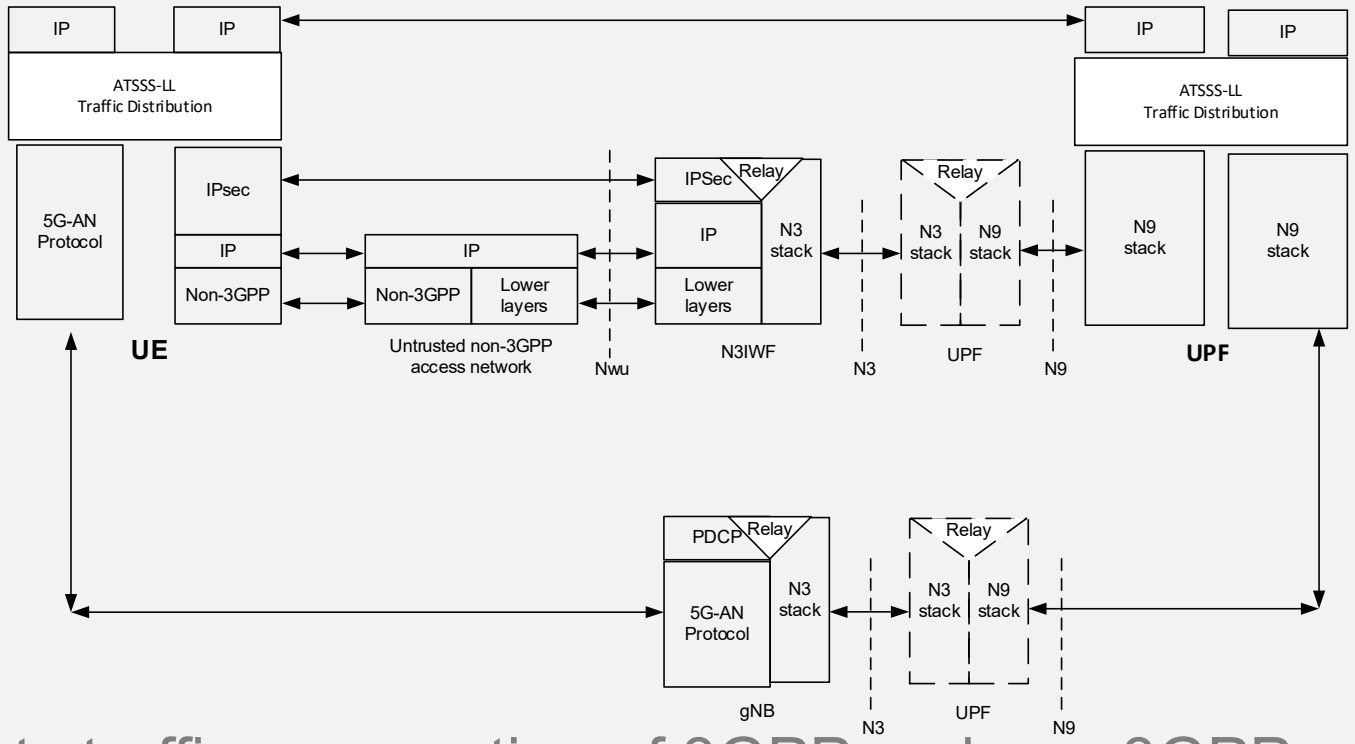
- The UE applies network-provided policy (i.e. ATSSS rules) and considers local conditions (such as network interface availability, signal loss conditions, user preferences, etc.) for deciding how to distribute the uplink traffic across the two access networks.
  When there are user-plane resources on only one access network, the UE applies the ATSSS rules and considers local conditions for triggering the establishment or activation of the user plane resources over another access.
- The UPF anchor of the MA PDU Session applies network-provided policy (i.e. N4 rules) and feedback information received from the UE via the user-plane (such as access network Unavailability or Availability) for deciding how to distribute the downlink traffic across the two N3/N9 tunnels and two access networks.

3GPP ATSSS: Steering functionalities

- Application Traffic Steering, Switching, and Splitting (ATSSS)
  - RFC8803 (0-RTT TCP Convert Protocol) based solution using MPTCP
  - ATSSS Lower Layer (ATSSS-LL)supports traffic aggregation of 3GPP and non-3GPP user plane paths, without any specific protocol between UE and UPF (steering/switching only)
- Enhanced ATSSS (eATSSS)
  - Goal: add splitting support for non-TCP traffic/any IP & Ethernet traffic
  - Additional goal: support for additional eATSSS modes

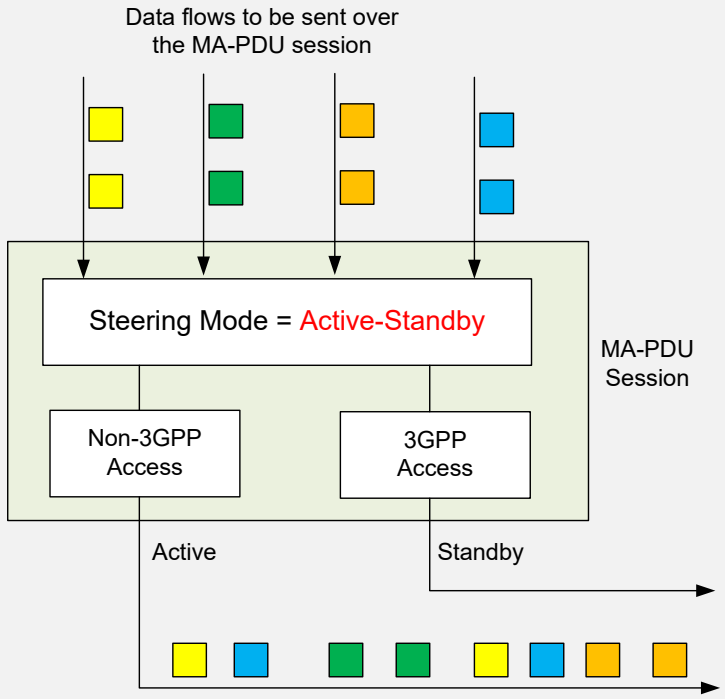


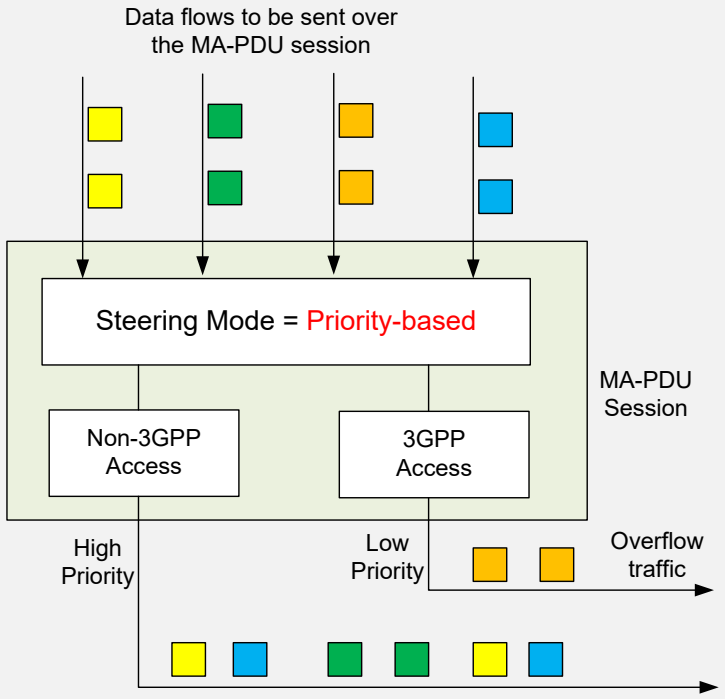
3GPP ATSSS Lower Layer (ATSSS-LL)



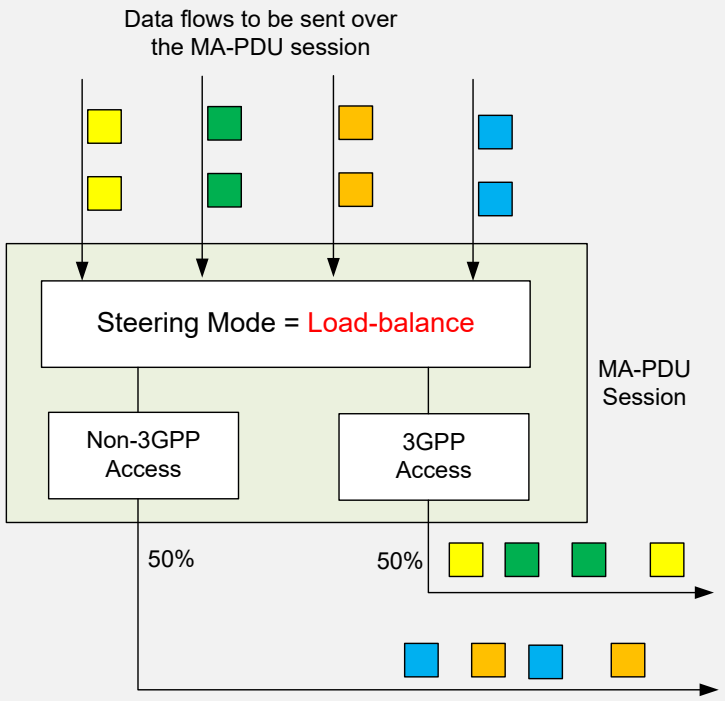
- It supports traffic aggregation of 3GPP and non-3GPP user plane paths, without any specific protocol between UE and UPF;
- It applies to both IP and Ethernet traffic;

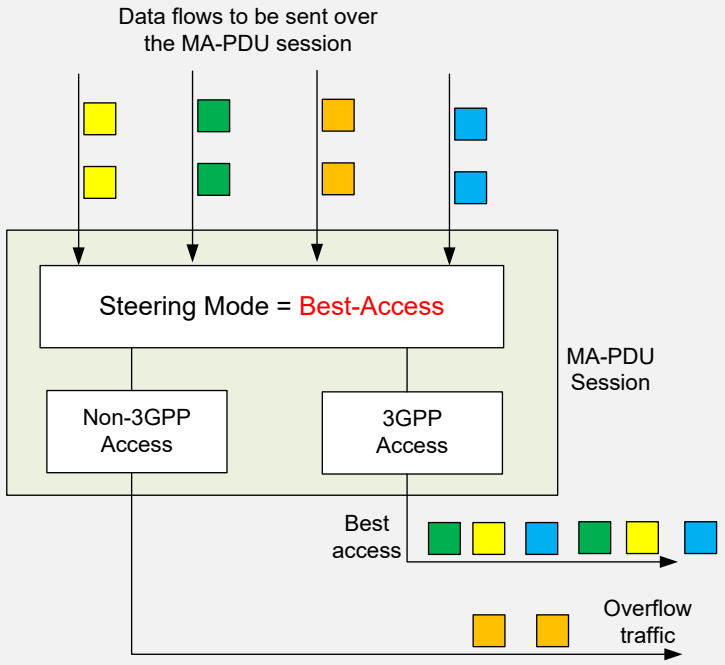
3GPP ATSSS modes:



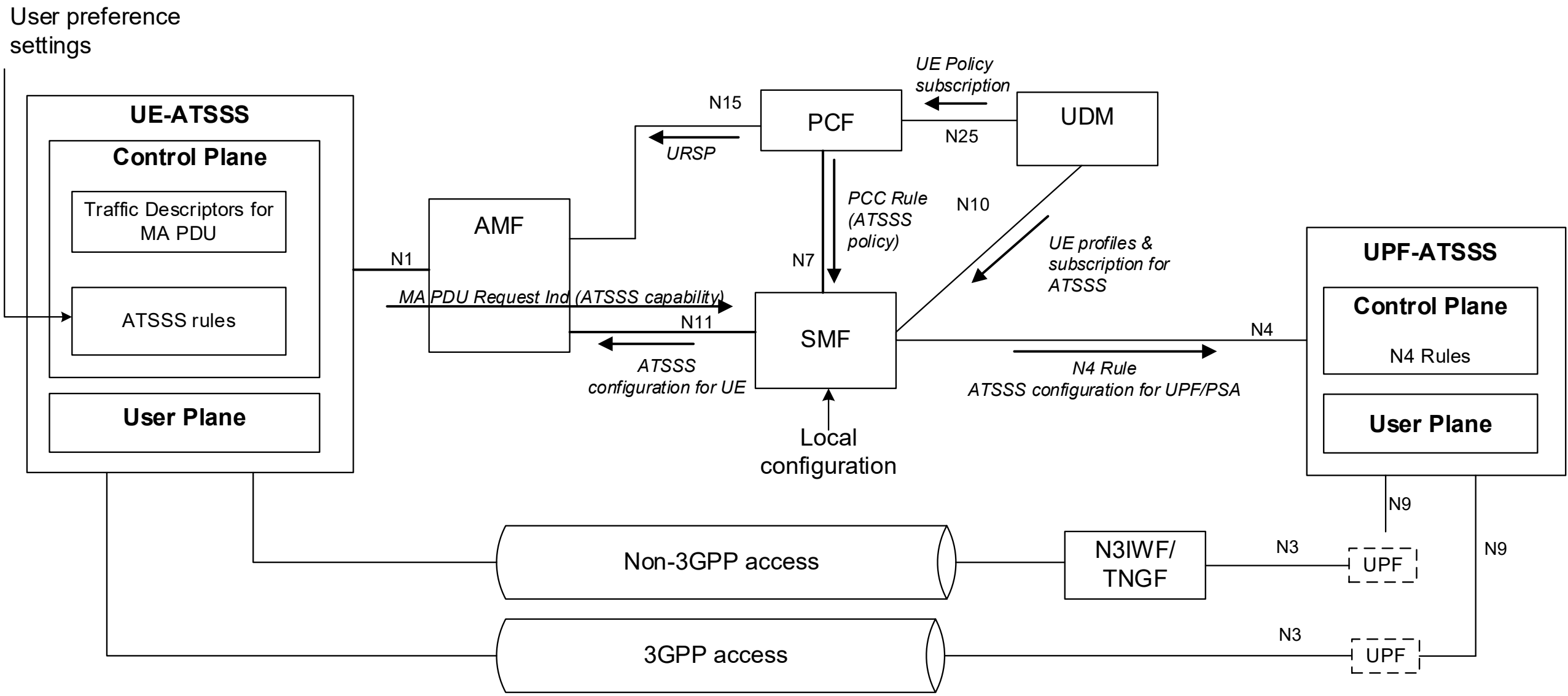


3GPP ATSSS modes:



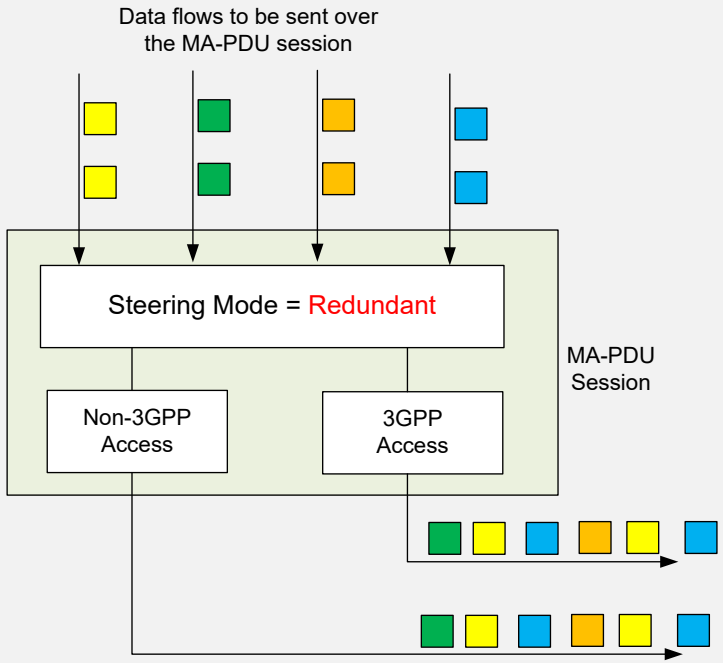


3GPP ATSSS – setting up a MA PDU session



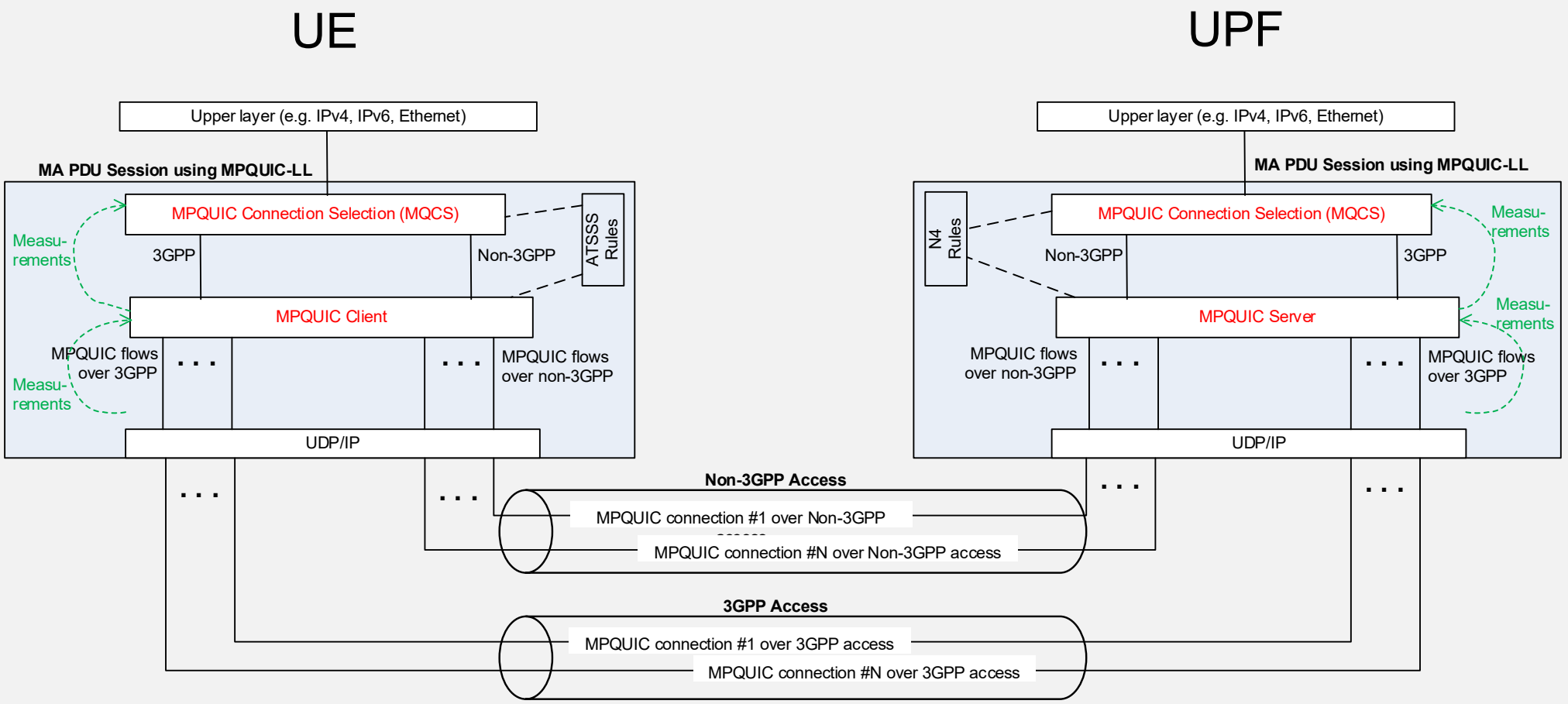
3GPP ATSSS – what's next?

- New steering mode: redundant mode.



3GPP ATSSS – what's next?

- New multi access transport for both IP and Ethernet using MPQUIC



5G AND WIFI CONVERGENCE

Policy Interworking and enhancements across Wi-Fi and 5G

MARK GRAYSON

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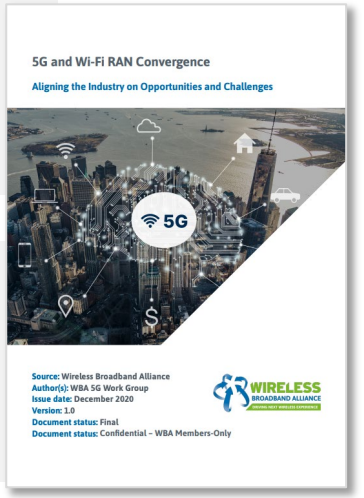
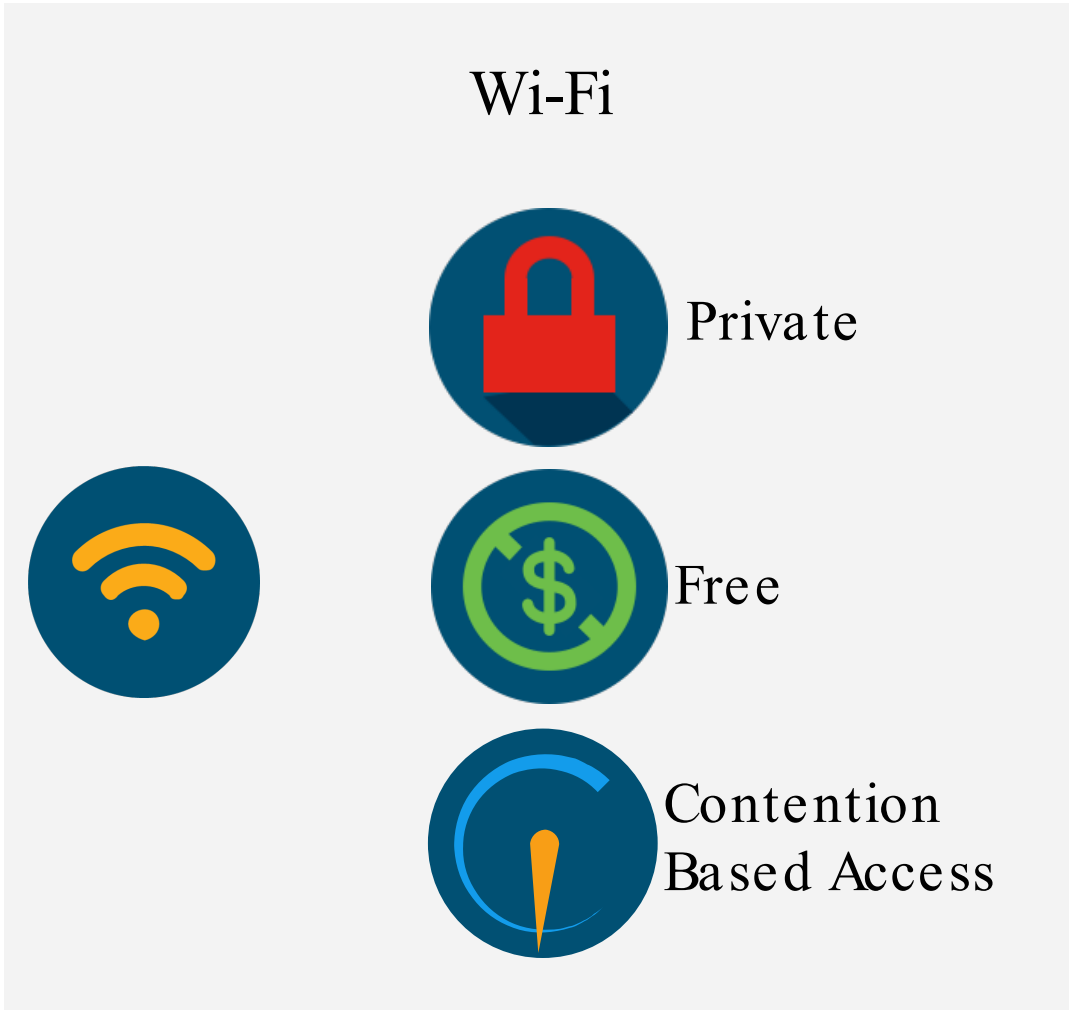
Enhancing Experiences using Wi-Fi and 5G

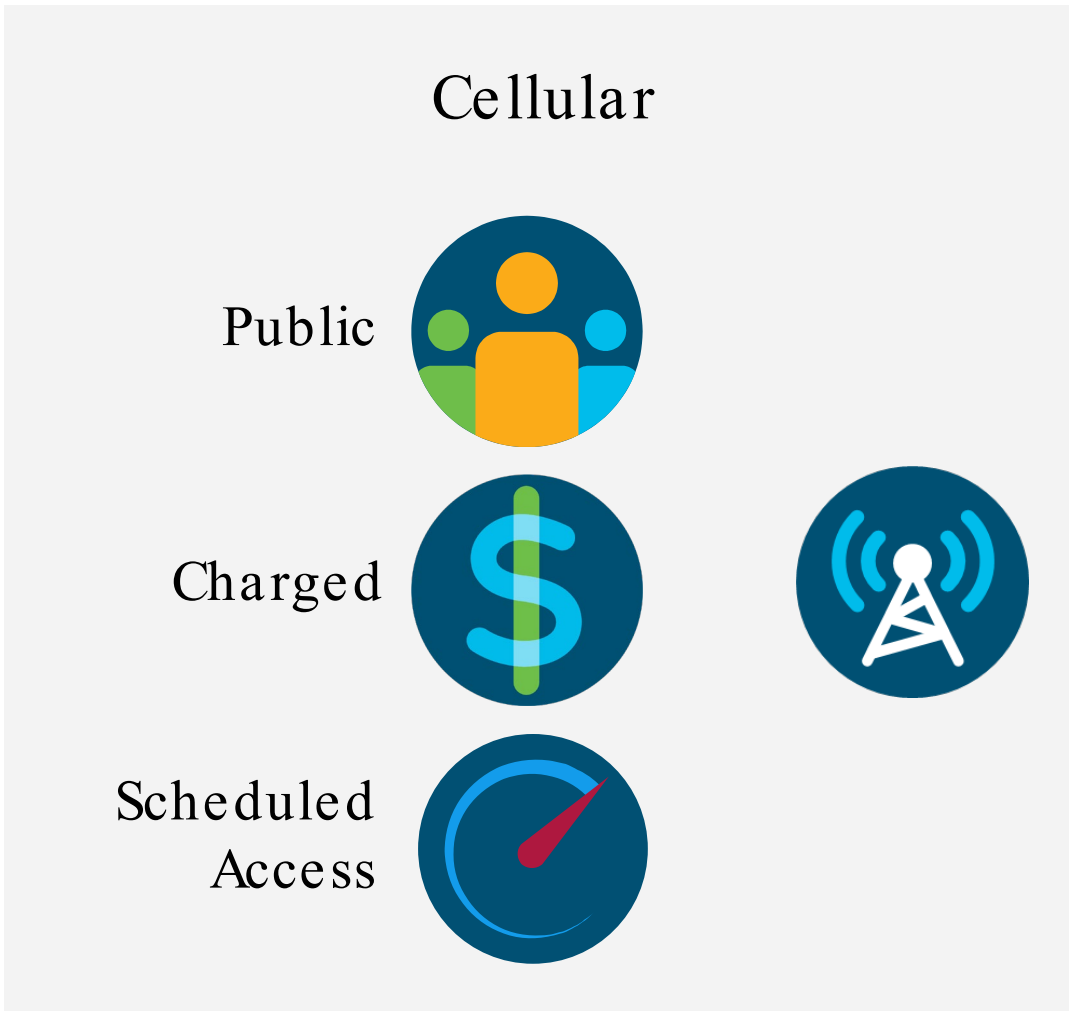
OPENROAMING

Access Selection	Pre-Establishment	Data Transfer
Ensuring Wi-Fi and 5G interfaces are available to all applications	Application requirements, prohibitions and preferences	Multi-Path Policy Enforcement
Access Network Discovery and Selection Policy	UE Route Selection Policy	ATSSS Policy



Legacy: Hard Coded Policies Based on Access Technology

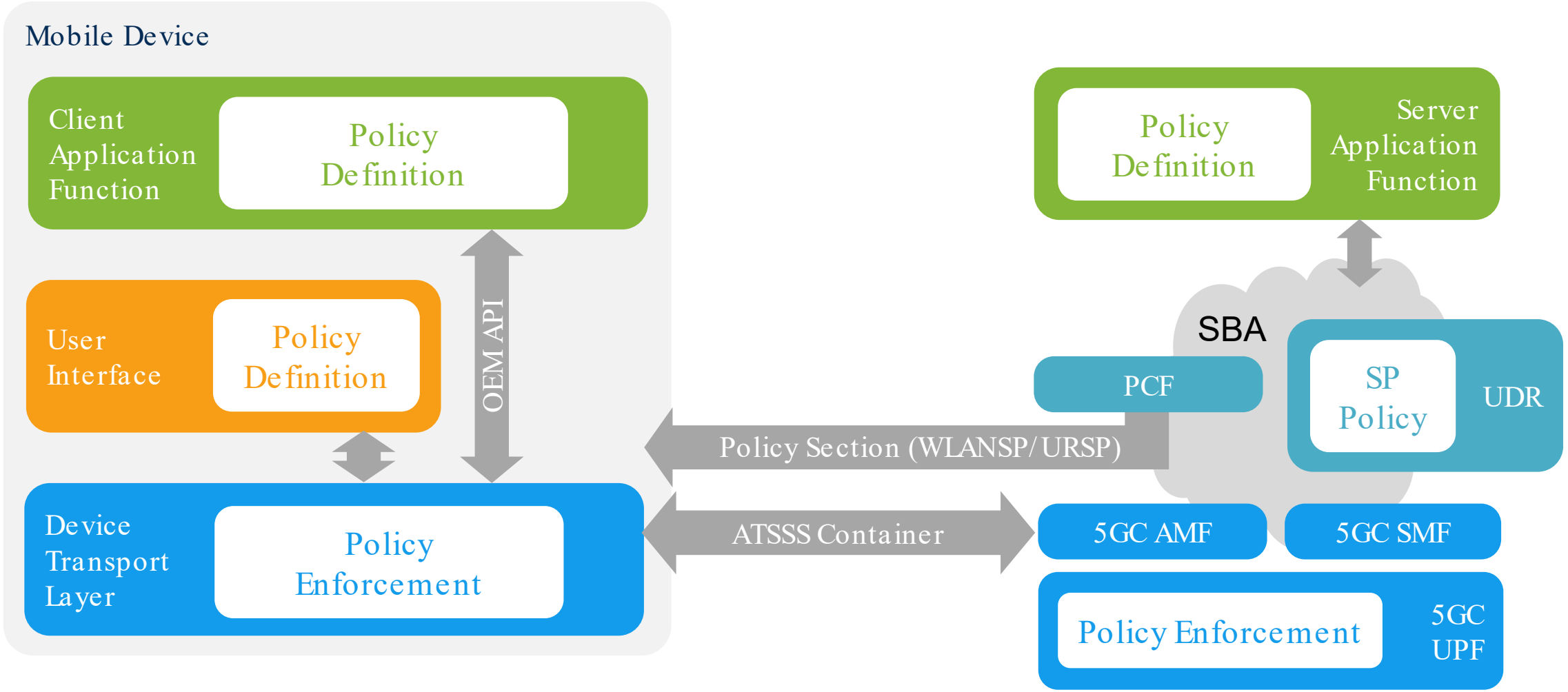




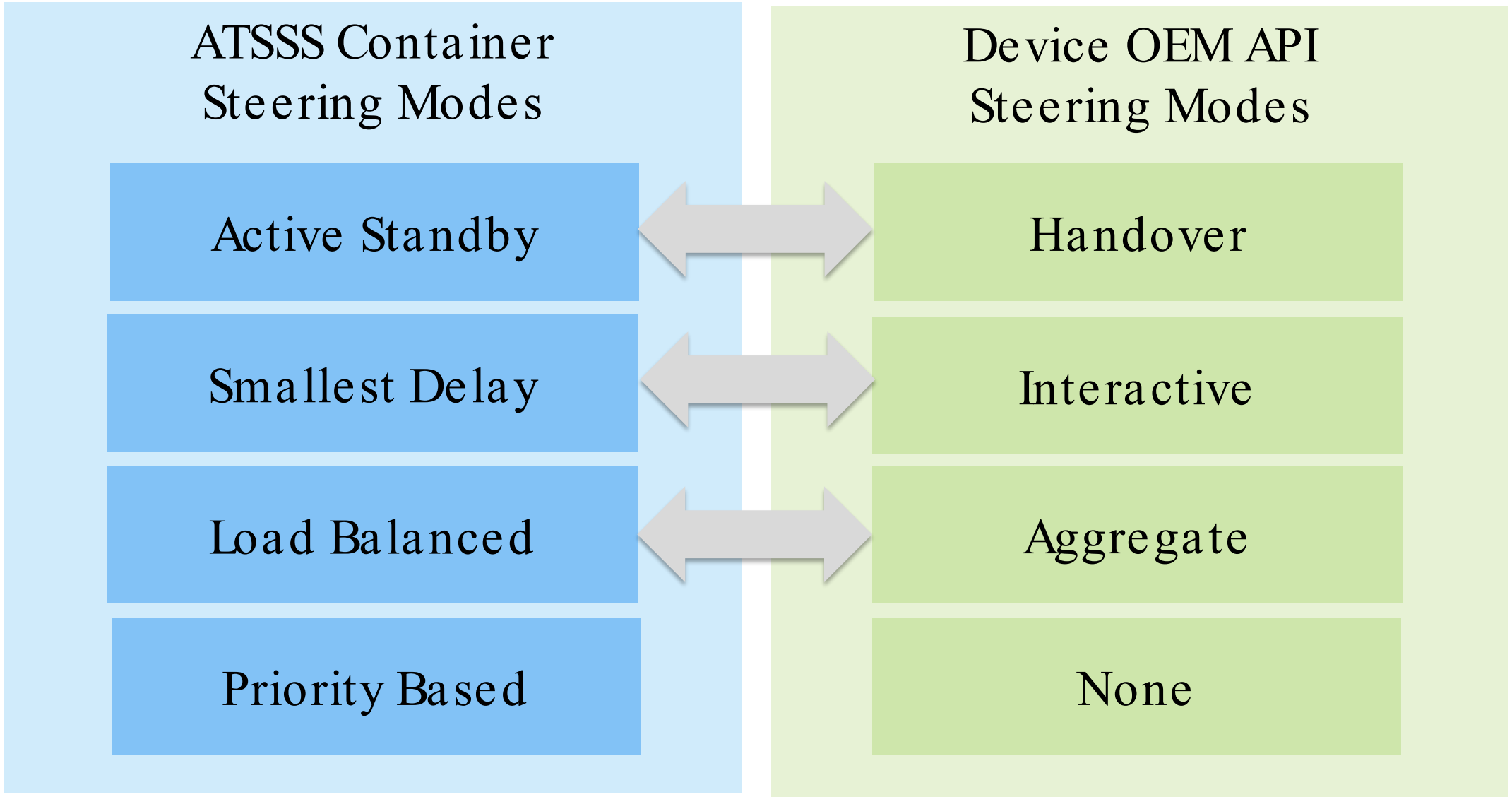
The Present: Blurred Boundaries Between Access Technologies

Wi-Fi Ready to Support 5G Services	Wi-Fi/ 5G Policy Increasingly Complicated
Private	Public
Free	Charged
Contention Based Access	Scheduled Access

Complex Coexistence of Policies



Comparing Steering Modes



Key Take-Away

1. Not either/or, but always 5G-NR combined with Wi-Fi
2. Blurring between Wi-Fi and 5G-NR creates opportunities for Wi-Fi, but complicates policy decisions
3. Common framework for policies:

   access selection, pre-establishment and data transfer
4. Alignment of data transfer policies between 3GPP ATSSS and device OEM APIs

   Active-Standby/Handover, Smallest-Delay/Interactive, Load-Balanced/Aggregate
5. Large number of policy stakeholders:

App Provider Defined Policy | Device OEM Defined Policy | User Defined Policy | Service Provider Defined Policy | Enterprise IT Defined Policy

Summary and Next Steps – Binita Gupta

WBA 5G and Wi-Fi RAN Convergence paper provides a deep-dive into convergence architecture and solutions

- 3GPP Release 15/16 defined solutions on WLAN integration architecture, trusted WLAN access selection, policies for access selection and traffic steering, ATSSS multi-access steering functionality and QoS model over WLAN access

It explores challenges and enhancements for the industry to address to provide improved integration

- 5G and Wi-Fi integration architecture
- ATSSS multi-access functionality
- End-to-end QoS for 5G flows over WLAN access
- Policy Interworking and enhancements across 5G and Wi-Fi
- Support for Wi-Fi only devices w/o USIM

Next steps: WBA is conducting liaison activities with other SDOs to align the industry and facilitate actions to address identified issues

- Liaisons being sent to 3GPP SA, WFA, IEEE 802.11, GSMA, IETF, ATIS and NGMN

Inviting operators, vendors and SDOs to work together to fully define and deliver on the 5G and Wi-Fi converged solutions

Moderated Q & A

5G & Wi-Fi RAN Convergence White Paper

WBA 5G Program: What next?

BRUNO TOMÁS

DIRECTOR OF PROGRAMS, WIRELESS BROADBAND ALLIANCE

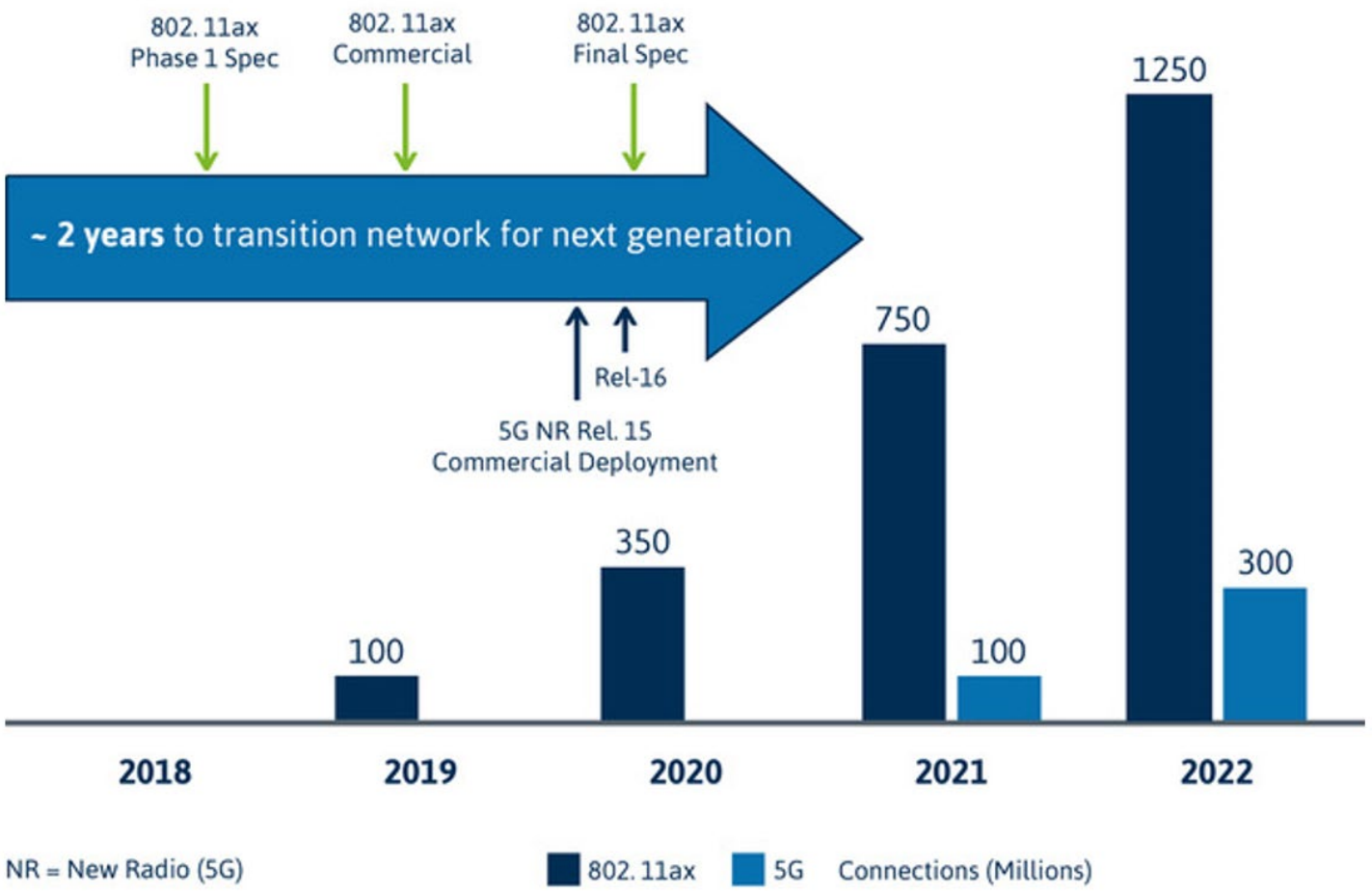
WBA 5G WORK GROUP

Call for Participation

PMO – February 2021

Role of Wi-Fi in 5G Roadmap

Uptake of Wi-Fi 6 and 5G NR based on the number of connections …



Source: GSMA, EISG, IHS Markit

Business rationale

- Accelerate time to market for 5G with Wi-Fi (802.11ax)
- Free, global and widely available Spectrum
- Improves Return of Investment (ROI) for 5G
- Lower cost/bit & complement other 5G tech
- Enhanced Carrier Grade & Cellular Integration

WBA Roadmap 2021

WBA WORK GROUPS & PROJECTS

5G
Work Group

Leading Wi-Fi and 5G RAN Convergence

- 5G & Wi-Fi Convergence in Private 5G Networks

IoT
Work Group

Augmenting Wi-Fi role in IoT

- Wi-Fi 6/6E for Industrial IoT
- Rural Wi-Fi
  Starts Q3/Q4
- AR & VR
  Requirements
  Starts Q4

NextGen
Work Group

Fast-tracking Wi-Fi deployments for operators

- Wi-Fi 6E
  Trials
- In-Home
  Multi-AP Solutions
- Wi-Fi Sensing
  Deployment Guidelines
- Trackside Connectivity & Spectrum
  Starts Q4

Roaming
Work Group

Incubating new business opportunities

- Roaming Evolution
  PKI RadSec
- In-Flight Connectivity
- Profiles & RCOIs Prioritization
  Starts Q1
- OpenRoaming for Private LTE/5G
  Starts Q3

Testing & Interoperability
Work Group

Achieving interoperable Wi-Fi services

- Captive Portal
  Onboarding Evolution
- Wi-Fi IMSI Privacy Protection
- Wi-Fi & Devices Identification

In progress Pipeline project

WBA OpenRoaming™
Task Group

Development of standards, federation governance and trials

Policy & Regulatory Affairs
Work Group

Industry liaison and advocacy of WBA global programs

Market
Work Group

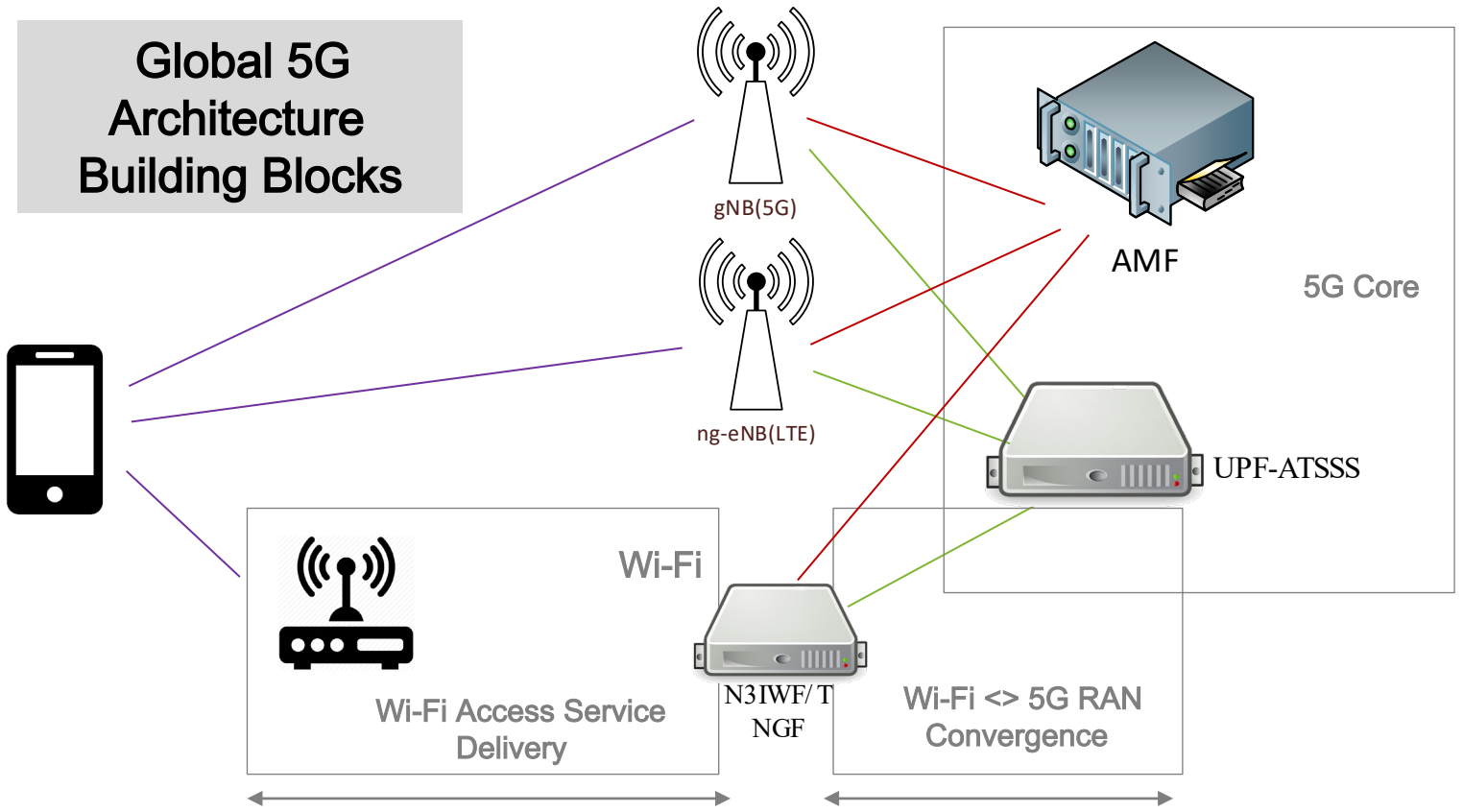
Marketing activities and industry dissemination

WBA Certification
Task Group

Addressing interoperability to foster adoption

Wi-Fi & 5G RAN Convergence Trials

Global 5G Architecture Building Blocks



Driving requirements and early trials including coexistence mechanisms

WBA Role

- Use of an access-neutral mechanism
- End-to-end service delivery over Wi-Fi
- Verticals test plans and trials
- Network Manageability and Policy Control
- Enablement of Wi-Fi Only Devices

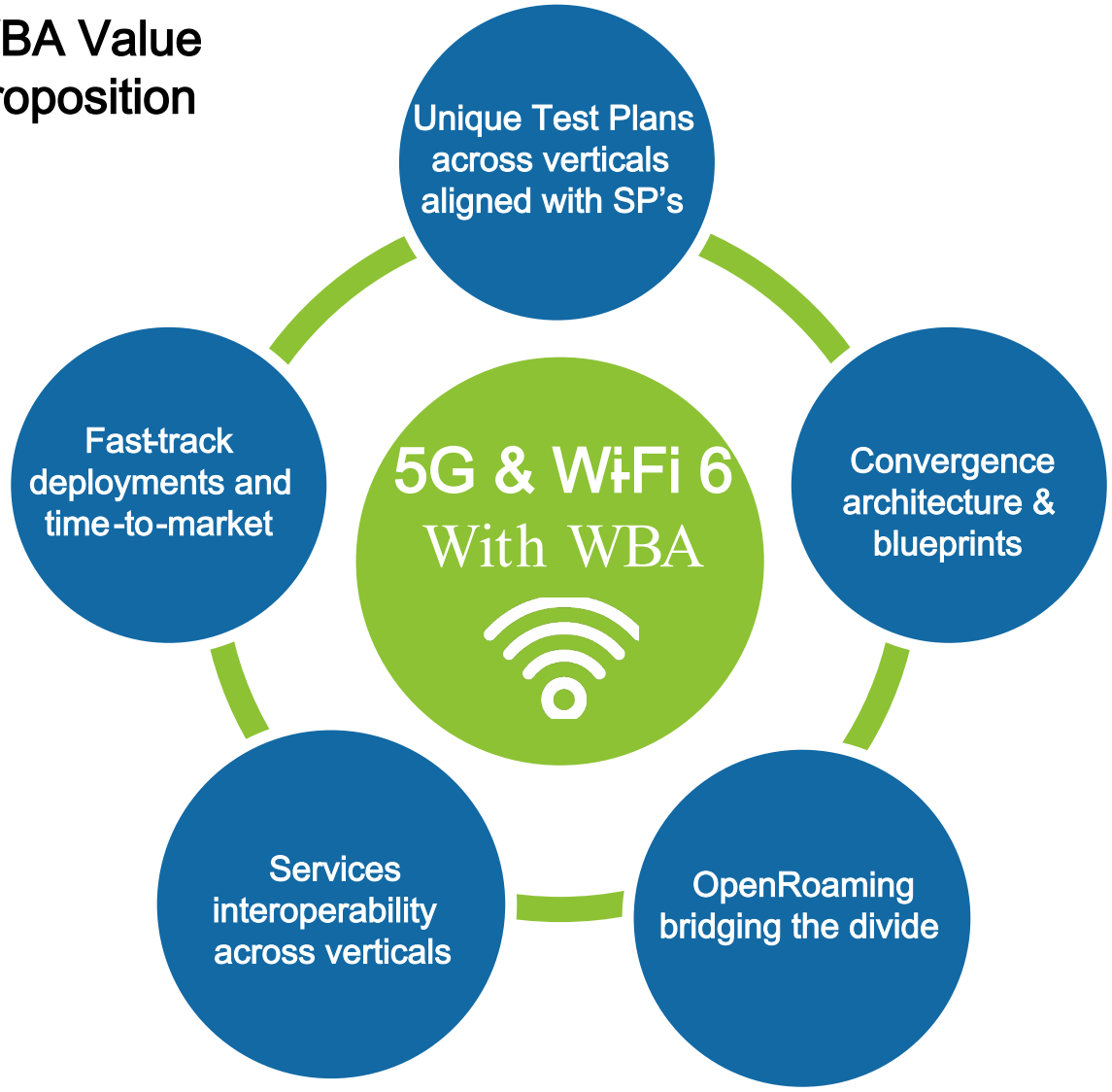
WBA Role

- Traffic Routing across Multiple Accesses
- EAP authentication framework
- WLAN Gateway Function (N3IWF/ TNGF)
- ATSSS for traffic routing
- End-to-end QoS across 5G and Wi-Fi

Kicking-off trials on Q2 2021

Call to Action

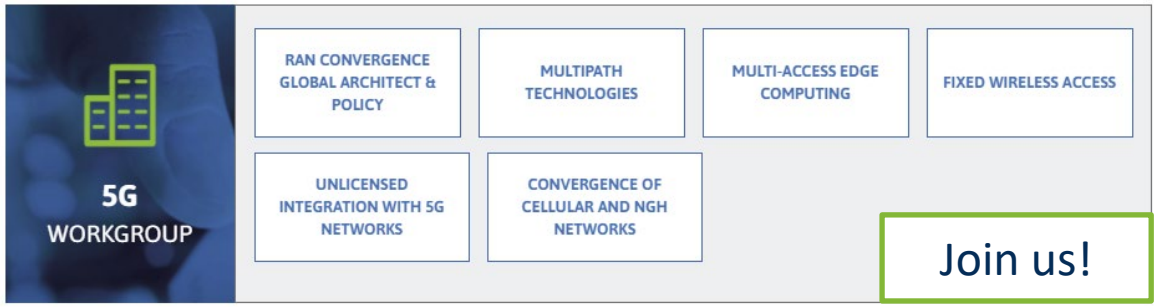
WBA Value Proposition



non-exhaustive

Participants for the WBA 5G Program

AMERICAN TOWER · BROADCOM · BT · CISCO · Google · intel · NOKIA · orange · tessares · Charter Spectrum · Shaw · Qualcomm · Viasat



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CLOSING

STEVE ANDREWS

CHAIRMAN LUMINET, NED EDGEWATER WIRELESS & WBA BOARD ADVISOR

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THANKS FOR ATTENDING

Next event:

Feb 8th – Next Generation of Wi-Fi
08:00 GMT

For 2021 events: wirelessglobalcongress.com/register-your-interest-for-2021-events

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