Three years of 5G Campus Networks - And what's next?

ITG Fachtagung 2023

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Campus Networks in Germany

>300 frequency allocations

Public Networks

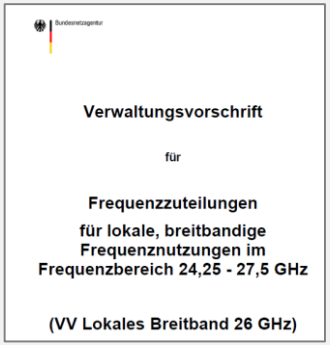
2G/GSM → 3G/UMTS → **4G/LTE** → **5G - Rel.15** → **Rel.16**

Verwaltungsvorschrift

für

Frequenzzuteilungen
für lokale Frequenznutzungen im
Frequenzbereich 3.700-3.800 MHz

(VV Lokales Breitband)



Verwaltungsvorschrift

für

Frequenzzuteilungen
für lokale, breitbandige
Frequenznutzungen im
Frequenzbereich 24,25 - 27,5 GHz

(VV Lokales Breitband 26 GHz)

Campus Networks

Private Networks

Wi-Fi 1/2 (802.11a/b) → Wi-Fi 3 (802.11g) → Wi-Fi 4 (802.11n) → Wi-Fi 5 (802.11ac) → Wi-Fi 6 (802.11ax) → Wi-Fi 7 (802.11be)

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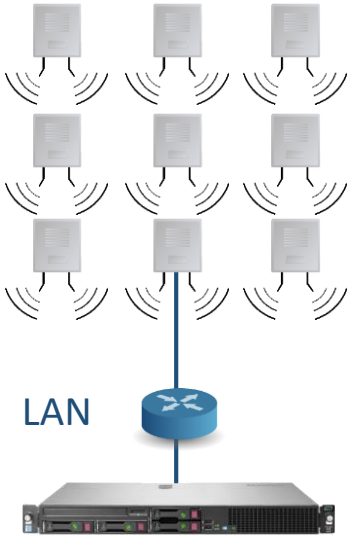
WLAN Technology

Developed for local networks, managed by the end-user



- Simple Planning
- Simple Installation
- Simple Operation

Mobile Network Technology

Developed for national networks, managed by an operator

Radio Access Network
(RAN)

3GPP Interface

Core Network
(CN)

3GPP Standards

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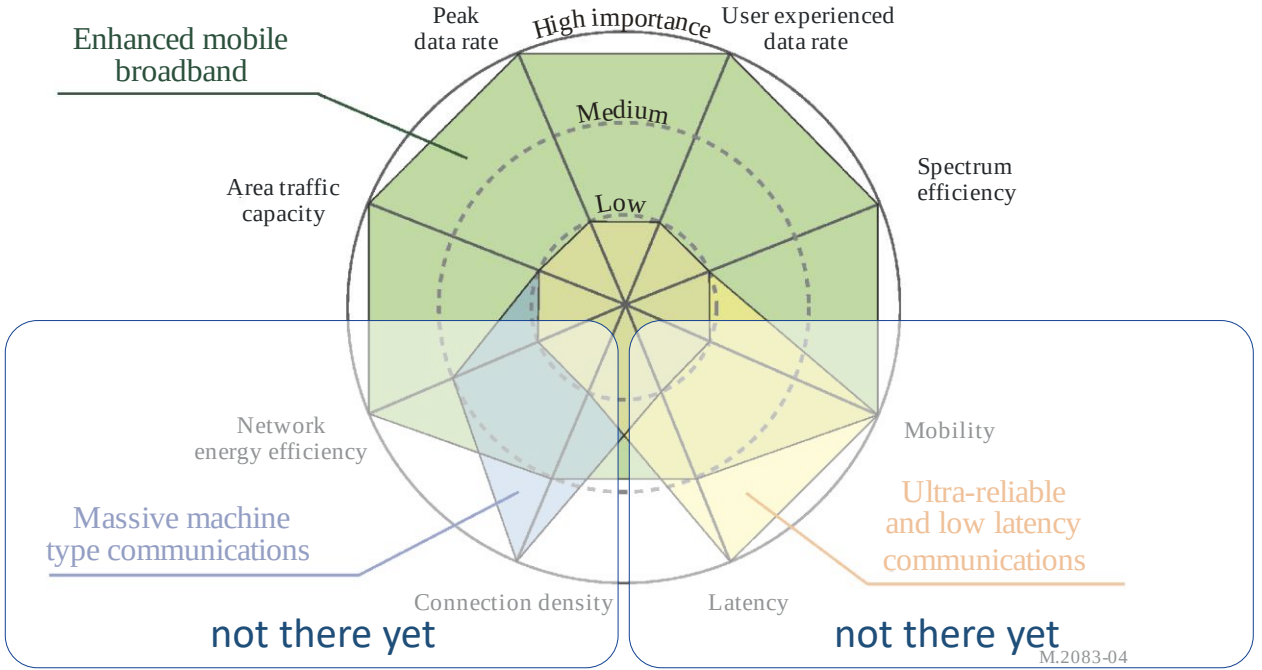
Why 5G?
Where are we now?



ITU-R M.2083-0 “IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond”

Why 5G?
Why not WLAN/WiFi?

Criteria: Total Cost of Ownership (TCO)

5G	WLAN
3 reasons to use 5G in a Campus Network:	
1. Spectrum – additional capacity 100 MHz (3.7-3.8 GHz)	5 GHz, 6 GHz (WiFi 6E) smaller cells → more APs
2. Spectrum – high availability exclusively allocated	banning other devices, e.g. phones → organizational effort
3. Spectrum – high performance unlimited EIRP[1)]	limited EIRP[2)] → limited performance

1) Safety regulations apply

2) 2.4 GHz: 100mW, 5.150 GHz-5.350 GHz: 200mW EIRP, 5.470 GHz – 5.725 GHz: 1W EIRP

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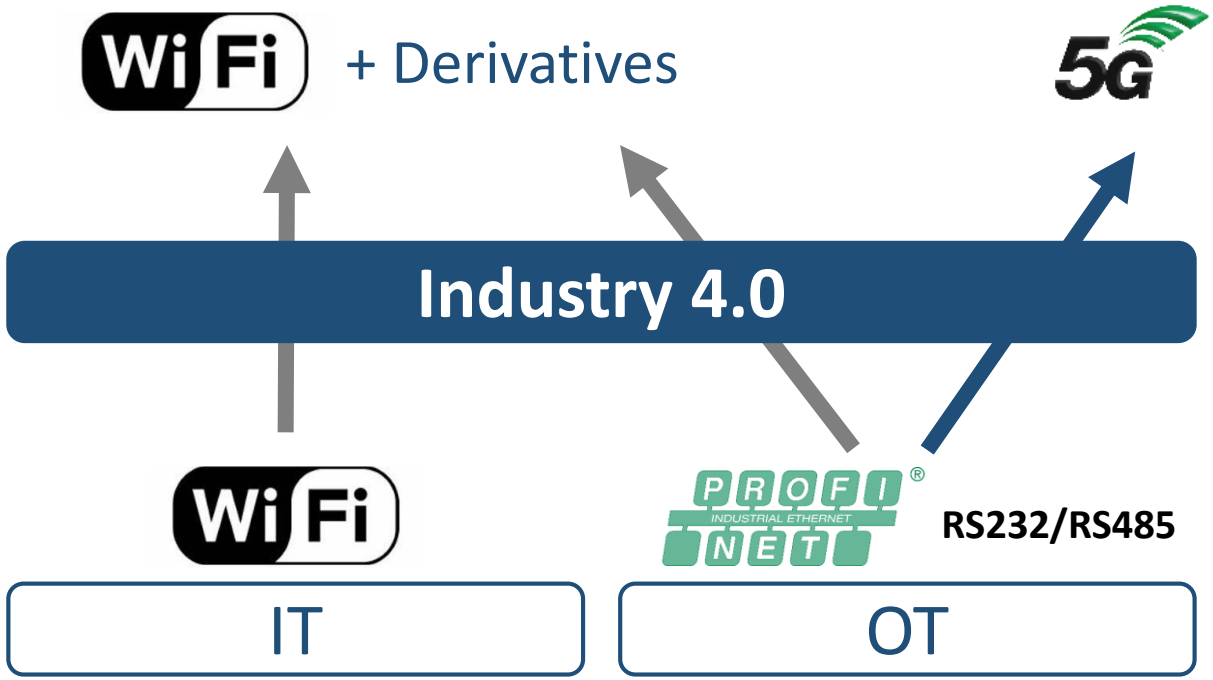
Why 5G?

Industrial applications may require exclusive spectrum



IT – Information Technology
OT – Operation Technology

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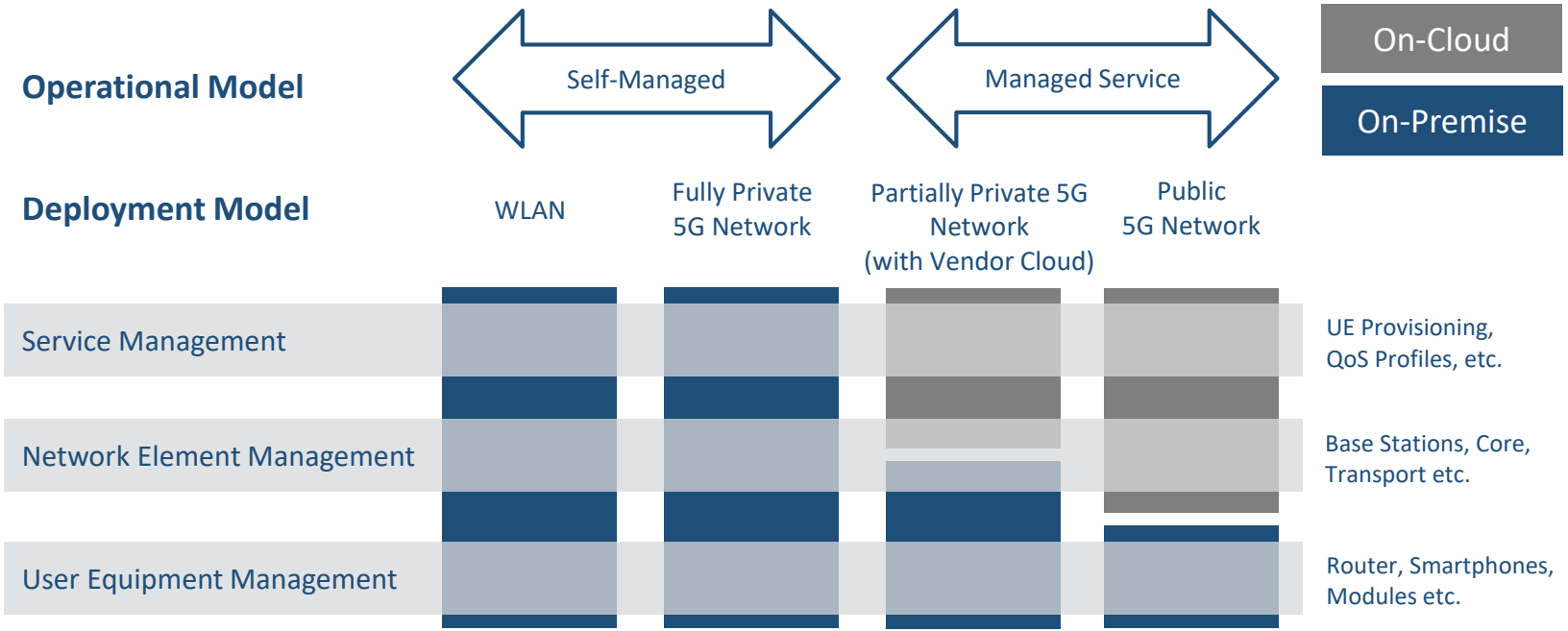
How to Deploy 5G?
Operational and Deployment Models



How to Deploy 5G?

Base station design evolution

Passive Antenna

Active Antenna
Radio Equipment (RE)
Remote Radio Head (RRH)
Remote Radio Unit (RRU)

analog
RF-Cable
(lossy, expensive)

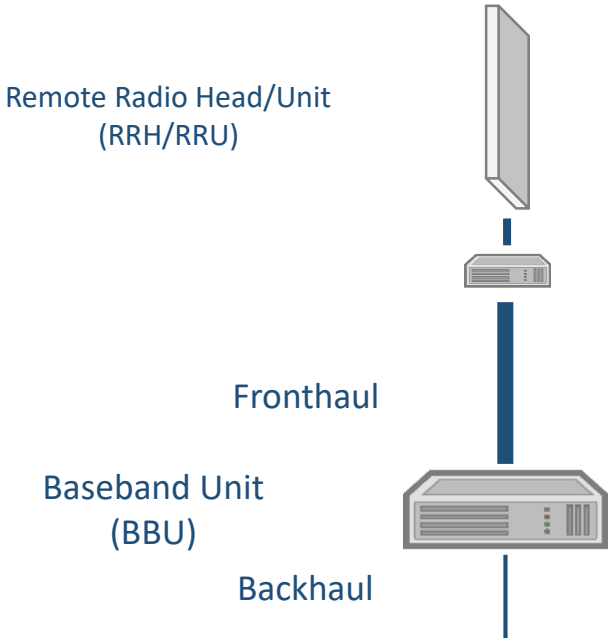
digital
Fiber
Common Public Radio Interface
(4G: CPRI, 5G: eCPRI)

Base Transceiver Station (BTS)

Radio Equipment Controller (REC)
Baseband Unit (BBU)

http://www.cpri.info/spec.html

How to Deploy 5G?
eCPRI issues

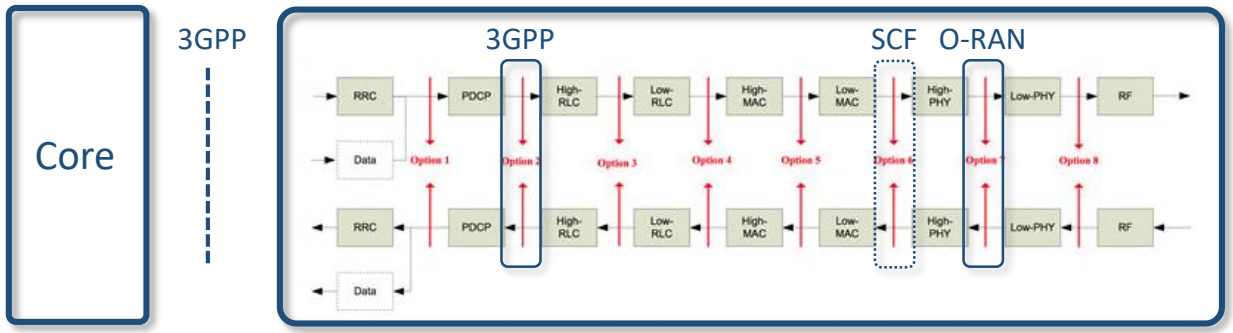


- Proprietary management and synchronization interfaces
  → vendor lock-in
- Physical layer (PHY) split
  → high QoS requirements (throughput, latency, jitter)

How to Deploy 5G?

OpenRAN – Hype or Innovation?

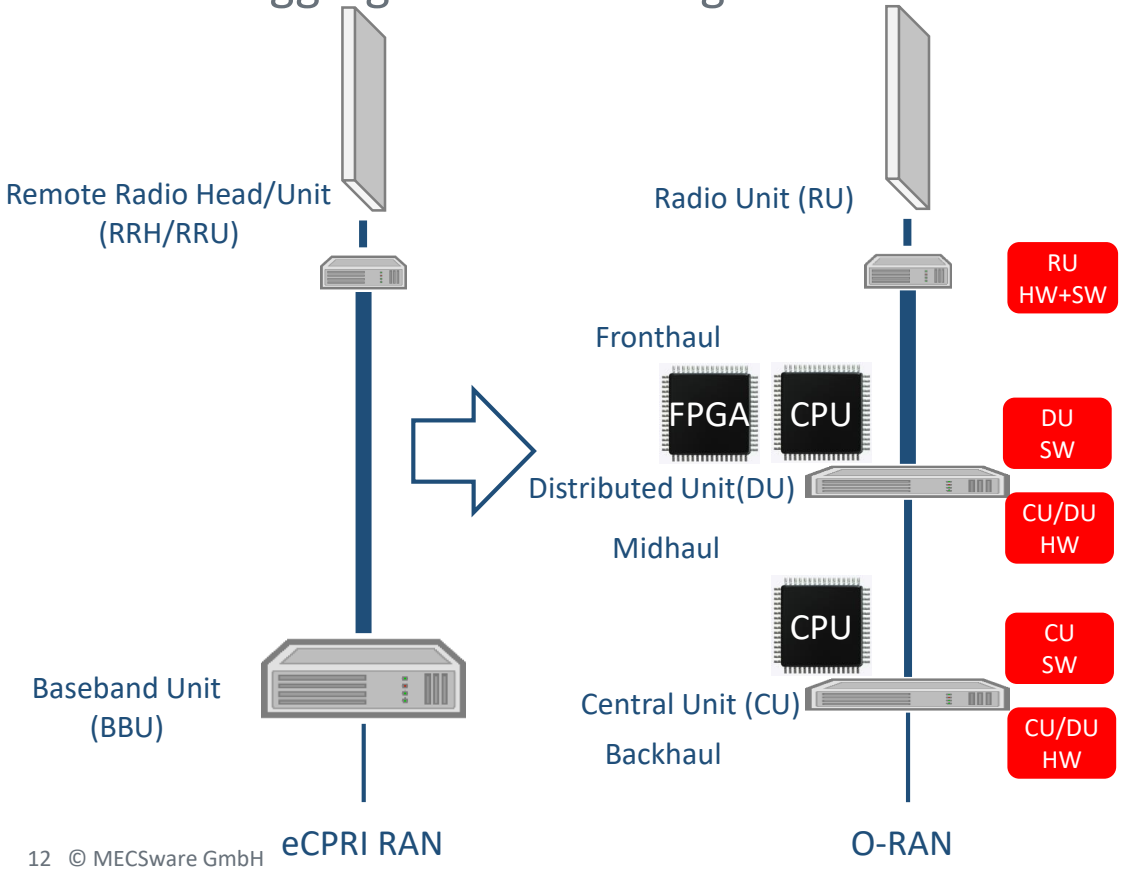
- **OpenRAN** is a concept, emerged from the **Telecom Infra Project** https://telecominfraproject.com/openran/ aiming at
  - Vendor independence
  - Hardware independence → Software Defined Networks (SDN)
- OpenRAN specifications are developed in several organizations: 3GPP, O-RAN Alliance, Small Cell Forum (SCF), …
- **O-RAN** is used in the context of **O-RAN Alliance** https://www.o-ran.org/
  - O-RAN specifications are based on 3GPP‘s pre-work



https://www.3gpp.org/news-events/2150-open_ran

How to Deploy 5G?

O-RAN disaggregation – an integration & maintenance challenge



Advantage

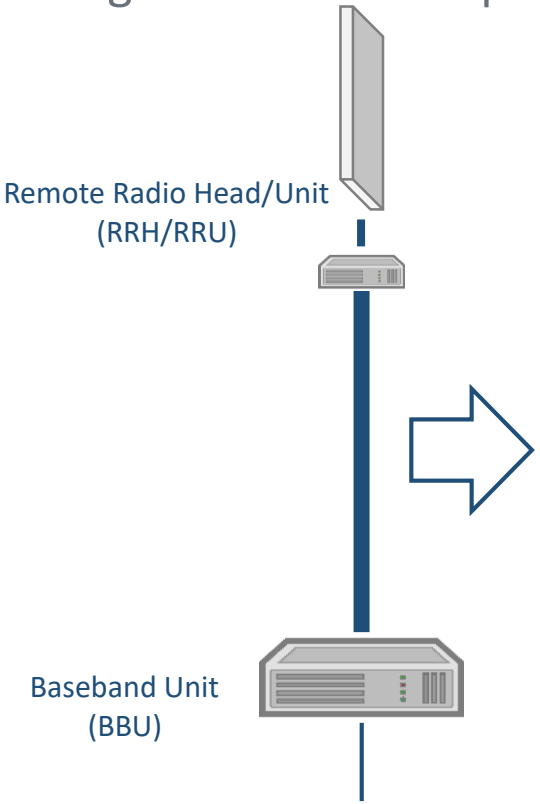
- SW-based upgradability

Disadvantages

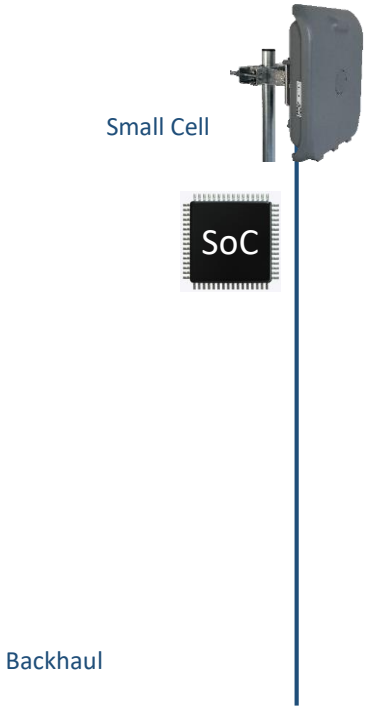
- Low efficiency
  - FPGA-based accelerator boards may be needed → no COTS anymore
  - High power dissipation
- High fronthaul QoS requirements remain
- System complexity → high effort for system integration and maintenance

How to Deploy 5G?

Integrated RAN – simple and easy



eCPRI RAN



Integrated RAN

Disadvantage

- Limited SW-based upgradability

Advantages

- Backhaul QoS requirements determined by the user application
  → existing Ethernet LAN can be reused
- Low system complexity
- **All interfaces** are standardized
  → no vendor lock-in

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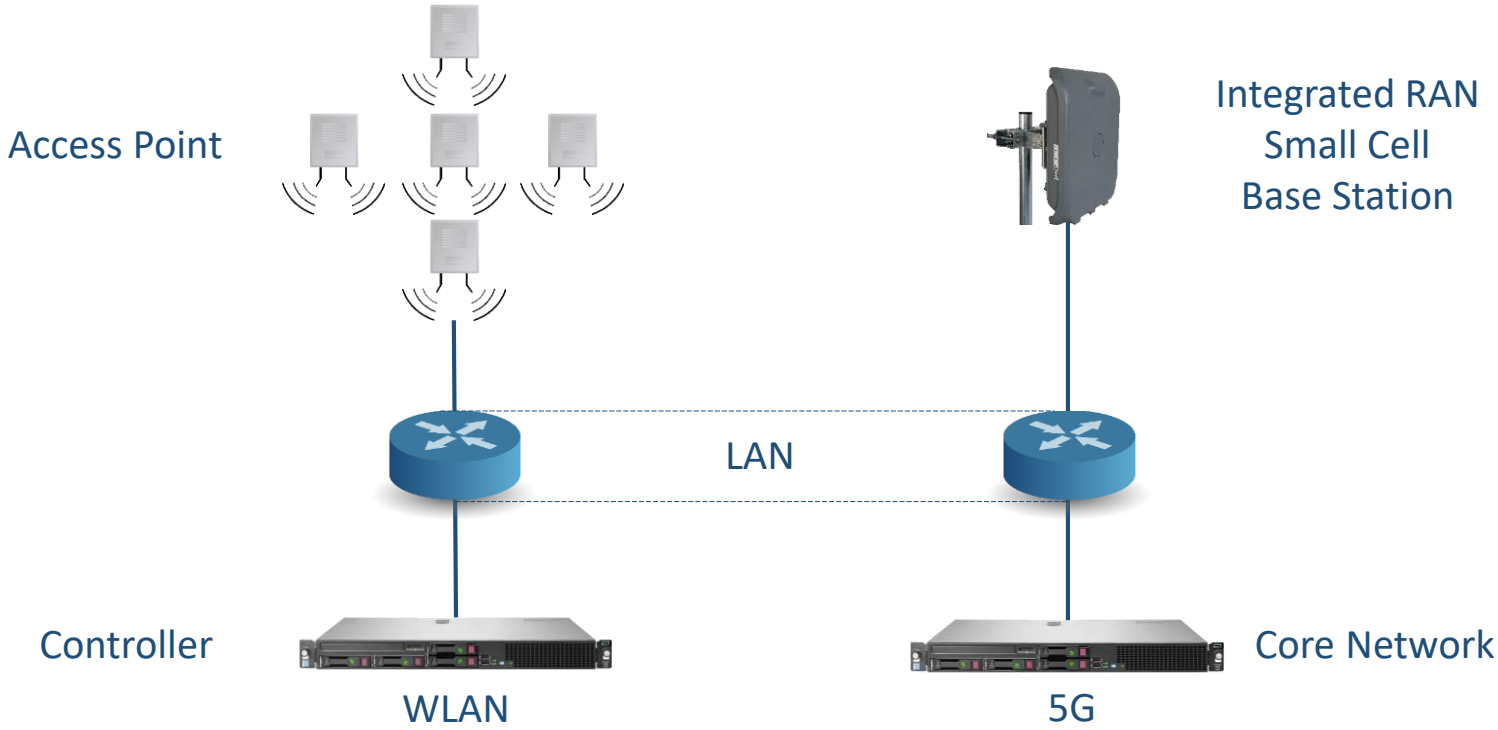
How to Deploy 5G?

WLAN vs. Integrated RAN



Summary

- Spectrum exclusivity is a fundamental advantage of 5G
- For broad application, 5G TCO must be comparable to WLAN
- OpenRAN disaggregation has an integration & maintenance challenge
- Integrated RAN Small Cells are comparable to WLAN Access Points – easy to install, to operate and to maintain

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