



*IT R&D Global Leader*

# WLAN과 5G 망간 연동기술


2019. 12. 04.

오현서

지능로보틱스연구본부

**ETRI**

Electronics and Telecommunications  
Research Institute



IEEE/ITF 표준 신기술 공동 워크숍

# 목 차

1

차세대 WLAN 기술

2

3GPP WLAN 연동 기술

3

IEEE ANNI WG 추진 현황

# 1 차세대 무선랜 기술

# 차세대 무선랜 개요

- IEEE802.11ax를 이용한 무선 데이터 서비스 망 구축 효과

- 5G 망 구축비용 대비 11ax를 구축 비용은 5G 대비 2% 비용

- 구글/퀄컴 등 4개사 주도의 뉴욕 Wi-Fi “Link NYC”

- 11ac 기술 기반 기술로 셀룰라 대비 5배 빠른 통신 서비스 제공

- 공중전화가 있던 자리에 **Links** 설치, 다양한 서비스 제공

- IEEE802.11ax의 특징

- 최대 **9.6Gbps** 급 초고속 데이터 서비스 제공

- **OFDMA** 기반 자원 최적화, 스펙트럼 효율성 증대

- 밀집도가 높은 지역에서 효율적인 **Wi-Fi** 서비스 제공



[뉴욕 공공 Wi-Fi : Links 설치 모습]

※ Links는 2020년까지 1만대 설치 예정

# 차세대 무선랜 개요

## ● WLAN 무선 전송 성능은 5G 성능을 만족

- Broadcom 시뮬레이션 결과 ITU-R IMT-2020 eMBB Indoor Hot Spot, Dense Urban 시나리오 성능을 모두 만족

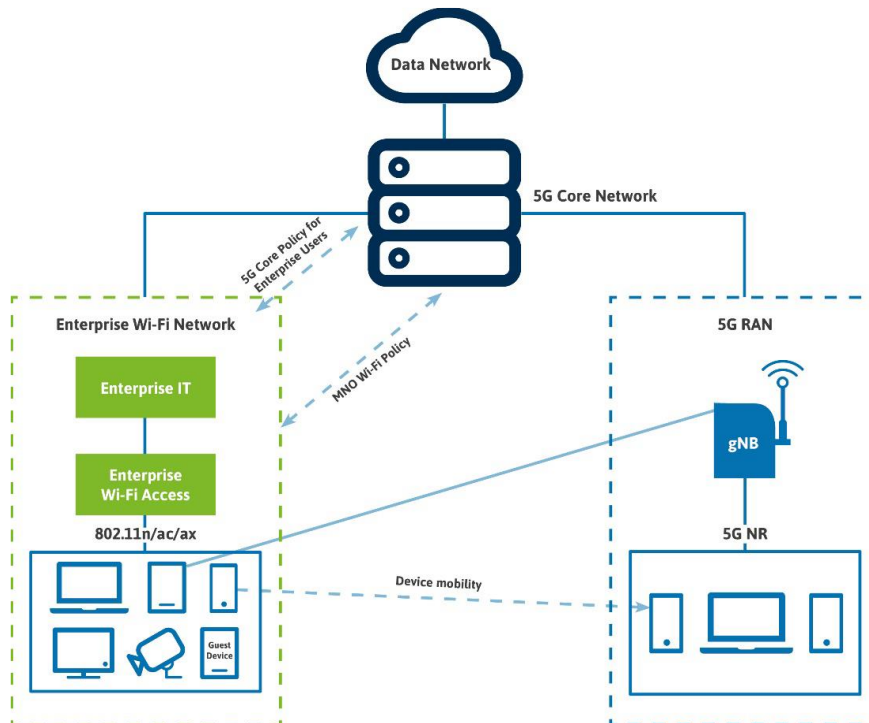
	Metric	ITU-R Evaluation Method	Minimum Requirement	802.11ax Performance
1	Peak data rate	Analytical	DL/UL : 20/10 Gbps	DL/UL : 20.78 Gbps [Note 1]
2	Peak spectral efficiency	Analytical	DL/UL : 30/15 bits/s/Hz	DL/UL : 58.01 bits/s/Hz [Note 2]
3	User experienced data rate	Analytical for single band and single layer; Simulation for multi-layer	Not applicable for Indoor Hotspot	Not applicable
4	5 <sup>th</sup> percentile user spectral efficiency	Simulation	DL/UL : 0.3/0.21 bits/s/Hz	DL/UL : 0.45/0.52 bits/s/Hz [Note 3]
5	Average spectral efficiency	Simulation	DL/UL : 9/6.75 bits/s/Hz/TRxP	DL/UL : 9.82/13.7 bits/s/Hz/TRxP [Note 3]
6	Area traffic capacity	Analytical	DL : 10 Mbit/s/m <sup>2</sup>	Required DL bandwidth = 170 MHz with 3 TRxP/site. [Note 4]
7	Mobility	Simulation	UL : 1.5 bits/s/Hz	UL : 9.4 bits/s/Hz
8	Bandwidth	Inspection	100 MHz, scalable	20/40/80/80+80/160 MHz
9	User plane latency	Analytical	DL/UL : 4 ms	DL/UL : 80 us [Note 5]

Indoor Hot Spot 경우 시뮬레이션 결과

# 차세대 무선랜 개요

## ● WLAN/5G 융합 분야

- WBA & NGMN Alliance 에 따르면 Enterprise, Factory Devices, Public Wi-Fi, Smart City, Home Wi-Fi 등 적용 가능
- WLAN이 5G 코어망과 접속을 통하여 Dual Access, Mobility, QoS 관리 등 성능 향상



- 단말은 5G 코어망과 접속을 지원
- Dual Access 지원
- Traffic Switching, Steering & Splitting 지원
- Network Management
- SIM card 없이 보안 기능 지원

# 차세대 무선랜 개요

## ● Key Challenges for WLAN & 5G Convergence

- Tight Integration between 5G and WLAN for improved session mobility
- Access visibility, network management and policy control
- Enablement of WLAN devices to connect 5G network
- Traffic routing across multiple accesses
- Network Slicing
- Device support to consider WLAN and 5G convergence

## 2 차세대 무선랜과 5G 망 연동 기술

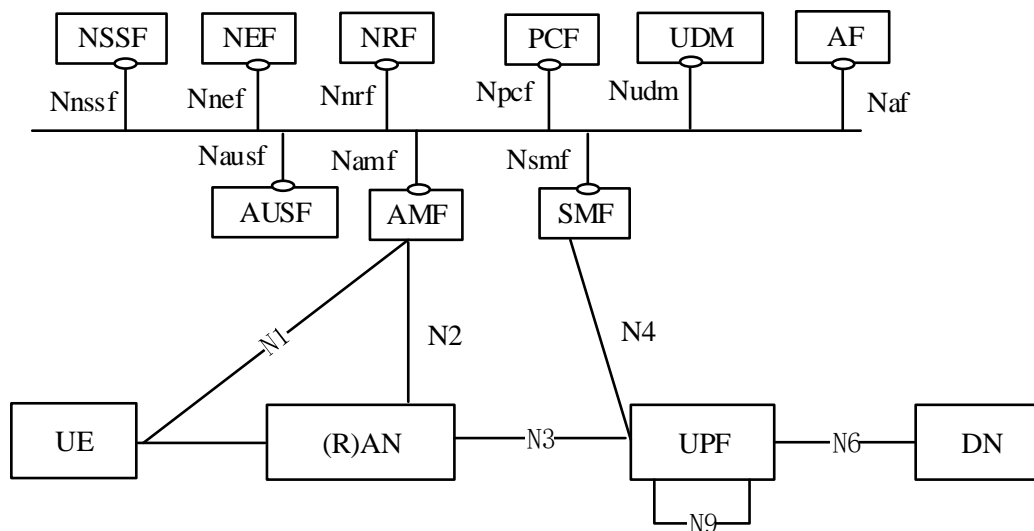


# 5G 망 연동 필요성

- Current WLAN access network can not access to 5G core network. So the station can not provide dual access of 5G and WLAN using 5G core networks. Therefore, it needs WLAN interworking to 5G network.
- 3GPP 5G communication network can support multi-RAT including non-3GPP access techniques.
- 3GPP already have released 5G core architecture to have multiple interfaces with 3GPP access type or non-3GPP access type.
- IEEE 802.11 access techniques need to provide interface and communication protocols to be interworked with 5G core network

# 5G 망 기본 구조

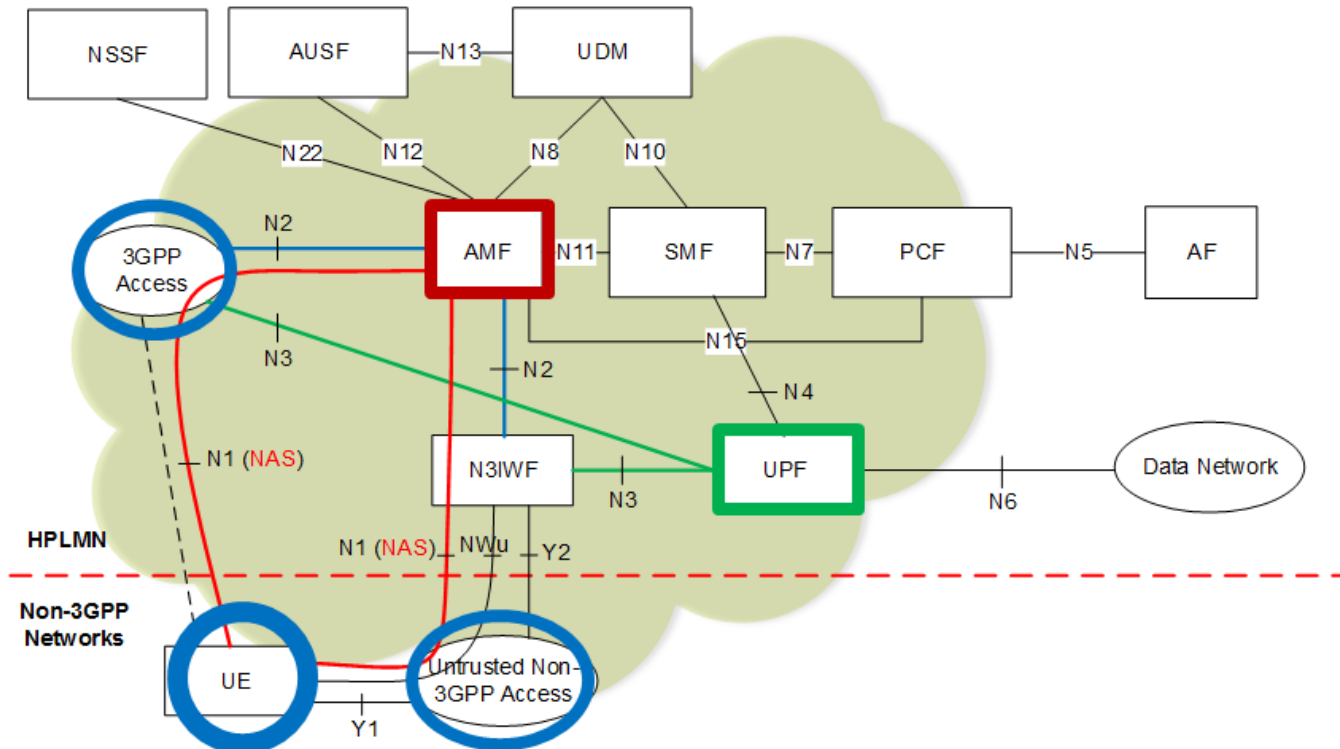
- 5G System Architecture supports signalling and data connectivity using Service Based Interface(SBI), separate Control Plane (CP) and Data Plane(DP)



- UE: User Equipment
- AN: Access Network
- UPF: User Plane Function
- AMF: Access & Mobility Management
- SMF: Session Management Function
- NSSF: Network Slice Selection Policy
- NEF: Network Exposure Function
- NRF: Network Repository Function
- PCF: Policy Control Function
- UDM: Unified Data Management
- AF: Application Function

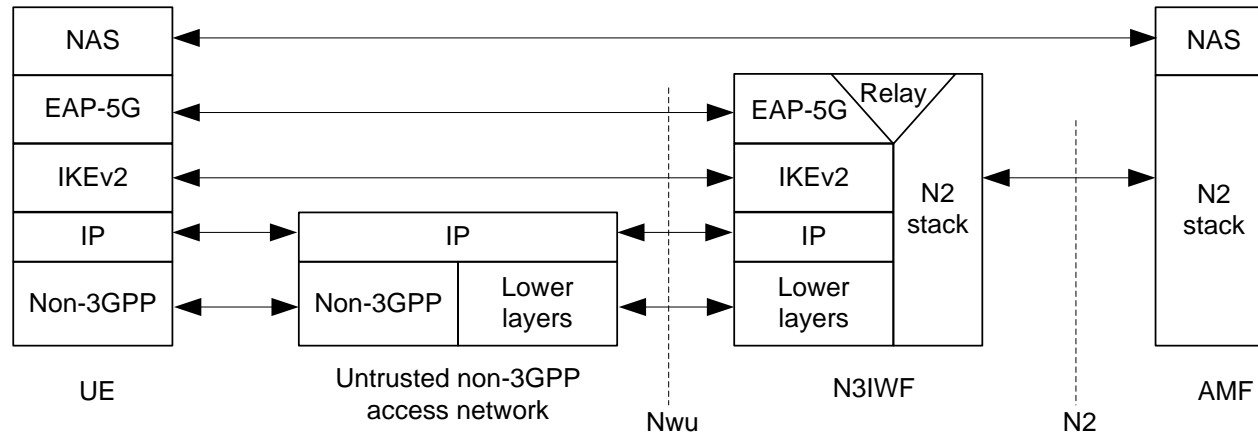
# 5G 망과 WLAN 연동

- N3IWF provides interworking between Untrusted Non-3GPP Access(ex, WLAN access network) and 5G core network
  - Y2, NWu, N1 interfaces are defined in the domain of 3GPP network



# Non-3GPP Access Network 연동 절차

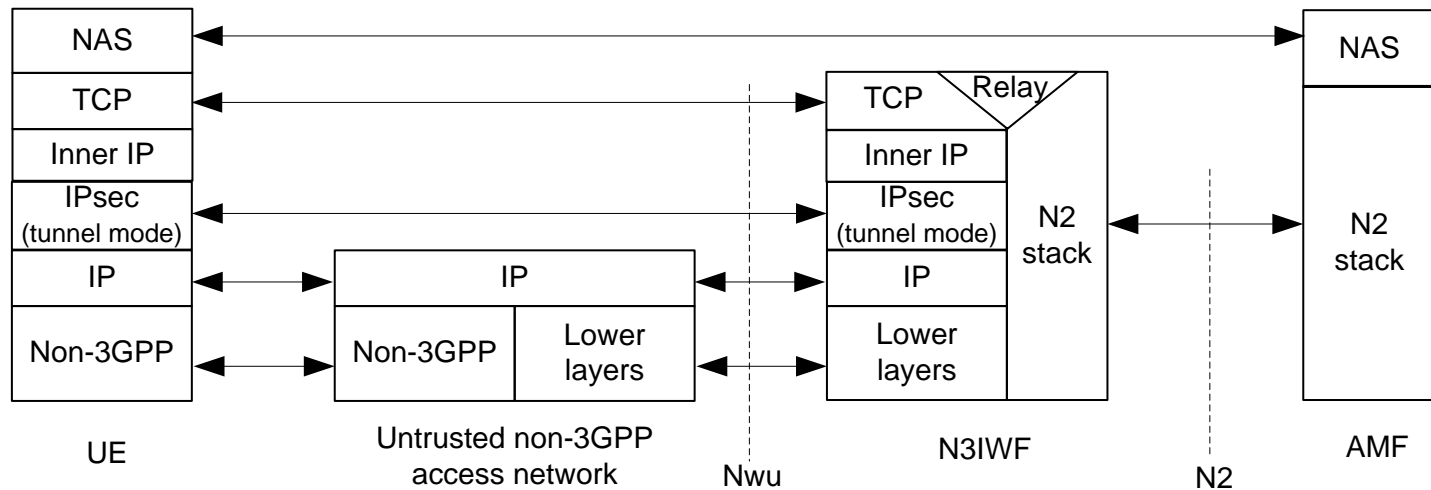
- UE initially gets IP address via Non-3GPP access network
- UE initiates IPsec Security Association(SA) by initiating IKE exchange
- UE initiates IKE\_AUTH exchange by using EAP-5G signalling
- UE receives encapsulated NAS message within EAP-5G packet



Control Plane before the signalling IPsec is established between UE and N3IWF (3GPP TS 23.501)

# Non-3GPP Access Network 연동 절차

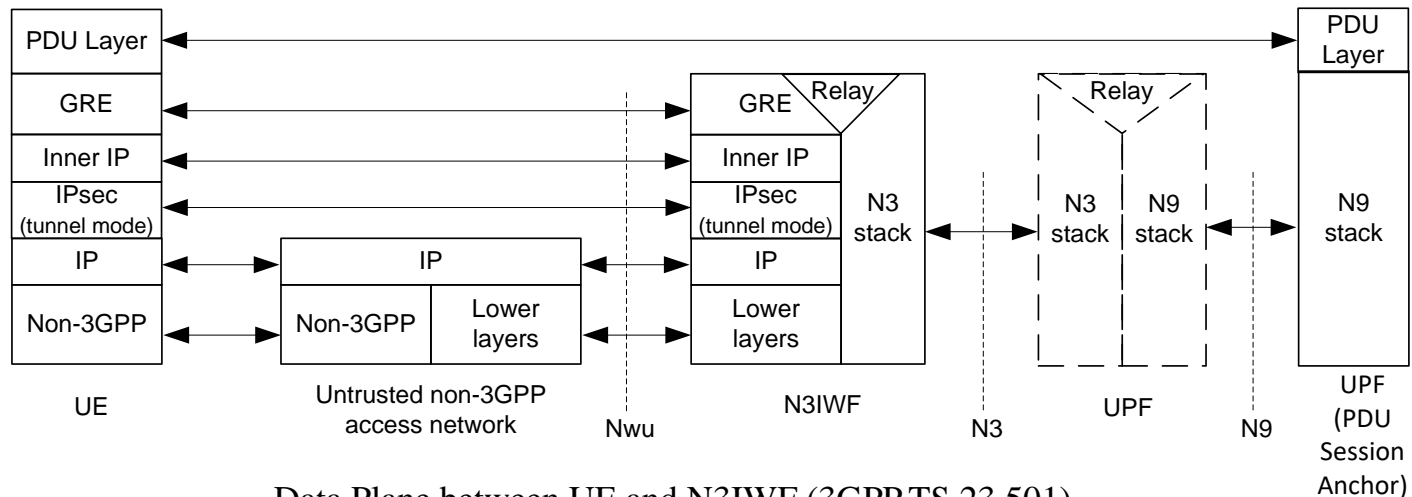
- UE establishes IPsec Security Association(SA)
- NAS messages between UE and AMF are carried over IPsec Security Association(SA)



Control Plane after the signalling IPsec is established between UE and N3IWF (3GPP TS 23.501)

# Non-3GPP Access Network 연동 절차

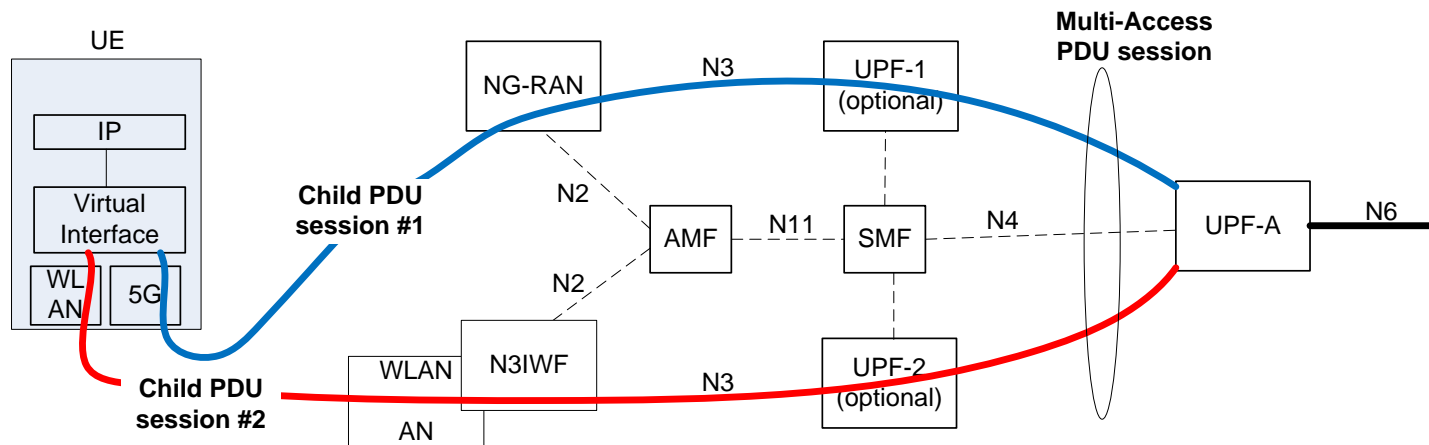
- Packet data unit is exchanged between UE and UPF in IPsec Tunnel Mode
- Large GRE packets are fragmented by the "inner IP" layer
- UDP protocol may be used below the IPsec layer to enable NAT traversal



\* NAT : Network Address Transnation

# 5G 망 연동

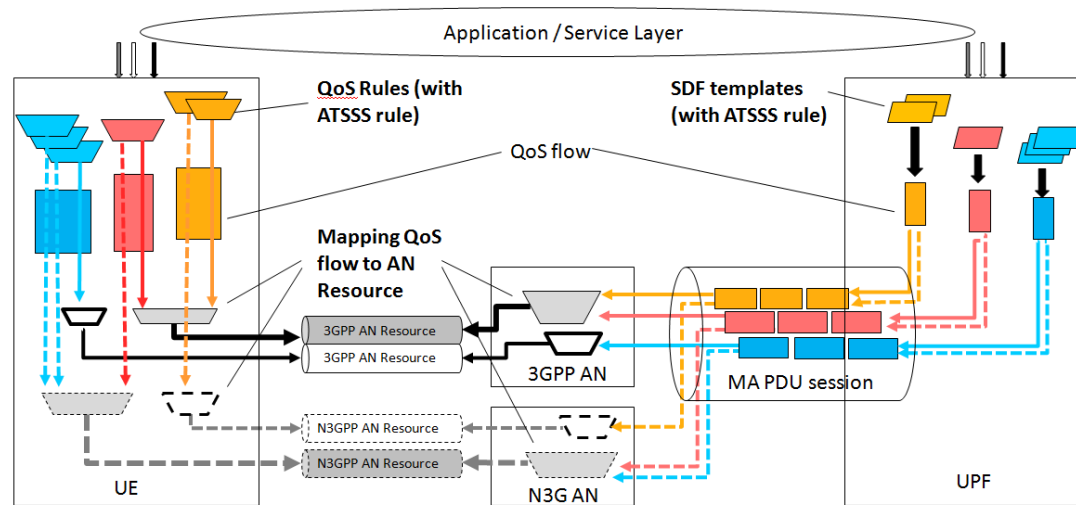
- 3GPP supports ATSSS between 3GPP and non-3GPP access networks
- ATSSS can enable traffic selection, switching and splitting between 5G and WLAN



Support of Multi-Access PDU Sessions (3GPP TR 23.793)

# 5G 망 연동

- ATSSS Policy Enforcement function in SMF is responsible for ATSSS policies enforcement and session management of all PDU sessions between 5G core and UE
- Policy Enforcement function can also provide ATSSS PDU session related rules to UE during PDU session establishment and PDU session modification



The principle for classification and User Plane marking for QoS Flows and mapping to AN Resources (3GPP TS 23.501)

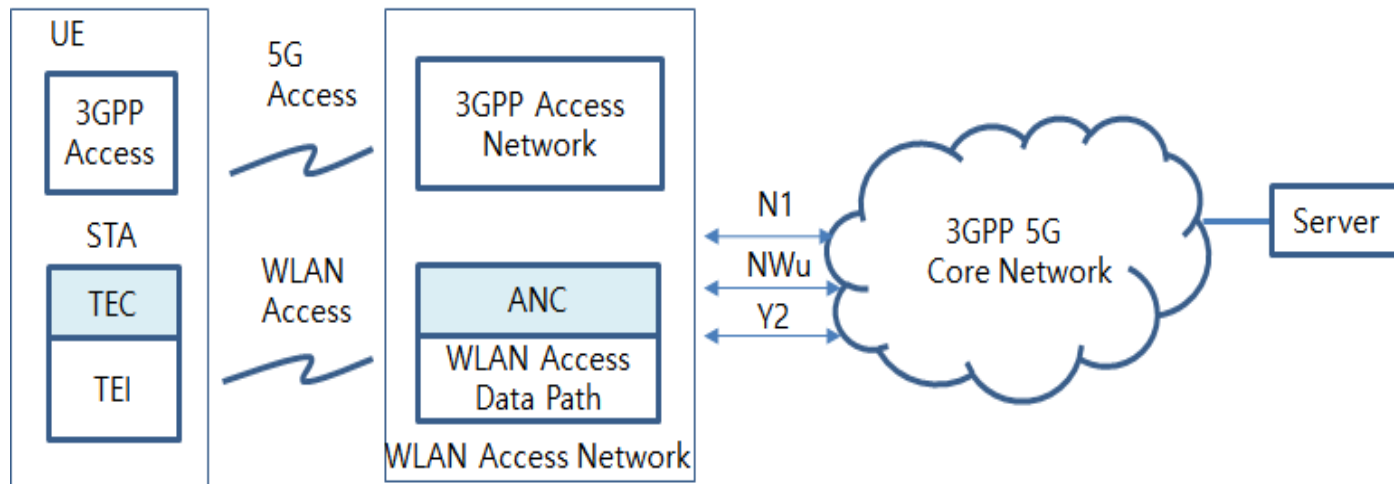


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## **IEEE ANNI 연동 기술**

# WLAN & 5G 망 연동 모델

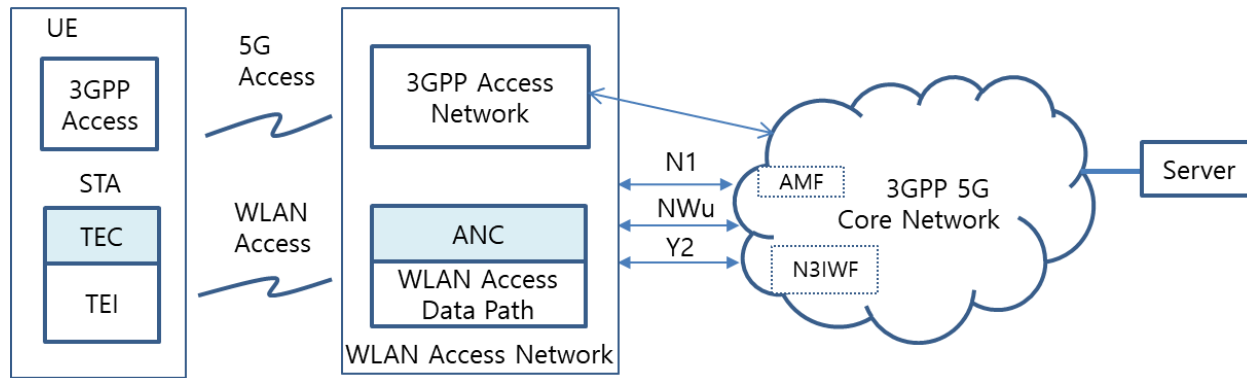
- The interworking reference model consists of UE, 3GPP and WLAN access network, 3GPP 5G core network and sever. UE have functions of 3GPP access and WLAN station, which consists of TEC and TEI.
- WLAN access network may have ANC and WLAN access data path according to WLAN network reference model IEEE 802.ICF-2019



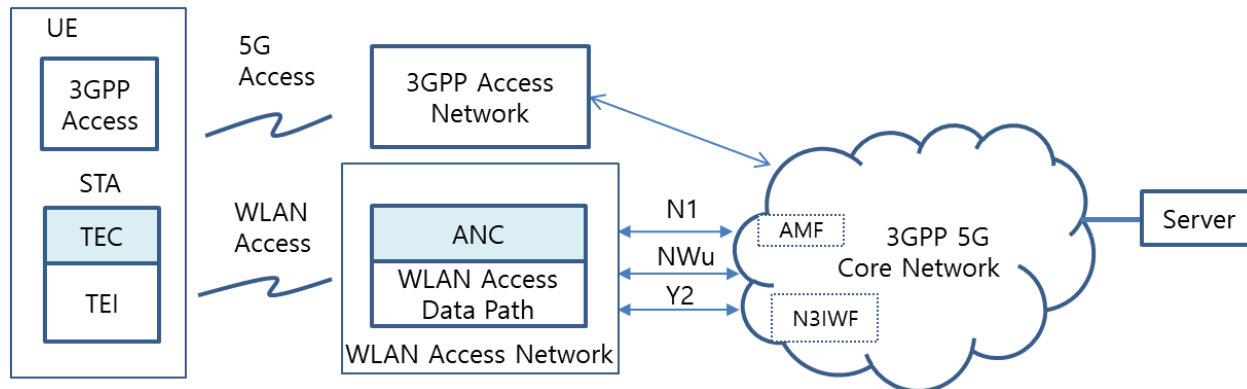
WLAN Interworking Model with 3GPP Core Network

# WLAN & 5G 망 형태

## ● WLAN Interworking Types



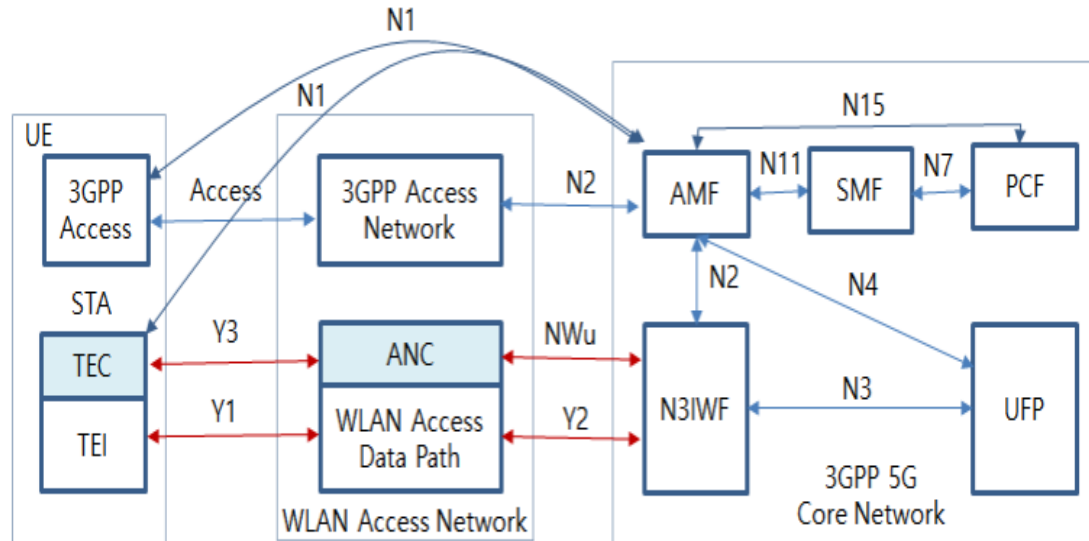
Tightly Coupled Interworking Type



Loosely Coupled Interworking Type

# WLAN & 5G 망 연동

- These red coloured Y1, Y2, Y3 and NWu interfaces are in the domain of WLAN and may be provided in STA and WLAN access network
- The other reference interfaces are referred to 3GPP core network.

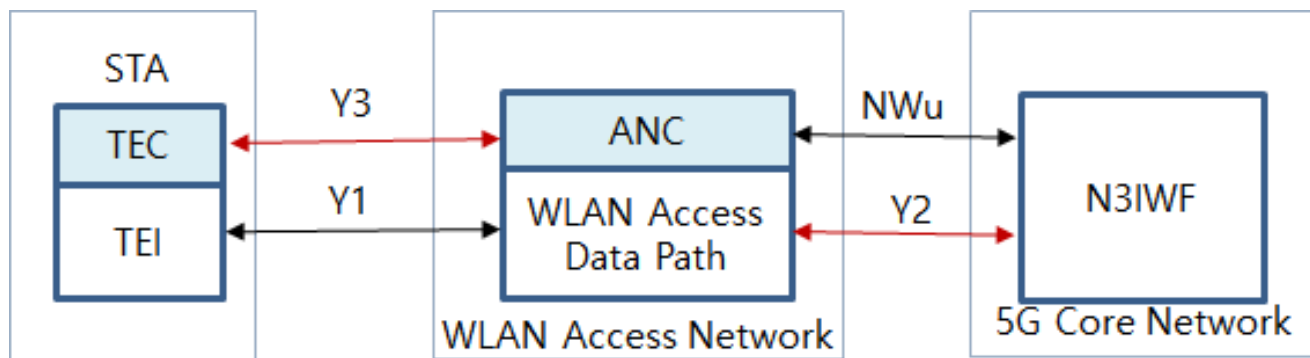


## ● Functional entities to be modified

- TEC (Terminal Control) and Access Network Control(ANC) function need to provide Nwu protocol
- communication protocol and QoS mapping

## ● Signal interface to be defined

- Y2 interface : wireline communication between WLAN access data path and N3IWF
- Y3 interface : NWu communication protocol



WLAN Interworking Reference Model with 3GPP Core Network

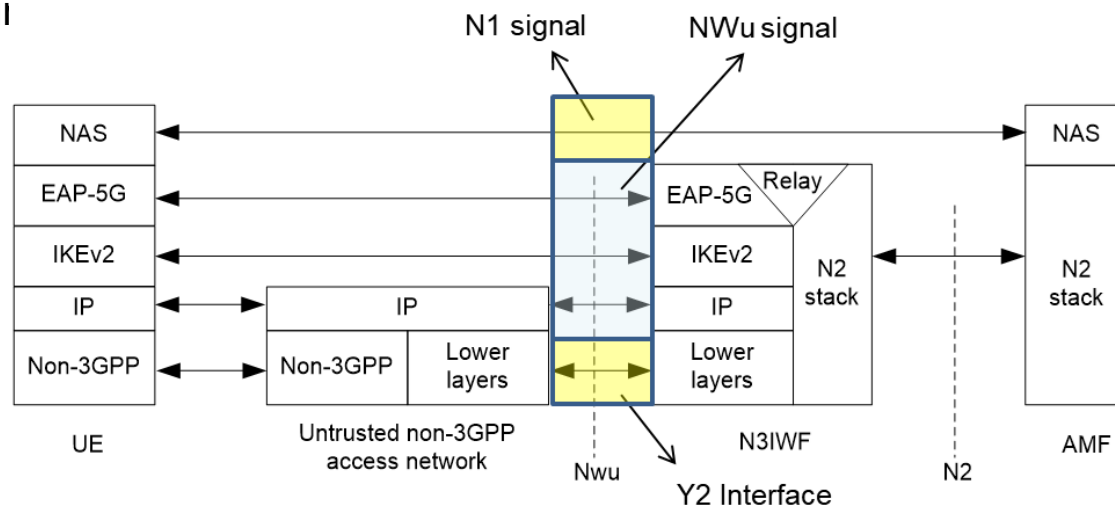
# 5G망 연동 기능 및 절차

## ● Radio channel sharing method

TEI of STA monitors the usage of WLAN access network if the radio channel is busy or idle. If the radio channel is idle, UE tries to send control or traffic data

## ● Registration & Authentication

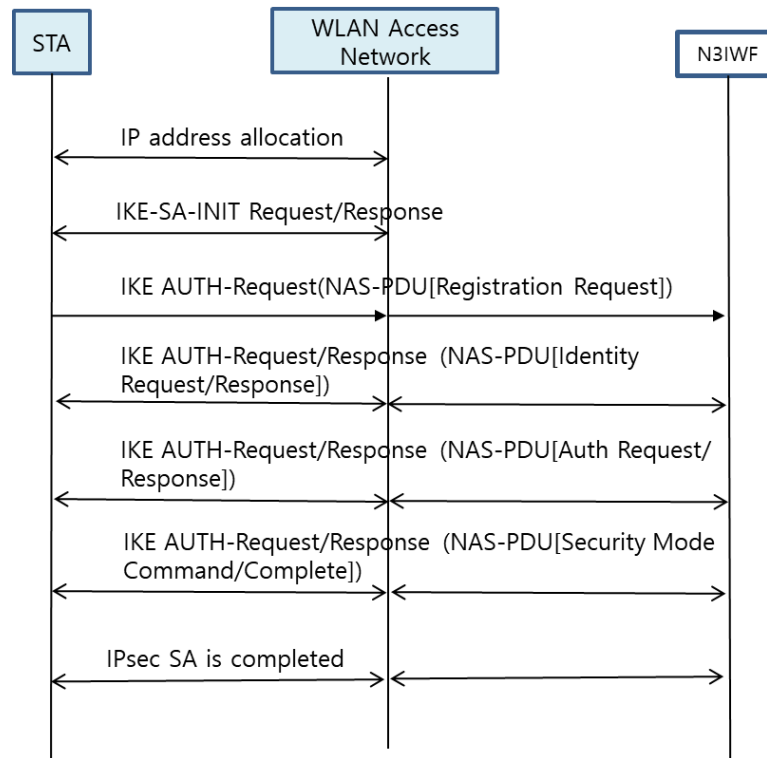
- IP communication protocol
- IKEv2 authorization protocol
- EAP-5G protocol
- NAS signalling



Message procedures in control plane

# 5G망 연동 기능 및 절차

- NWu is IP based communication protocol between STA and N3IWF to establish secured channel. IKEv2 and EAP-5G protocol are used.



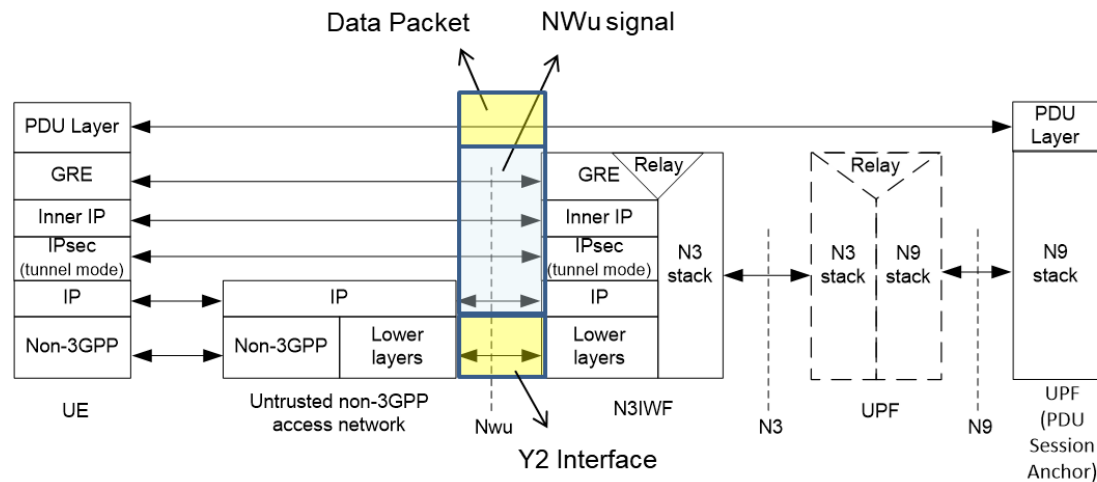
NWu message procedures in control plane

# 5G망 연동 기능 및 절차

## ● IPsec Tunneling Function

SC of UE and ANC of WLAN access network shall have specific functional requirements to interwork with 3GPP 5G core network.

- IP communication protocol
- IPsec communication protocol
- GRE communication protocol



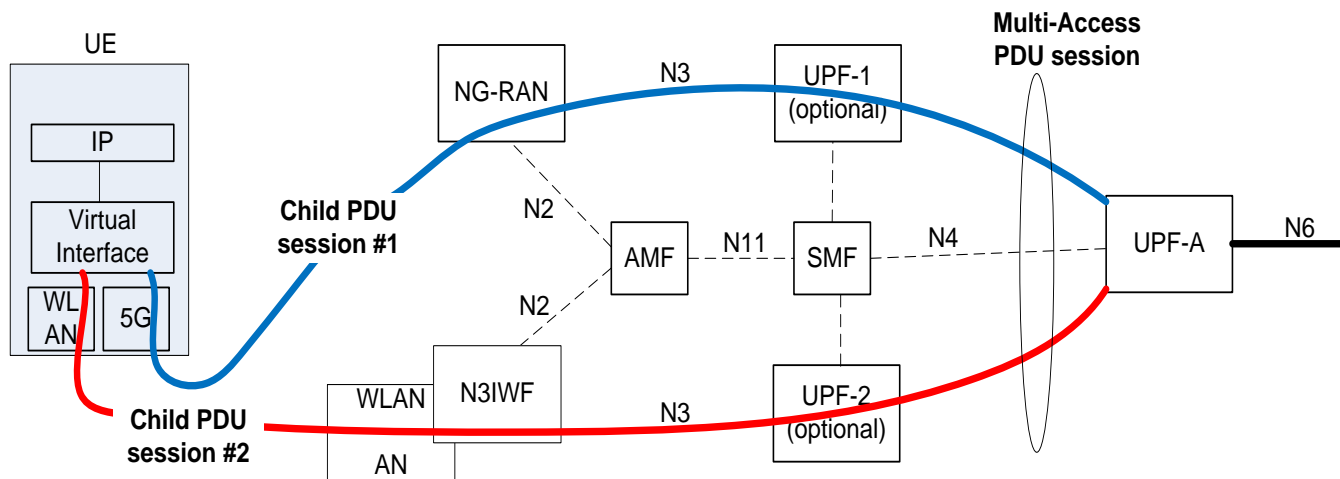
## Packet exchange in IPsec tunnelling mode



# 5G망 연동 기능 및 절차

## ● Traffic Selection, Switching and Splitting(ATSSS)

- Fast switching time & session continuity support
- All IP protocol support
- Traffic routing should be under policy control



# Future Work

- **Technical report in IEEE ANNI WG**

- Subject : Technical report on interworking between 3GPP 5G network and WLAN
- Milestone: 1<sup>st</sup> draft will be written in January meeting and updated in the following meeting, and will be completed in May meeting
- Supporting members: ETRI, all Radio Co. Ltd, KT, Nevision Telecom Inc., TTA, RCN Broadcom

- **Scope of technical report**

- The current report covers Rel. 15 version of 3GPP network. Broadcom suggested extension on Rel. 16 version of 3GPP network
- 3GPP Rel. 16 studies on **5GS Enhanced support of Vertical and LAN Services**

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## ● References

1. 3GPP TS 22.261 V15.5.0 (2018-06) "Service requirements for the 5G system (Stage 1)"
2. 3GPP TS 22.278 "Service requirements for the Evolved Packet System (EPS)"
3. 3GPP TS 23.402 "Architecture enhancements for non-3GPP accesses"
4. 3GPP TR 23.716 "Study on the Wireless and Wireline Convergence for the 5G System Architecture"
5. 3GPP TR 23.793 "Study on Access Traffic Steering, Switching and Splitting support in the 5G system architecture"
6. 3GPP TR 23.799 "Study on Architecture for Next Generation System"
7. 3GPP TS 23.501 "System Architecture for the 5G System (Stage 2)"
8. 3GPP TS 23.502 "Procedures for the 5G System (Stage 2)"
9. 3GPP TS 24.302 "Access to the 3GPP Evolved Packet Core (EPC) via non-3GPP access networks (Stage 3)"
10. 3GPP TS 24.501 "Non-Access-Stratum (NAS) protocol for 5G System (5GS) (Stage 3)"
11. 3GPP TS 24.502 "Access to the 3GPP 5G Core Network (5GCN) via Non-3GPP Access Networks (N3AN) (Stage 3)"
12. 3GPP TS 33.501 "Security Architecture and Procedure for the 5G System"
13. 3GPP TR 33.899 "Study on the Security Aspects of the Next Generation System"
14. RAN convergence paper, WBA and NGMN alliance, September, 2019.
15. IEEE 802.1CF-2019; IEEE Recommended Practice for Network Reference Model and Functional Description of IEEE 802® Access Network, 2019
16. RAN Convergence Paper, WBA and NGMN Alliance, September 2019.



감사합니다.

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