Local 5G Seminar Tokyo

5G NR for Industrial Applications Introduction

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ROHDE&SCHWARZ

Make ideas real

From a two-man laboratory to a global group of companies with various fields of business

86 years
of success

12.100
employees

300
new products

Test and Measurement

Networks and Cybersecurity

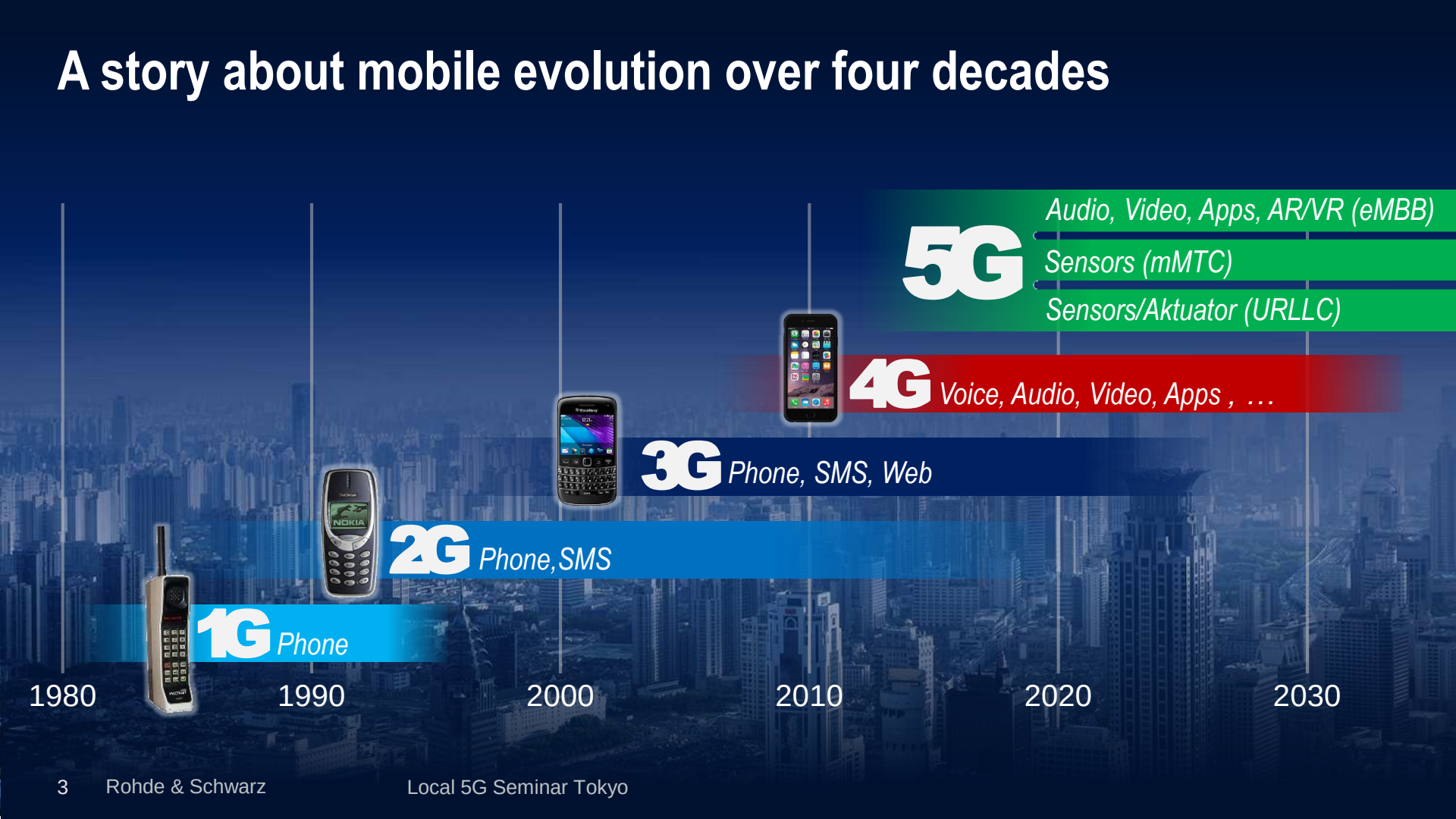
Aerospace & Defense

Security

Broadcast and Media

Make ideas real

A story about mobile evolution over four decades

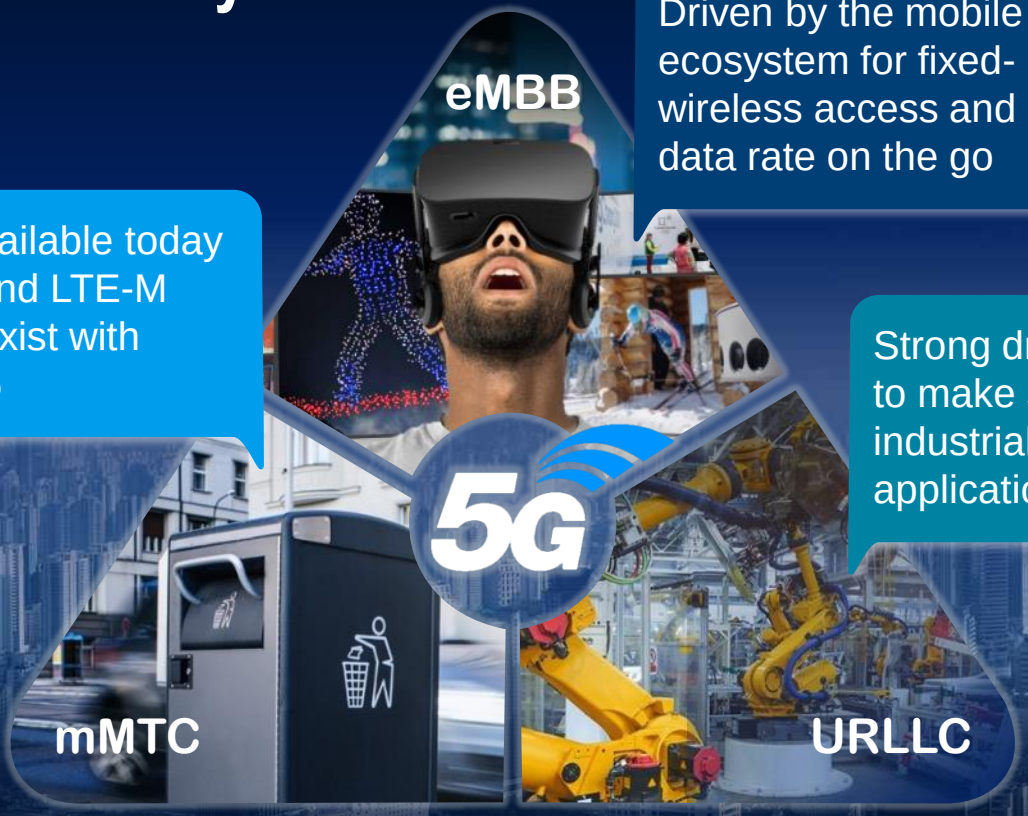


5G becomes reality

Driven by the mobile ecosystem for fixed-wireless access and high data rate on the go

Essentially available today with NB-IoT and LTE-M which will coexist with 5G NR Rel.16

Strong drive by verticals to make 5G ready for industrial and automotive applications



WHO USES 5G IN FUTURE AND HOW?

- New **classes** of users in 5G
  - **Humans** (smartphone use case)

more interactive eMBB applications

  - **Automotive** (connected, autonomous driving, Vehicle-to-X)
  - **Industry 4.0** (Smart Manufacturing, private 5G networks)
  - **IoT, mMTC** (Smart City, Connected Energy,...)

Really low latencies require standalone 5G

- **Each user class generates individual traffic patterns and has individual network requirements!**
- **A network optimized for human users may not deliver best performance for cars or industry**

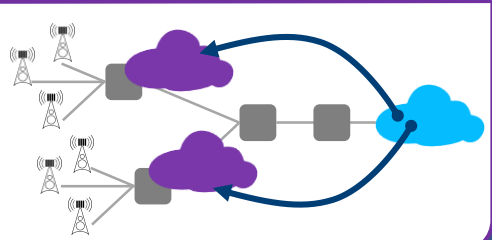
The magic triangle of communication is smart factories

- Security is a must!
- Reliability is essential, but on different levels
- Strongest latency requirements apply for specific applications (e.g. AGV)

5G roadmap and ecosystem expansion

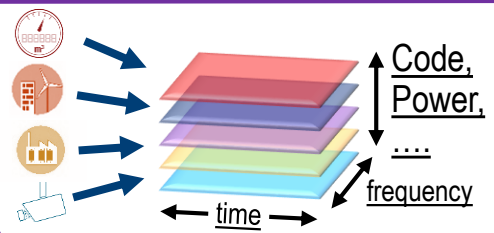
5G NR technology cornerstones to meet latency requirements of URLLC applications (Rel 16)

Mobile edge computing



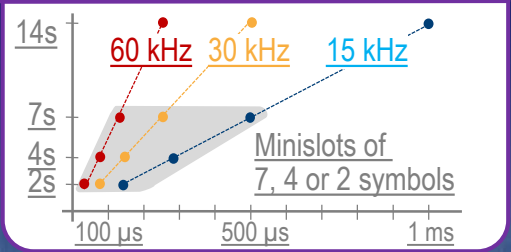
- bring cloud to edge of network
- controlled private environment in NPN (non-public networks)

Grant free access



NOMA: power/code domain multiplexing

Minislots – short symbols



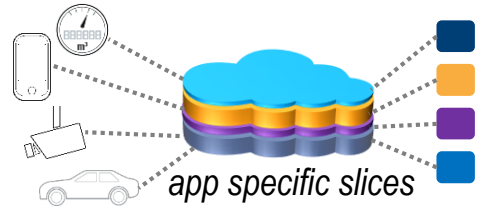
- new 5G NR numerology and TTI for lower latency
- basic URLLC in Rel 15 with TTI structures for low latency (AR/VR entertainment)
- flexible slot structure for different SCS: mini-slot 35µs

NOMA: non-orthogonal multiple access

SCS: 5G NR subcarrier spacing

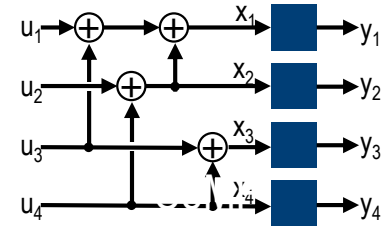
5G NR technology cornerstones to meet reliability requirements of URLLC applications (Rel 16)

Network Virtualization



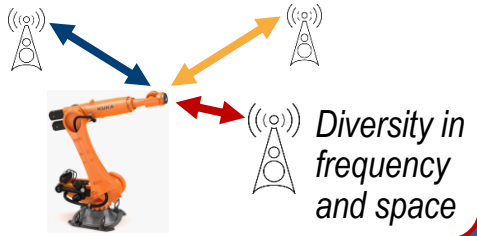
- ensure QoS
- network slicing tailored to applications

Robust coding



- Robust coding in Rel 15
- Rel 16: Data duplication and multi-connectivity enhancements

Multipoint connectivity

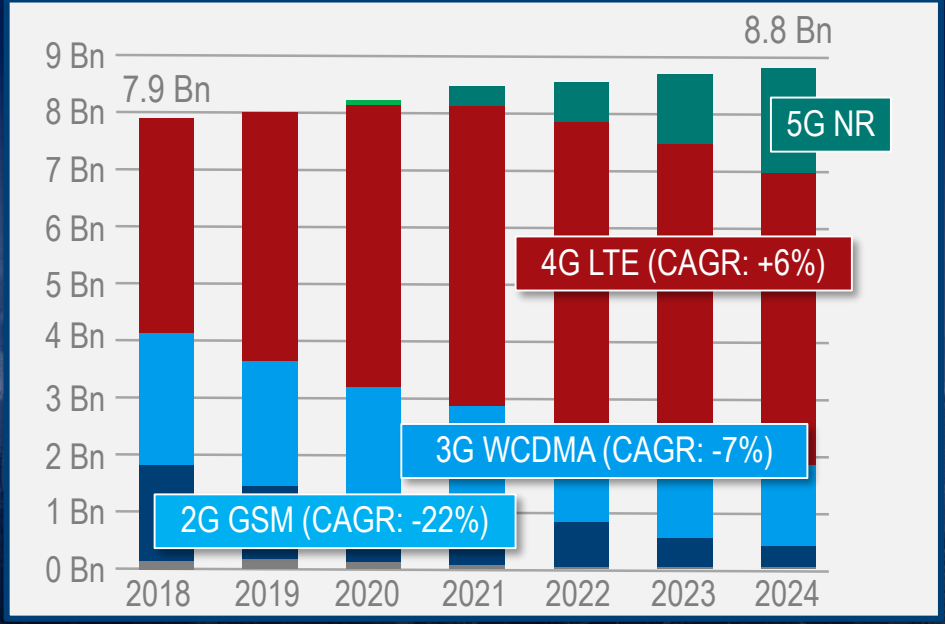


- CoMP: spatial diversity for reliability, capacity (interference reduction)
- frequency diversity: reliability against rouge devices trying to access

CoMP: coordinated multipoint transmission and reception

The state of the mobile network

Mobile subscription forecast (excl. IoT subs)



Source: Ericsson Mobility Report, June 2019

# of 4G LTE subscriptions continues to grow to reach 4.9 Bn by e2024

By the end of 2024 1.9 Bn 5G subscriptions are projected

High diversity of 5G applications in smart factories, ….

mMTC

- Sensors
- Door looks
- Screwdrivers
- ……

eMBB

- VR/AR human-machine i/f
- Handhelds
- Surveillance CAMs

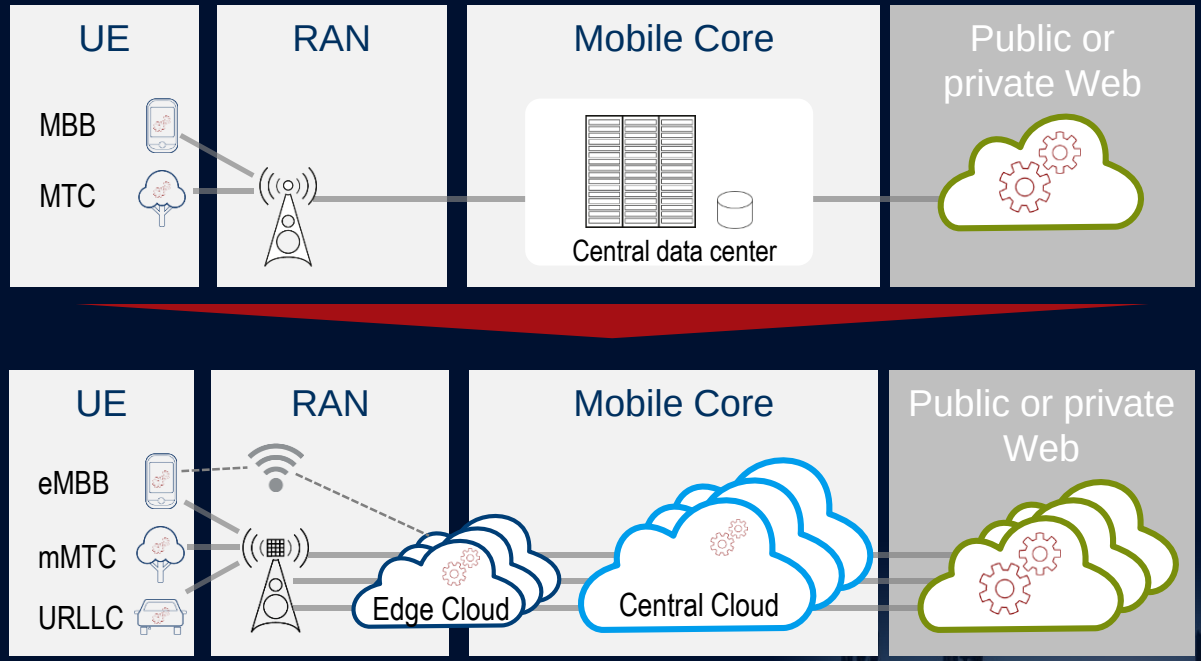
uRLLC

- Robots
- Automated guided vehicles (AVG)

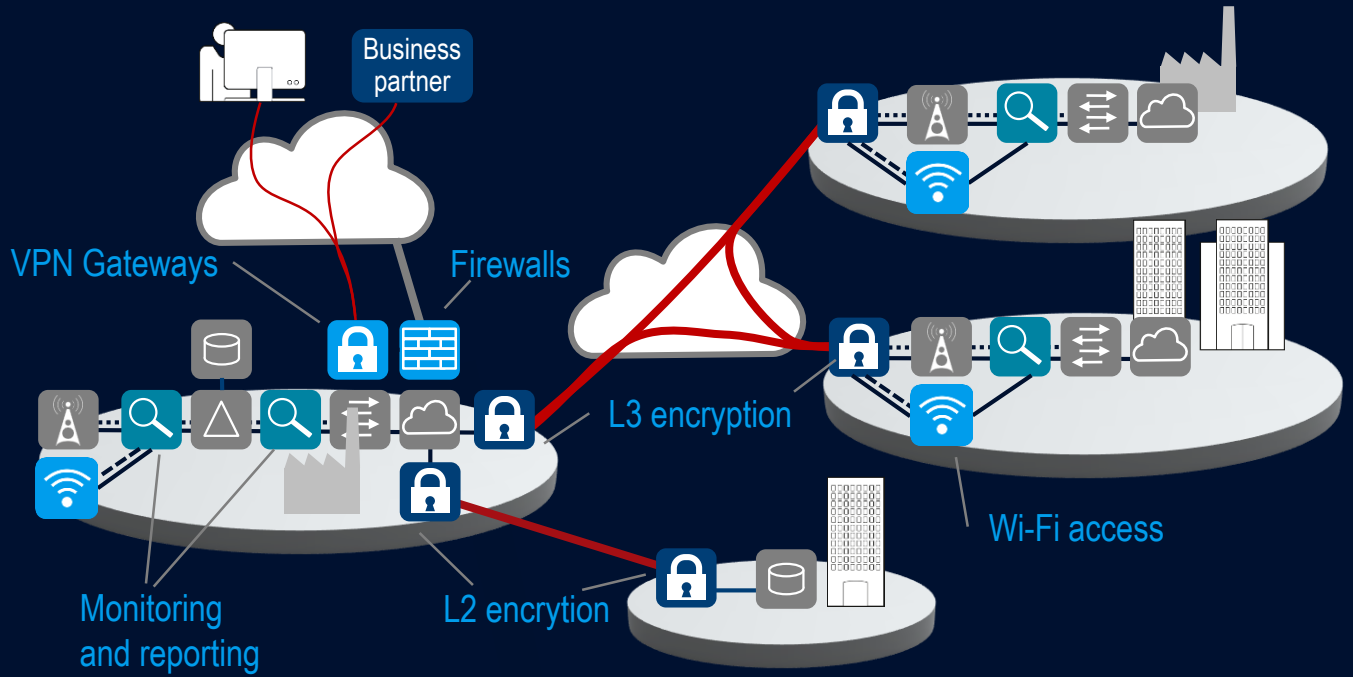
…. which require safe, reliable and secure operation 24/7/365

5G is just another mobile communication standard, but some aspects make security a hot topic in 5G

- New network architecture incl. virtualization, cloud and edge computing makes 5G more complex and vulnerable
- New services and deployment models (e.g. non-public) make 5G network more attractive for attackers
- Significantly more network endpoints creating more ‘opportunities’ for cyber criminals



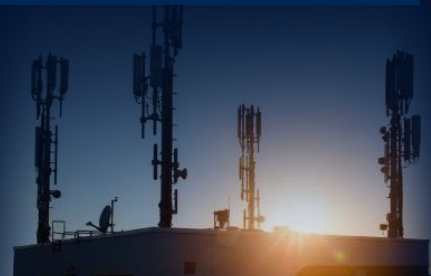
Security solution for secure access, interconnectivity and monitoring applicable also for non-public 5G networks



Secure access and network protection with solution from LANCOM: Wi-Fi, VPN, FW

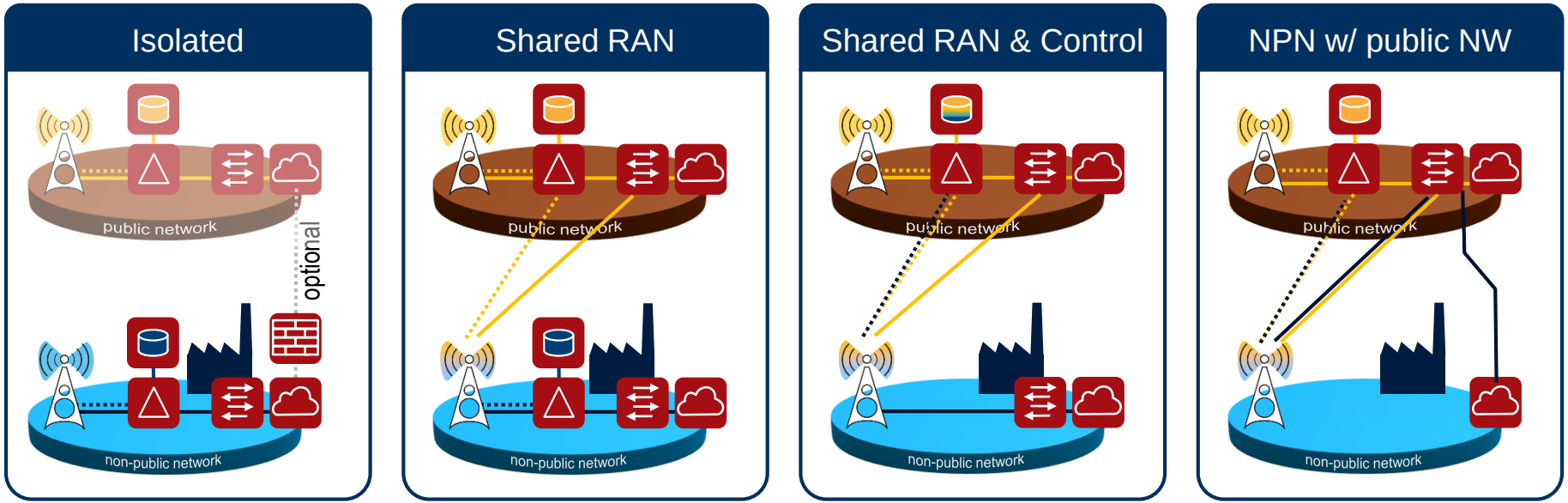
Secure interconnection between location by L2 or L3 encryptors from RSCS

Smart IP network monitoring of C/U-plane traffic with solutions from ipoque



INDUSTRY 4.0 SPECIFIC DEPLOYMENT SCENARIOS

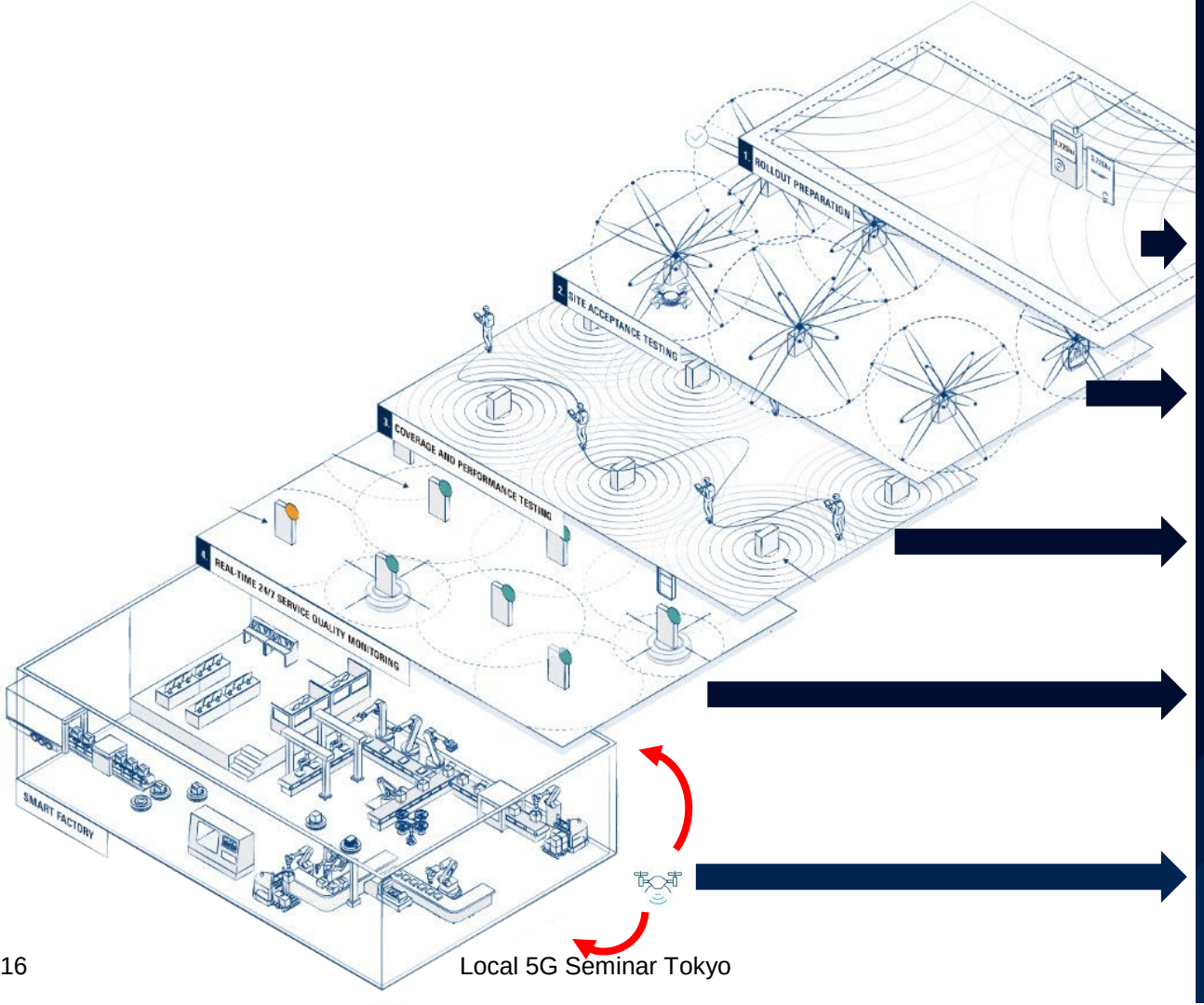
5G-ACIA WP: 5G NON-PUBLIC NETWORKS (NPN) FOR INDUSTRIAL SCENARIOS



- WP provides a description of the four industrial deployment scenarios for 3GPP-defined 5G non-public networks (NPN)
- NPN provides 5G network services to a clearly defined user organization or group of organizations
- NPN deployed on the organization's defined premises, such as a campus or a factory

R&S FACTORIES WILL DEPLOY 5G PRIVATE NETWORKS

- Big manufacturers will deploy own, private 5G networks (sometimes in dedicated spectrum)
- 5G deployed in private spectrum opens the door for high efficiency and more flexibility
- Strong need for Network Performance Testing and Security solutions



DIFFERENT PHASES OF TEST

1) Rollout preparation / spectrum clearance
2) gNb installation / site acceptance testing (redundant coverage, CoMP)
3) Coverage and performance testing (once / regularly / continuously)
4) Service Quality Monitoring / Service Level Agreement verification
5) Regulatory obligations: spurious emissions from campus network

TEST PHASES

1) Rollout preparation / spectrum clearance
2) gNb installation / site acceptance testing (redundant coverage, CoMP)
3) Coverage and performance testing (once / regularly / continuously) incl. interference hunting
4) Service Quality Monitoring / SLA verification
5) Regulatory obligations: spurious emissions from campus network

RELIABLE CAMPUS NETWORKS REQUIRE:

- Before deployment: Is the spectrum free?
- Low noise floor?
- If not: Interference hunting inside / outside the factory!

- Functional test + Site Testing incl. demodulation
- Sufficient coverage / number of gNb signals everywhere for CoMP?

- Sufficient coverage (RSRP) and signal quality (SINR)?
- QoE: Application / throughput / interactivity tests
- Trouble shooting in case of non-optimal performance

- Measure the campus network quality and performance
  - Manual tests regularly
  - Automatic tests continuously (fixed RF/QoE probes)
- Analytics + Machine Learning: identify risks pro-actively

- Check signal leakage outside campus area
- Walk test or “fly” test (drones) around campus

TEST SOLUTION OPTIONS

1) Rollout preparation / spectrum clearance
2) gNb installation / site acceptance testing (redundant coverage, CoMP)
3) Coverage and performance testing (once / regularly / continuously) incl. interference hunting
4) Service Quality Monitoring / SLA verification
5) Regulatory obligations: spurious emissions from campus network

Scanner: TSMA6

Spectrum Analyzer

QualiPoc Android

Spec. Analyzer FPH

5G Site Testing Solution

?

RF probes

QualiPoc Probe

RF probes

SmartMonitor/Analytics ML

?

TSMA6

R&S TEST SOLUTIONS TO DEPLOY MOBILE NETWORKS

Field Services, Interference Hunting



R&S®TSMA6 R&S®FPH 31GHz R&S®FSH

Clean spectrum


R&S®MNT100/PR100 R&S®MobileLocator

Site Acceptance

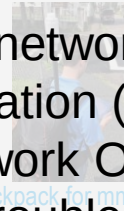
Correct infrastructure deployment;
Trouble shooting


R&S®TSMA6 QualiPoc Android

5G NR network measurement solution

Passive measurements

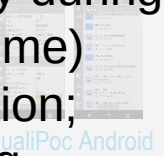

R&S®TSME6 R&S®TSMA6

Shoulder bag Backpack for mmwave

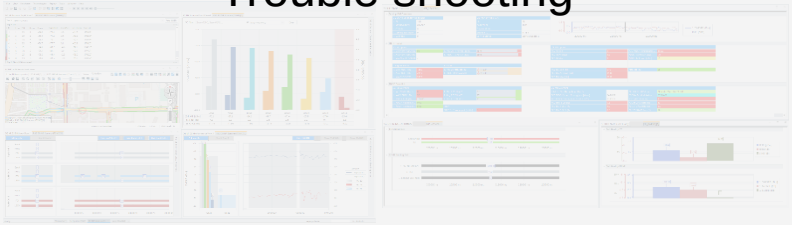
Active measurements

Smartphones Mobile Test Platform



QualiPoc Android

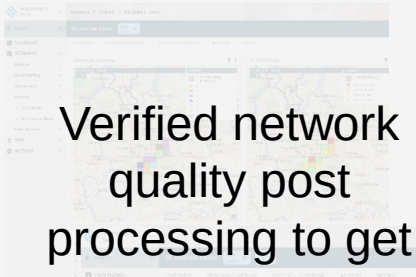
Verified network quality during operation (in real-time)
Network Optimization;
Trouble shooting



R&S®ROMES4: 5G NR Software for network engineering, analysis and optimization

Data Analytics

SmartAnalytics Scene



Verified network quality post processing to get deep insights;
Quality Benchmarking;
Network Monitoring

SmartAnalytics Scene - NPS

ROHDE & SCHWARZ T&M PERSPECTIVE

- Comprehensive coverage for 5G NR lab and field testing solutions
- Focus remains on efficient OTA test solutions for chipset, device and BS verification
- Development towards cloud testing, smart analytics and mobile network testing services

Making your IoT ideas real with our test solutions

- Network scanning, optimization & benchmarking
- RF design verification & conformance testing
- Interference analysis & avoidance
- Protocol conformance and e2e performance
- Low power design & battery lifetime optimization
- Verifying secure IP communication

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Make ideas real