



5G: Are We Ready?

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June, 2019

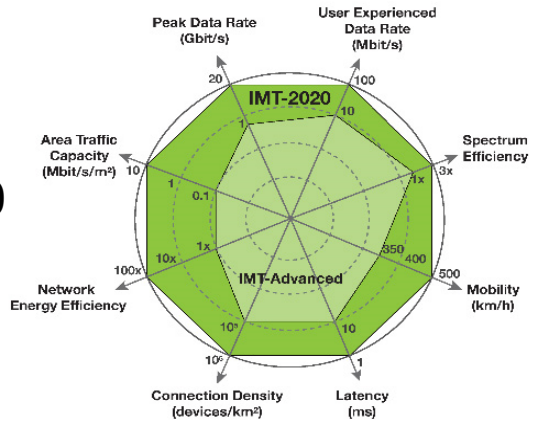
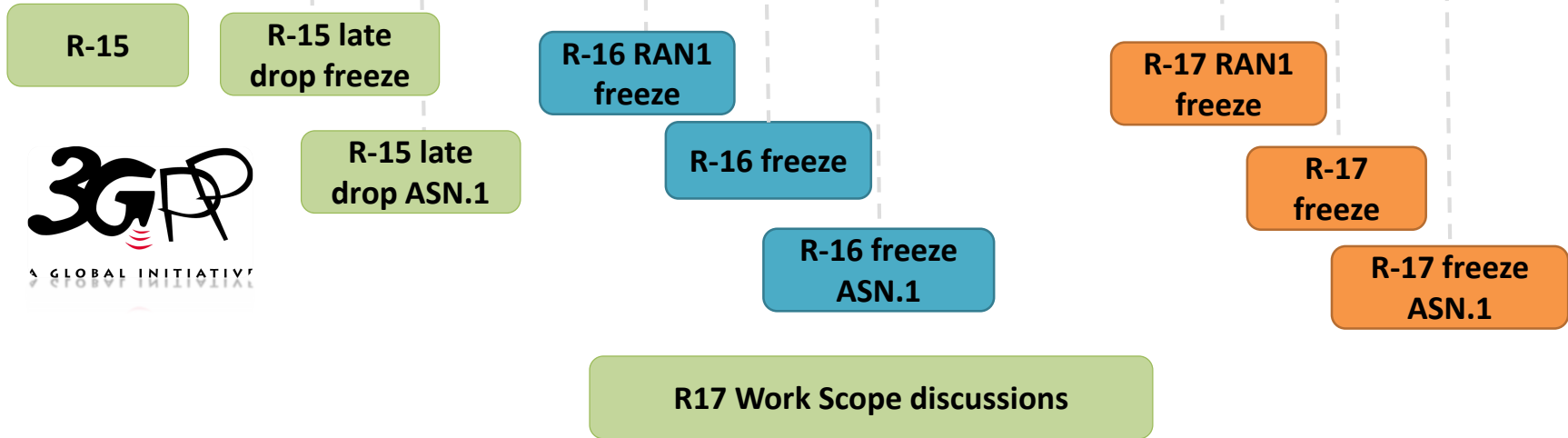
Outline

- Overview
 - 5G NR specification
 - Commercial launch plan
 - Spectrum allocation/policy
- Readiness of the ecosystem
 - Infrastructure
 - Devices
- Enterprise/private 5G network
- Taiwan 5G activities
- Summary

Overview

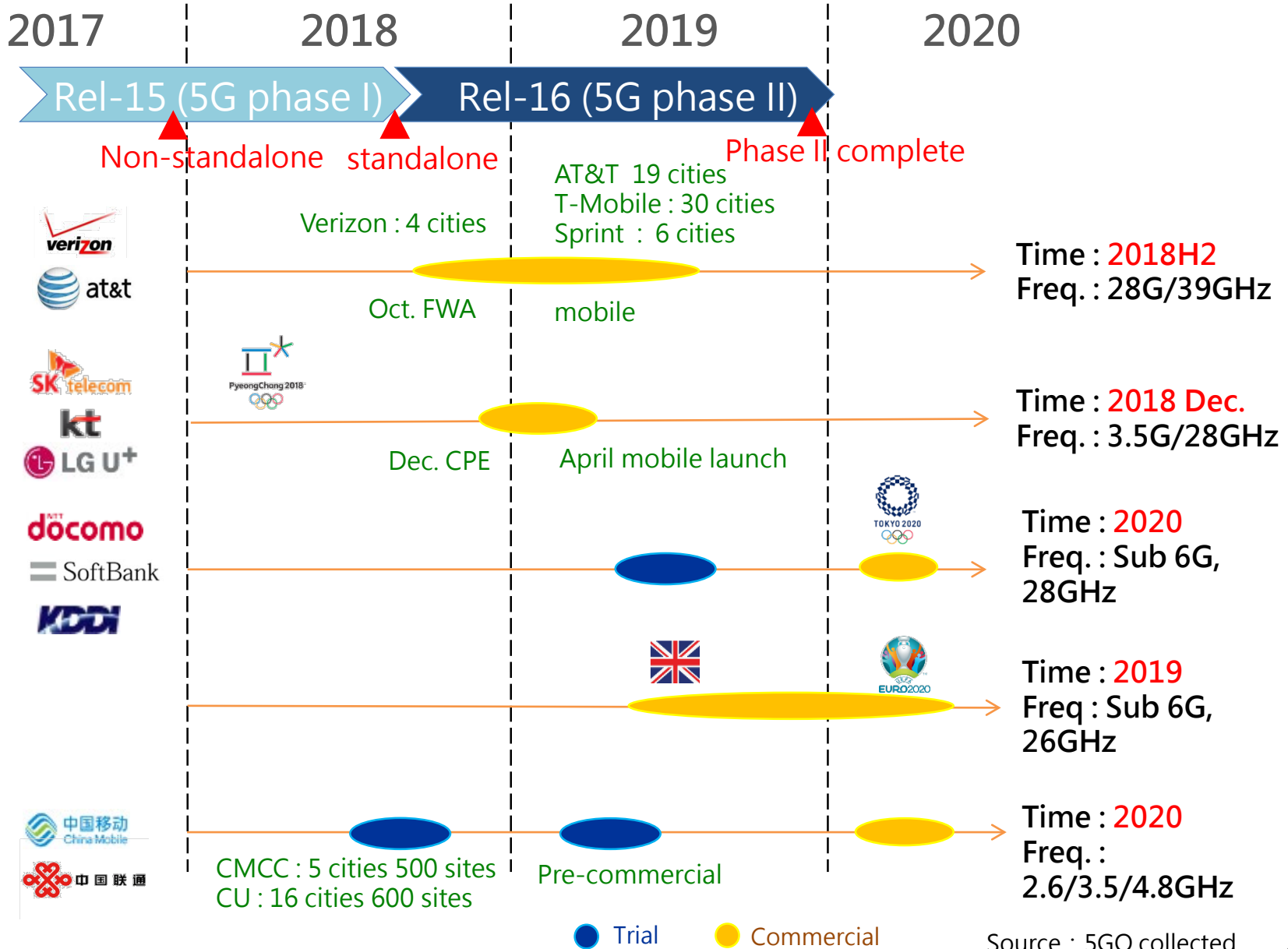
Standard Timeline

2018	2019				2020				2021				2020
Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	



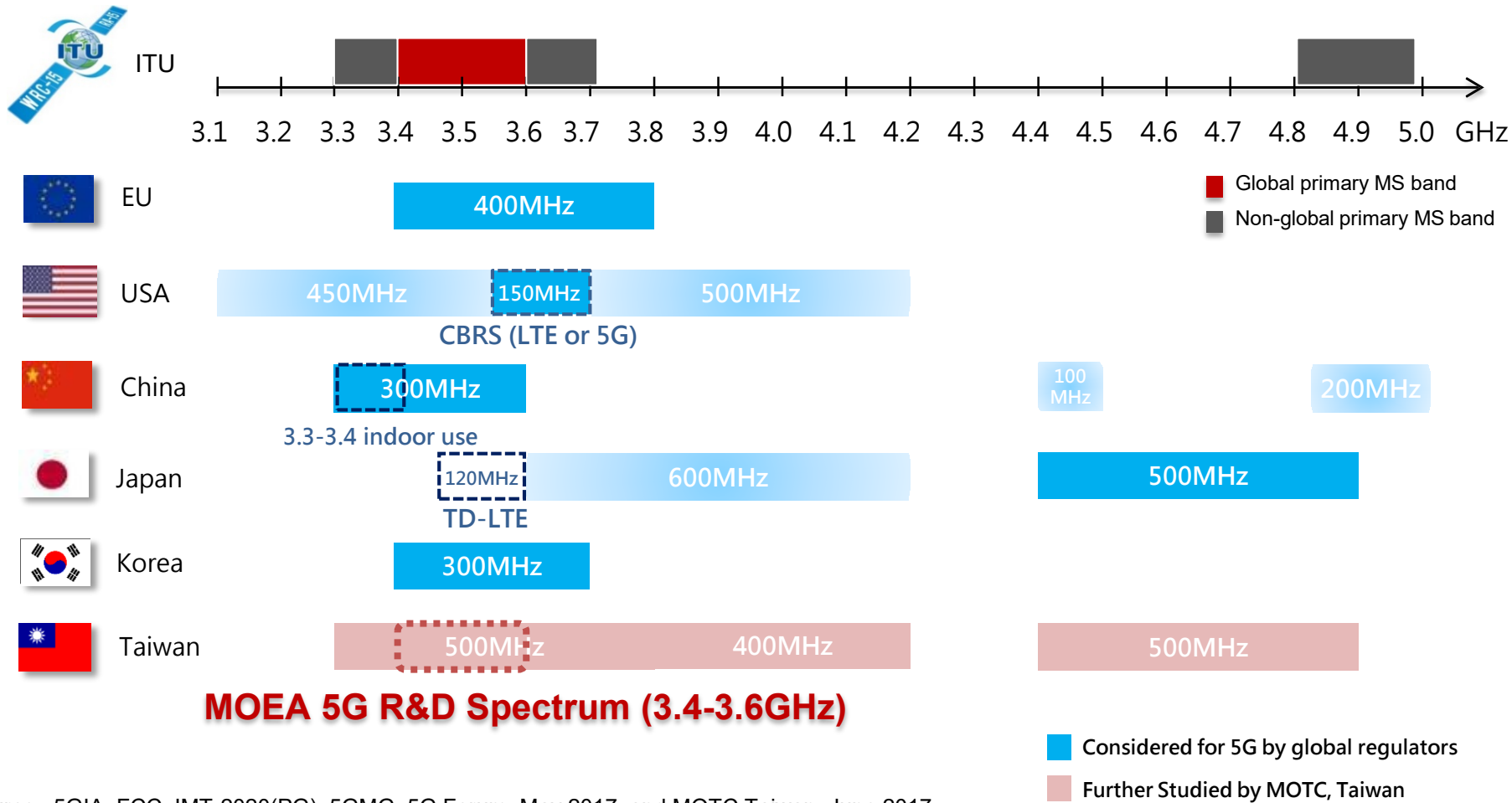
Official 5G Approved 2020

5G Commercial Launch Plan



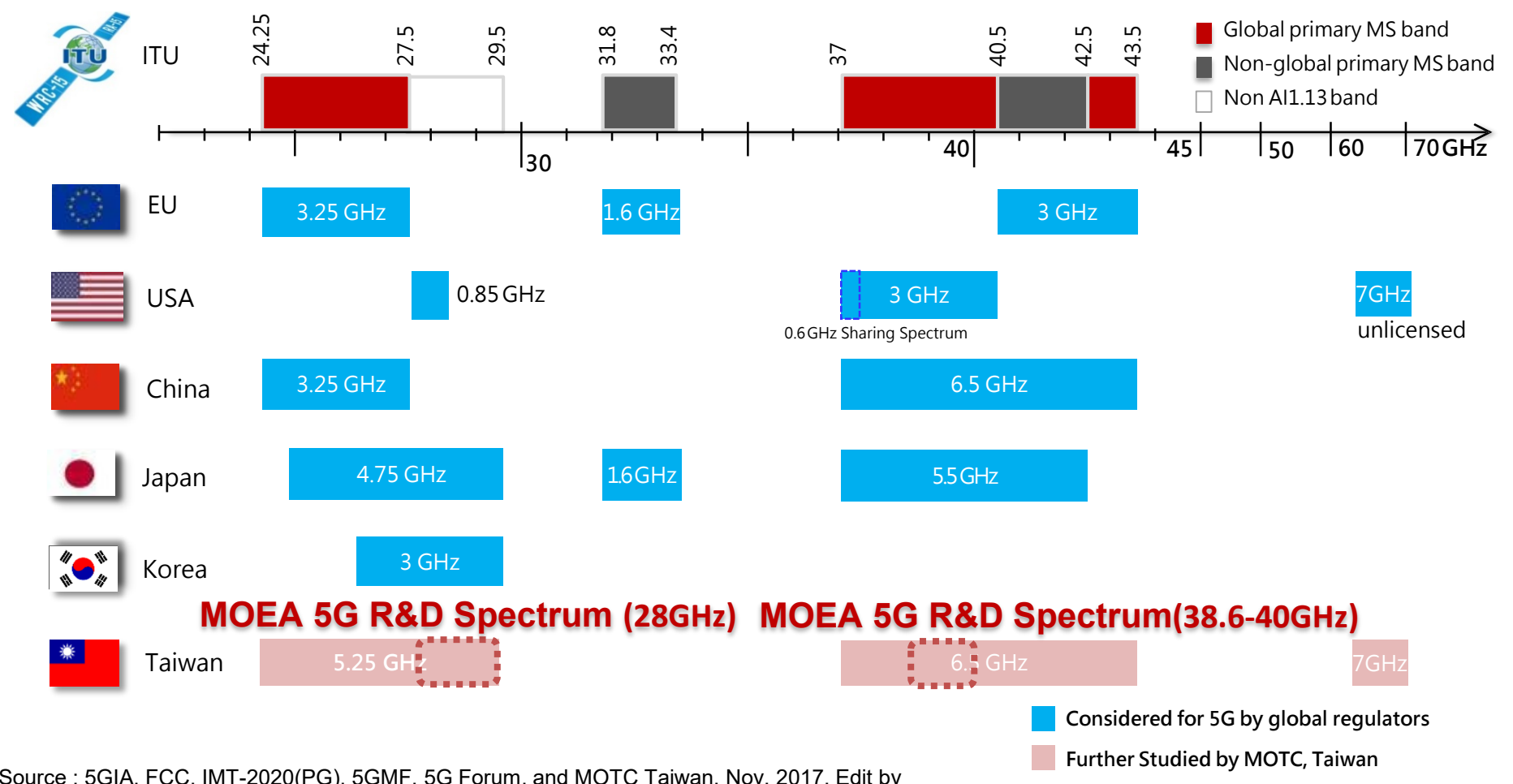
Global 5G Spectrum – Sub 6GHz

- Consider 5G single carrier bandwidth will be $\geq 100\text{MHz}$ in Sub 6GHz, at least 300MHz is need for market innovation and competition.



Global 5G Spectrum – Above 6GHz

- Global harmonized spectrum for high band can boost 5G infrastructure, terminal and semiconductor economy scale and speed up emerging service.



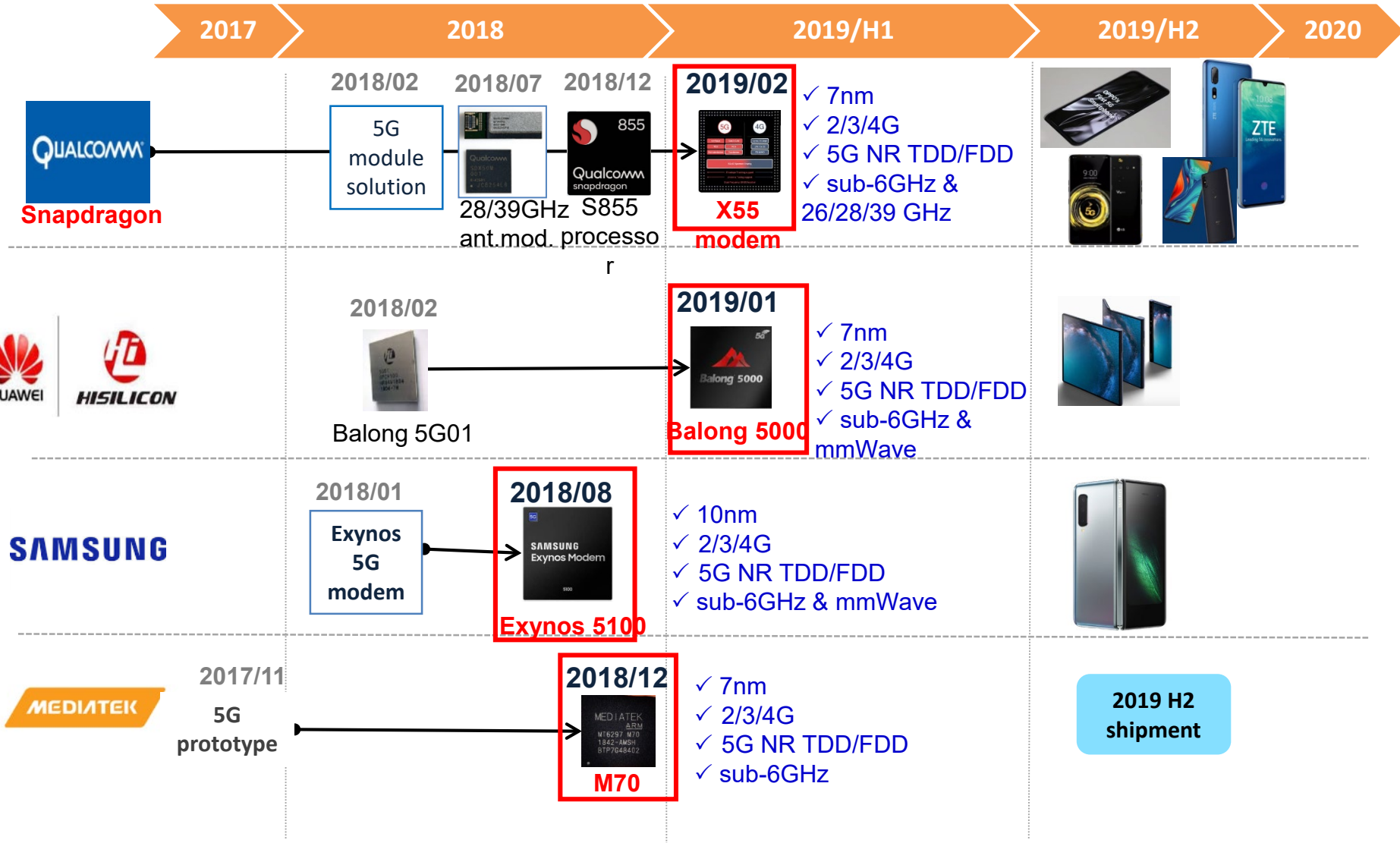
Source : 5GIA, FCC, IMT-2020(PG), 5GMF, 5G Forum, and MOTC Taiwan, Nov. 2017. Edit by 5GO and MIC.

5G Commercial Deployments

- Fixed wireless, router, smart phones
- Islands of deployment without continuous national coverage
- Non-standalone (NSA), EN-DC architecture available, SA is yet to be proven
- eMBB as initial services

Ecosystem Readiness

End Devices



Infrastructure

- Open RAN
- Edge Computing
- Ultra-low latency
- Virtualization, micro-services, containers and performance optimization
- Network Slicing
- Cyber security
- AI-assisted network management and operation

Private Network: End-End System Solution

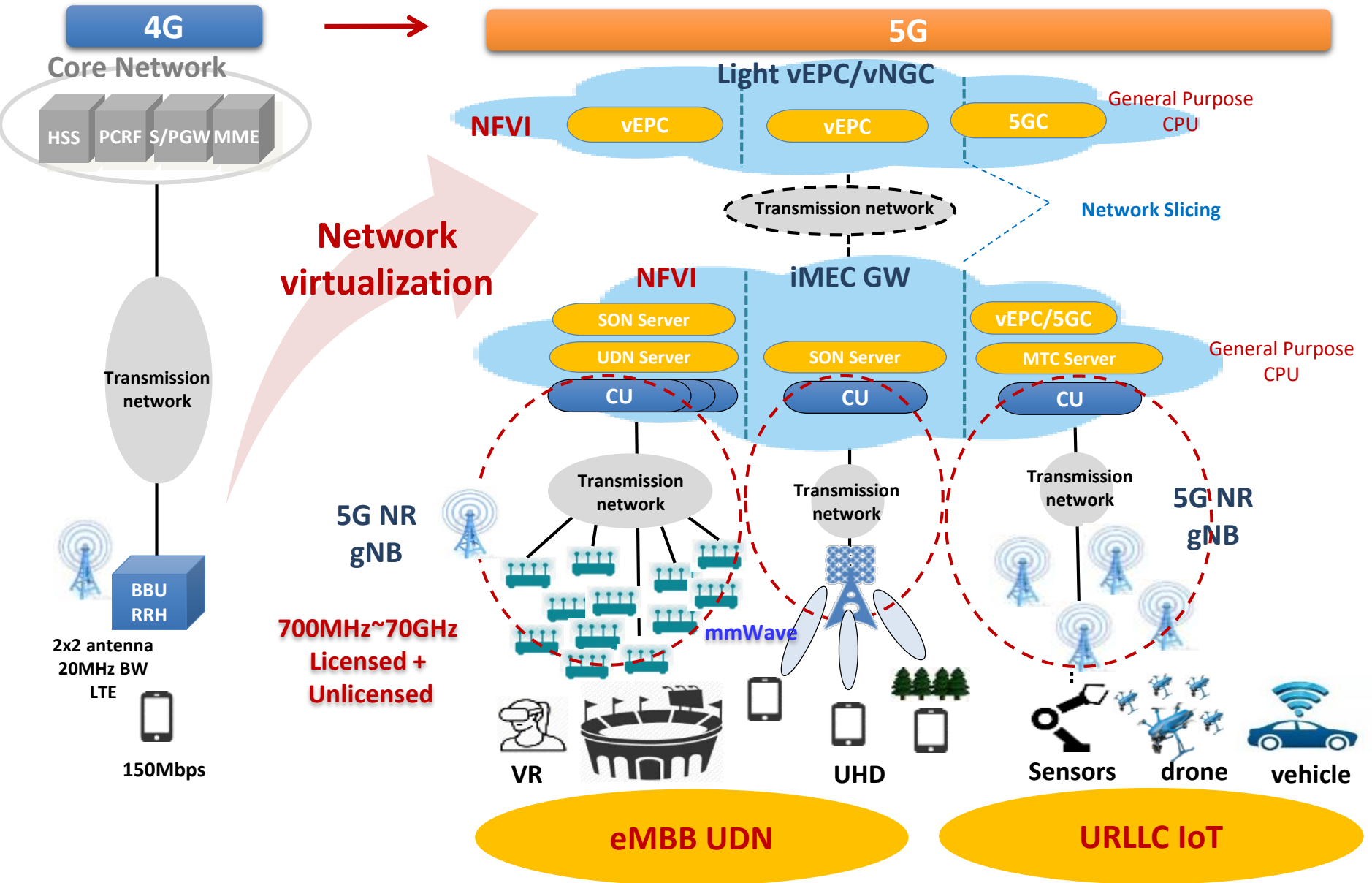
Demands for Enterprise Network

- Secure
 - Avoid operating confidential data outflows or external security attacks (private network vs. public network)
- Ownership, QoS control
 - Total controls of network access, traffic quality (security 、 QoS)
- Reliability and flexibility
 - dedicated network 、 not subject to other interference
- Coverage
- Applications tailored end-end solution
 - Quickly import professional domain knowledge and fast deploy innovative service

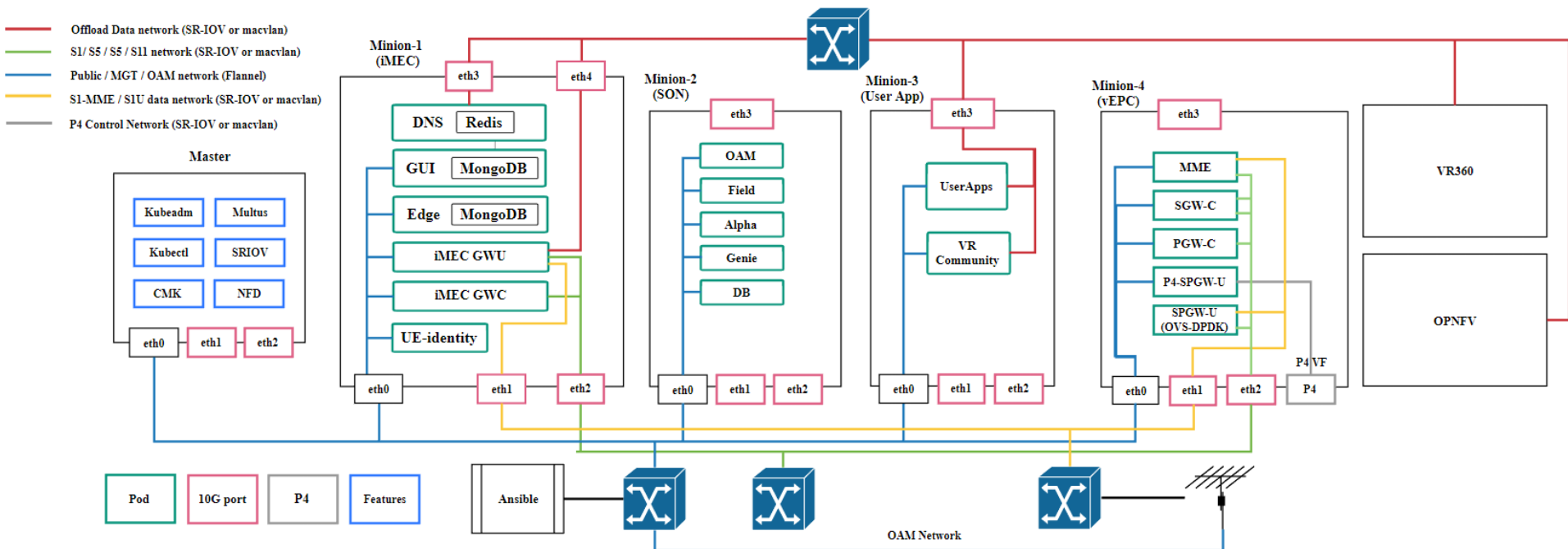
Taiwan 5G Activities

- 5G Program Under MoEA
 - ITRI/III, domestic and international partners
 - Target for vertical applications, trials for factory operation, smart hospital, chemical plant and entertainment
- EU-Taiwan collaboration
 - H2020 EU-TW Open Target Call Phase II: Clear 5G, 5G Coral
 - Phase III projects: 5G CONNI, 5G DIVE to be started in Oct. 2019
- Taiwan 5G alliance
 - Lead by operators
 - To facilitate collaboration among MNOs and domestic ICT industries on small cells, switches, servers, terminals, and IoT devices
 - Pilot team led by CHT was formed in Jan. 2018
 - Pioneering team led by FET was formed in Nov. 2018
- MoST/MoEA joint R&D
 - To leverage resource and research results from academia and apply results to system implementation

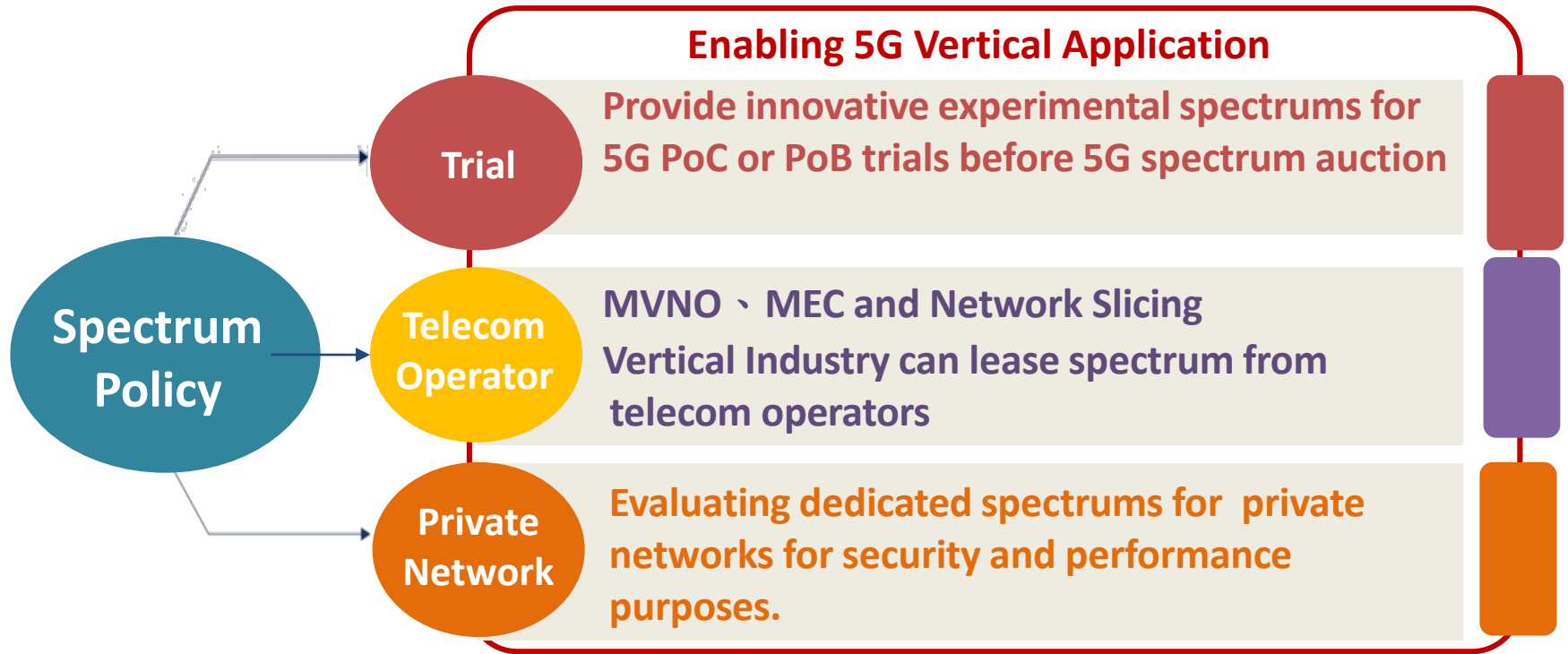
5G E2E System Architecture



Pod Containers on K8S



Taiwan 5G Spectrum Plan



	~1GHz	1~6GHz	6GHz~
Phase 1 (Early 2020)		1775~1785/1870~1880 MHz 3.3-3.57 GHz	27~29.5 GHz
Phase 2 (Planning)	600 MHz 800 MHz	4.5~5.0 GHz	24.25~26 GHz 37~40 GHz

Source: Taiwan 5G SRB, Oct. 2018

Summary

- Global spectrum harmonization is in the right direction
- Initial commercial launches are mainly for eMBB & fixed wireless, isolated/dense hot spots
- Fully service based infrastructure is yet to be architected and implemented
- For vertical applications
 - Business model, architecture, spectrum, flexibility, specifications, performance etc., need to be addressed



5G Pre-commercial Trials

The 1st real-time VR 360 live streaming show adapting 5G eMBB Enterprise Network of Taiwan Industries

Immersive viewing experience at first row seat with VR 360 headset



Arbitrary view points switching, favorite perspective to catch exciting moment



Share fun with friends through VR interactions and enjoy real-time body expressions

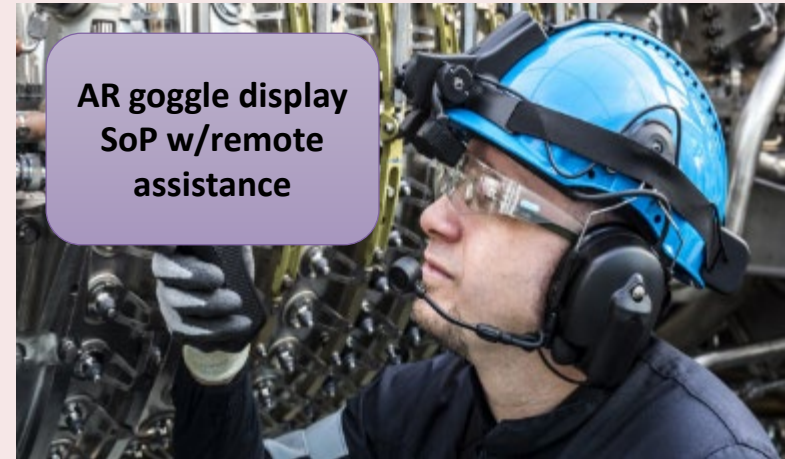


The Next 5G Field Trial - Chemical Plant

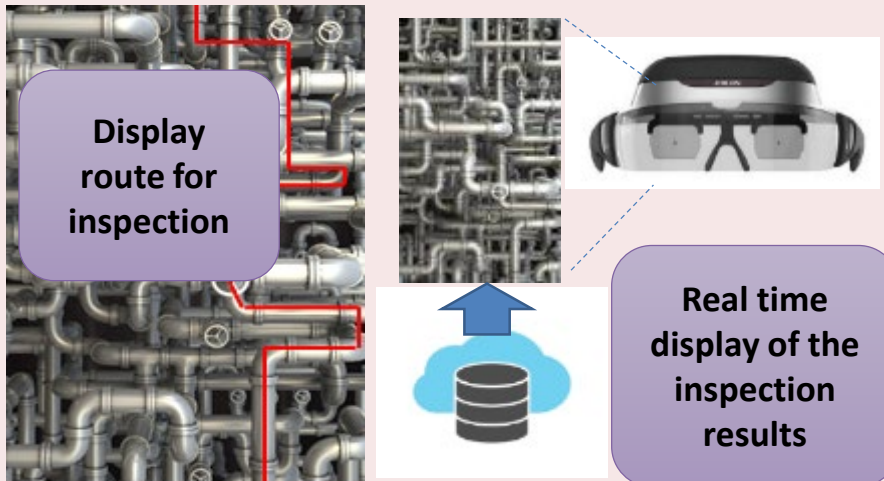
Access control



Operation Safety Assurance



Site Inspection w. AR Goggle



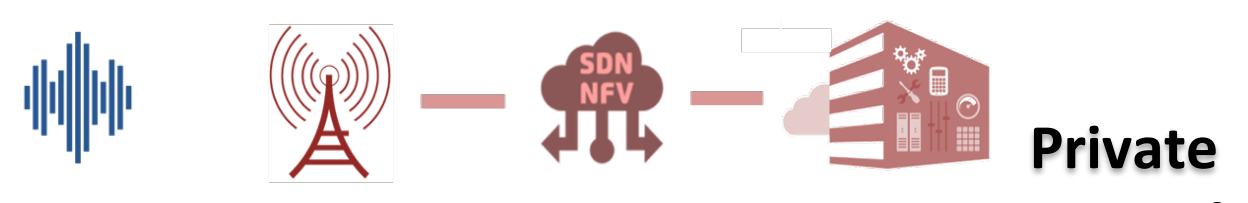
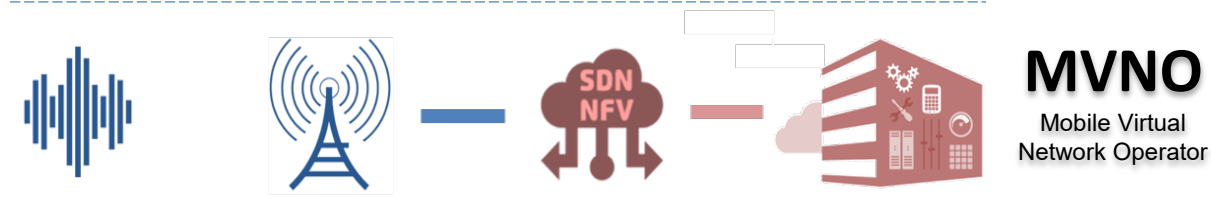
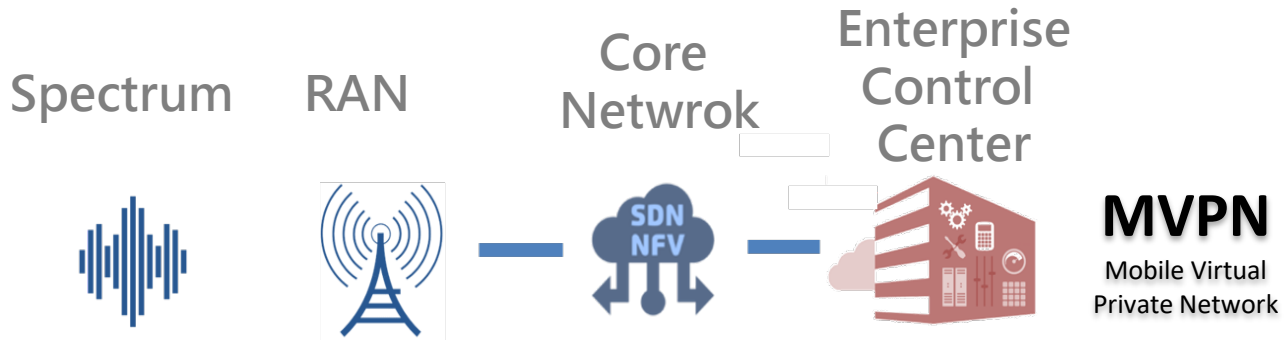
Streamline Operation Efficiency



*Collaboration will
Make Dream Come True*

Backup

Deployment Scenarios



● : Telecom Operator ● : Enterprise

Public
 Wide area
 Low Entry point

control
 Security
 Regional
 Private Network