

# A Few 5G Technical Challenges

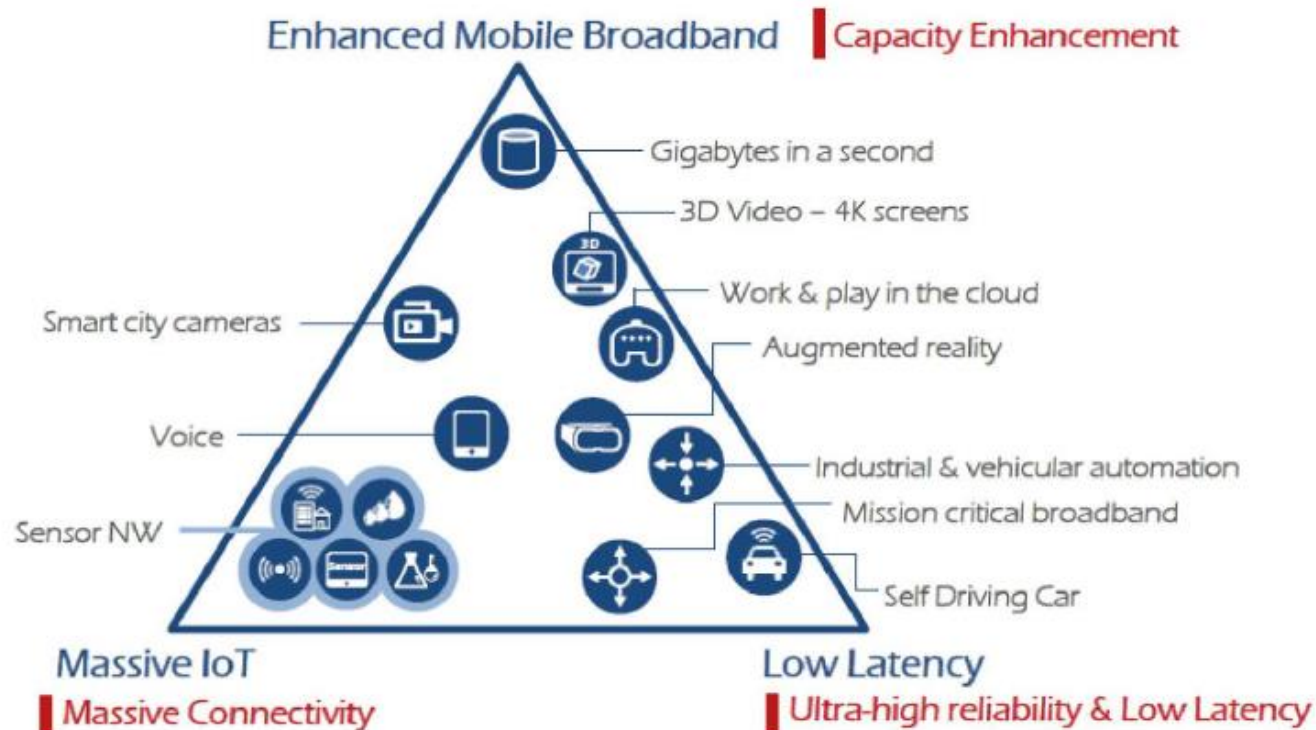
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# Agenda

- 5G promises and framework
- Automation in the 5G era
  - Dynamic production and operation of “network slices”
  - An IoT example
- Security by design
- Spectrum
- Standardization
- Takeaways

# 5G Promises

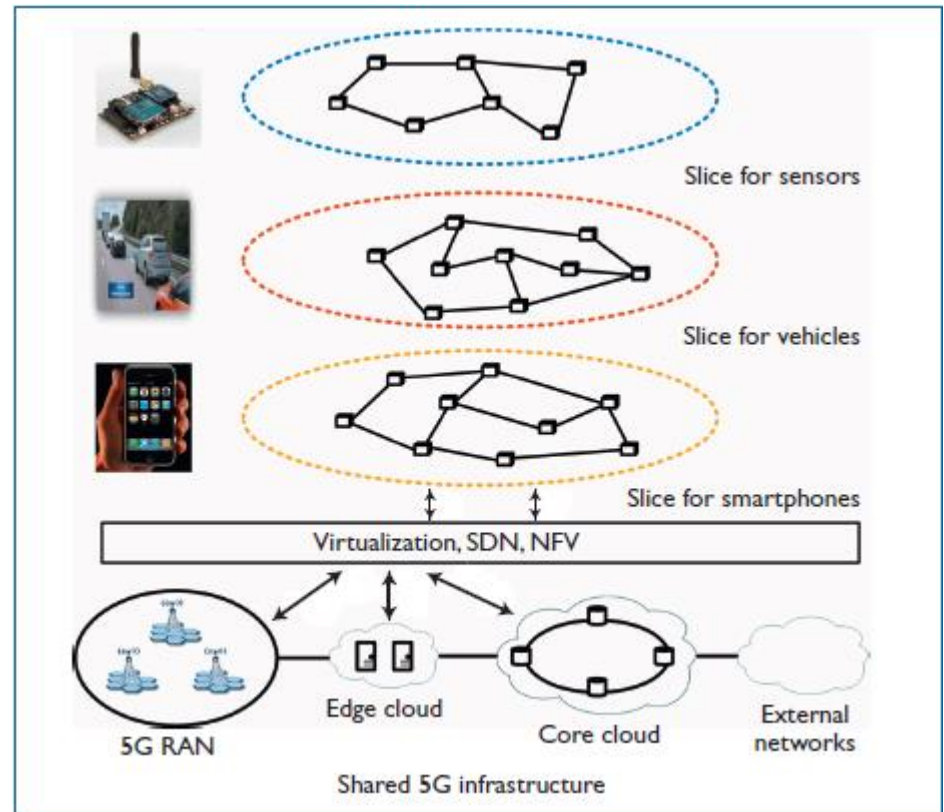
- More objects, higher rates, low latency and high availability



Source: ETRI, from ITU-R IMT 2020 Requirements

# 5G Base Concept

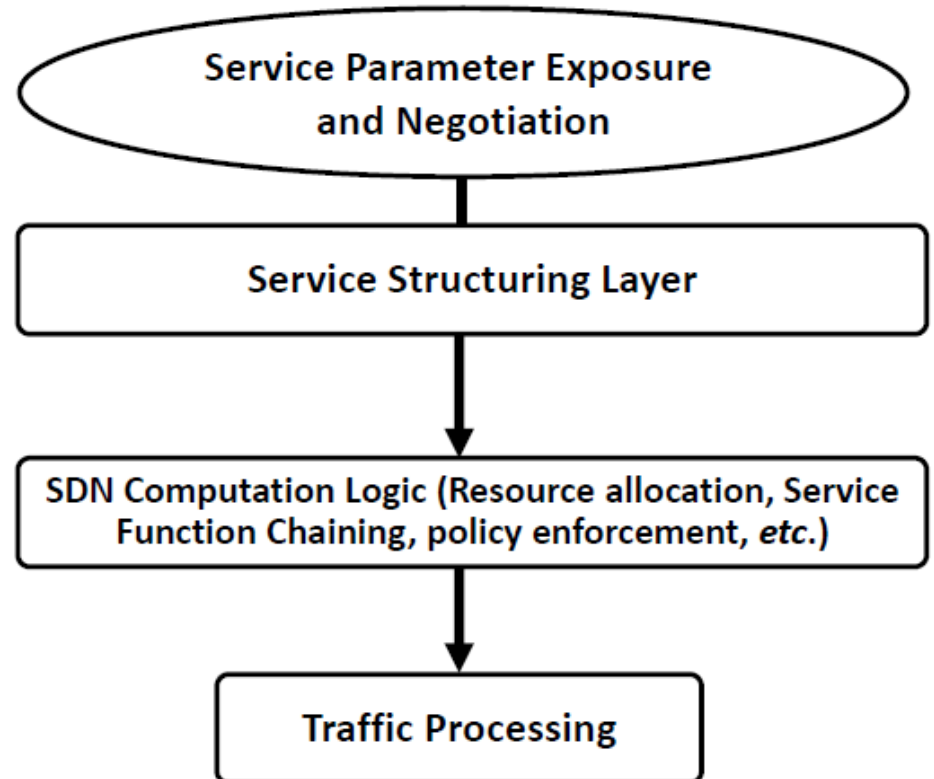
- A modular and flexible, context-aware, multi-access, Network-as-a-Service infrastructure
  - Based upon the dynamic creation, invocation and operation of so-called, (service-inferred) “network slices” (NGMN in its own words)
  - No one-size-fits-all approach anymore



Source: Network Slicing for 5G: Challenges and Opportunities, [IEEE Internet Computing](#), Vol. 21, Issue 5, Sept. 2017

# Automated 5G Service Delivery

- Outcomes of service parameter negotiation feed 5G computation logics (orchestration, SDN)
  - Along with other inputs, like network-originated notifications and available resources
- 5G service and slice are structured accordingly
  - Based upon abstract service components depicted in (service-inferred) data models
- SDN computation logic then allocates resources (network, storage, CPU)
  - Forwards policy decisions and configuration information to participating devices

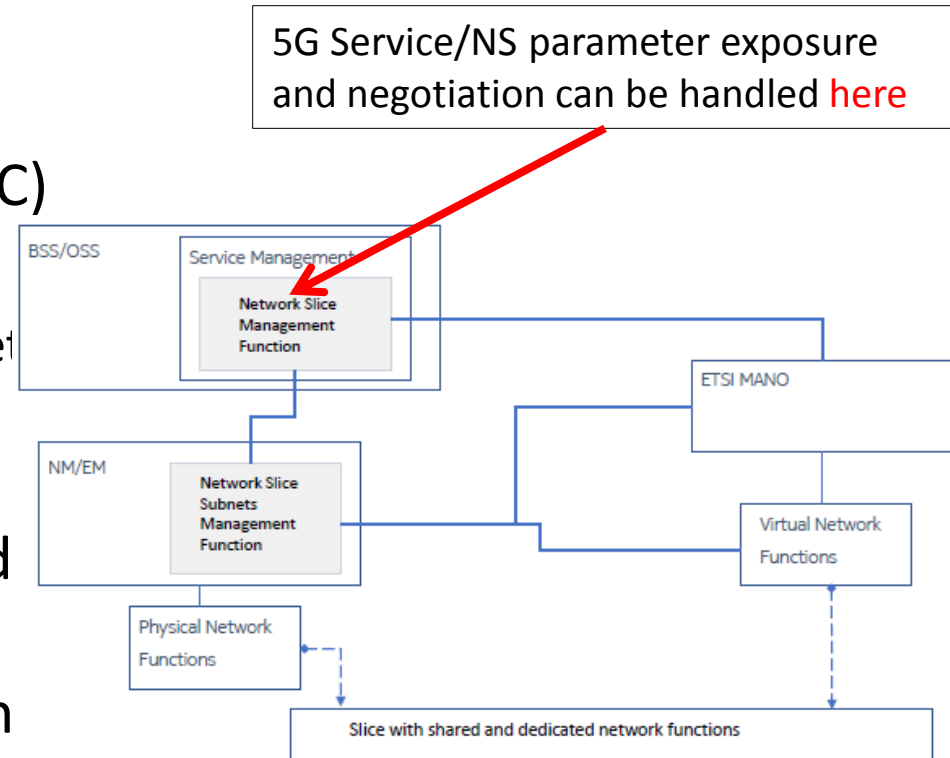


# On Network Slices

- Provide multiple logical networks on top of a (shared) infrastructure
  - Each instance of a network slice represents a virtually independent network
- Are composed of various resources (network, CPU, storage) and functions (forwarding and routing, QoS, security, *etc.*)
  - As a function of the service
- “...Can be regarded as a new sophisticated form of Virtual Private Network (VPN) technology”
  - “NFV Enabling Network Slicing for 5G”, B. Chatras et al., [ICIN 2017](#)

# 3 Standard Slice Types and an Embryonic Management Framework (So Far)

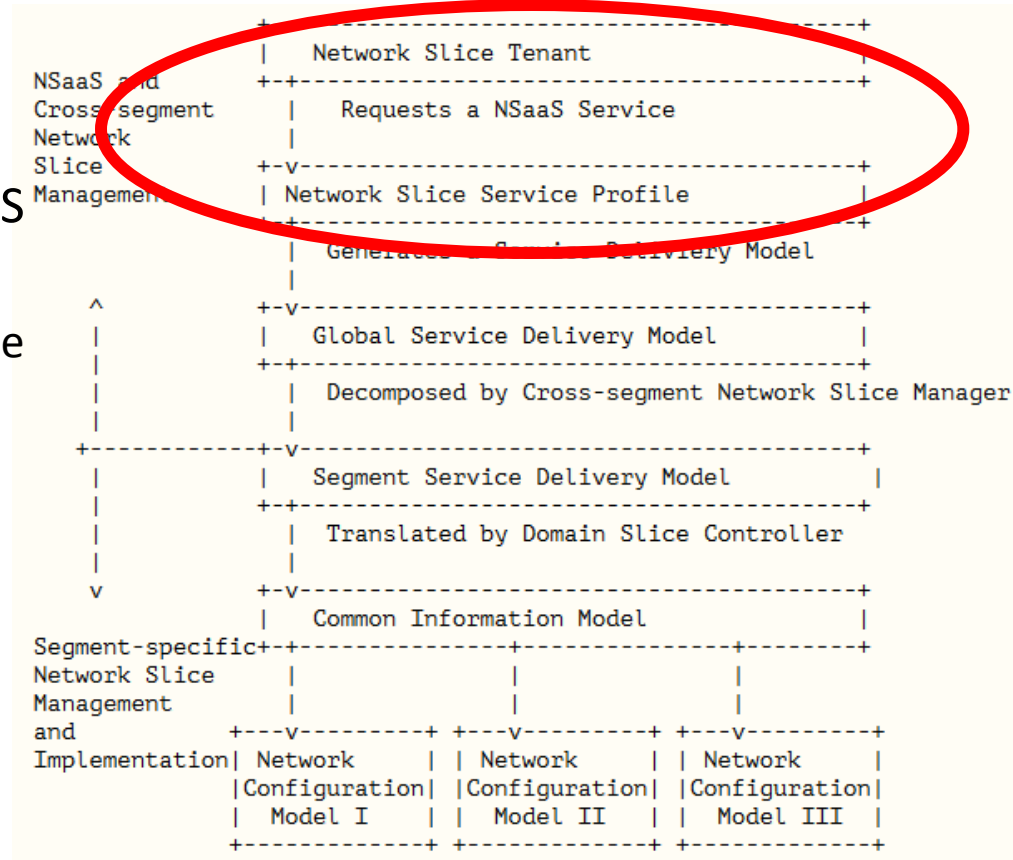
- Enhanced Mobile Broad-Band (eMBB), Ultra-Reliable Low Latency Communications (URLLC) and Massive IoT (MIIoT)
  - Each type/service comes with a set of specific requirements documented in [TS.22.261](#)
- Network Slice Management and Orchestration is being investigated and documented in [TR.28.801](#), in particular
- But slice parameter negotiation remains unaddressed (so far)



Source: Network Slicing Management and Orchestration, [draft-flinck-slicing-management](#), July 2017

# Negotiating Network Slices

- Network slice tenant in a “NSaaS” environment
  - Triggers negotiation cycle with NS provider
    - Network slice and related service functions parameters
- Completion of negotiation process then triggers slice design and instantiation
  - Involving orchestration/SDN computation logics
  - Based upon relevant data model

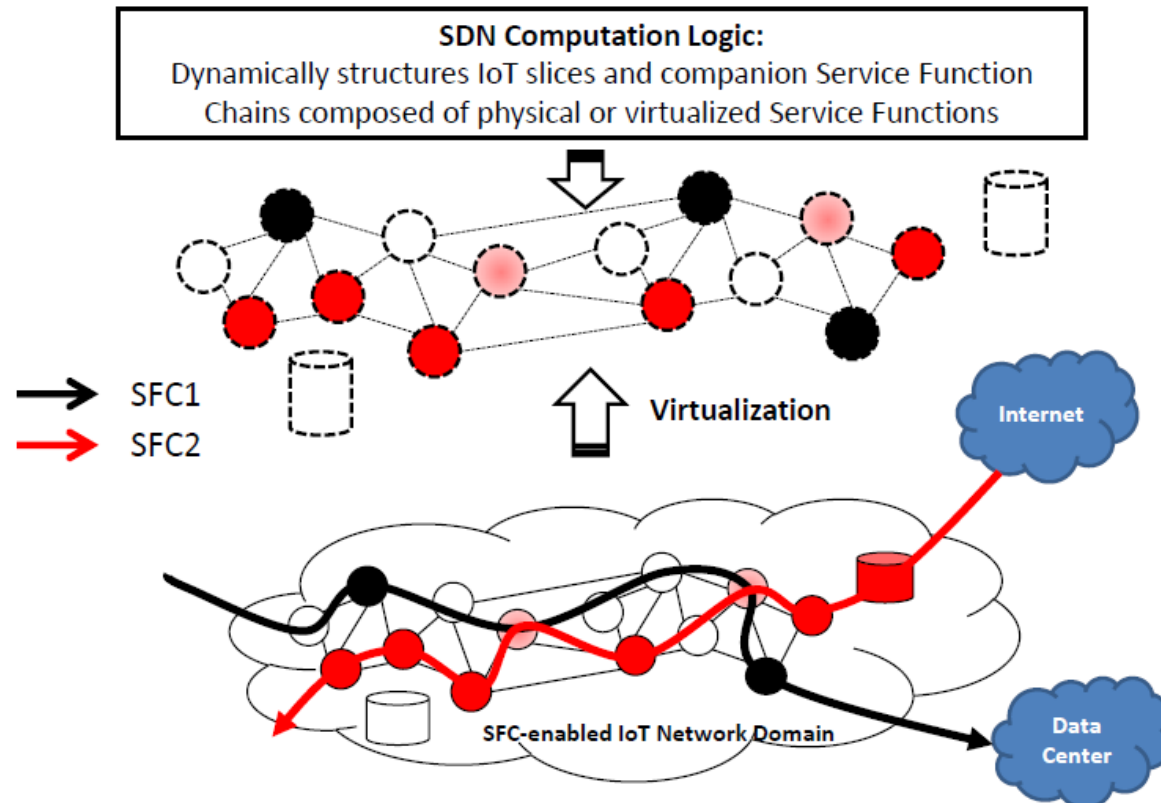


Source: “Problem Statement of Supervised Heterogeneous Network Slicing”, [draft-geng-coms-problem-statement](#), October 2017



# Example of MIoT 5G Service Negotiation Outcomes

- Two services (*e.g.*, e-health and home automation) structured as **two MIoT slice instances** associated with two Service Function Chains (SFC):
  - SFC1 = {DPI; 6lo (WPAN) encapsulation; ETX setting; 6lo de-capsulation}
  - SFC2 = {DPI; SCHC compression; 6lo (NFC) encapsulation; CoAP-to-HTTP; SCHC de-compression; 6lo de-capsulation}

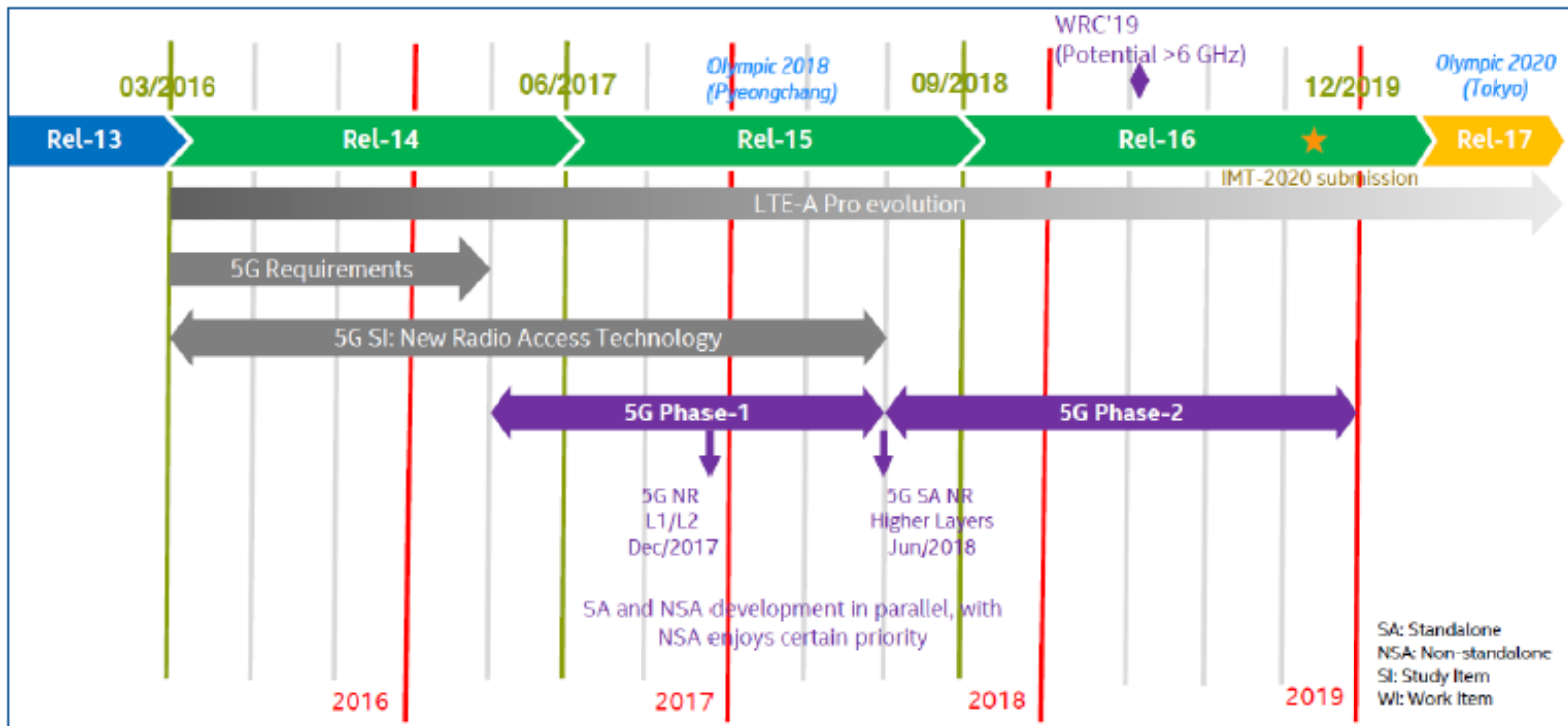


# Security: The 5G Infrastructure Becomes Protective

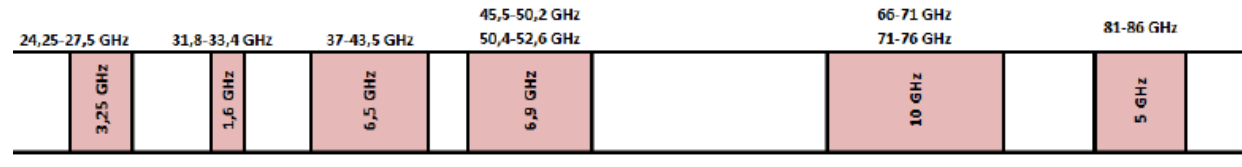
- Attacks are becoming massively distributed and more and more efficient
  - 2017 Symantec [report](#) indicates that it takes less than 2 minutes to hack an object
  - Attacks last longer (24h+ for some of them) and generate more traffic (1+Tbps observed on [OVH](#) servers late 2016)
- Prevention and anticipation by means of predictive analysis and adapted signaling mechanism
  - Smart agents embedded in 5G resources (cloud, network) observe traffic (on specific ports) and signal any suspicion of malicious traffic
    - To their peers and to controller agent located in the 5G control plane
  - Malicious traffic wells and adapted filters are dynamically enforced
  - Behavioral analysis is then conducted, possibly leading to the distortion of traffic models

# 3GPP Standardization Roadmap

- European launch is foreseen in 2020
  - Field trials to ignite in 2019



# 5G Spectrum



- Harmonization

- Unlike CMR-15 conference conclusions that reflect European recommendations, US and some Asian countries will be launching experiments in the 28 GHz band
- Europe will first investigate 26 GHz (given likely bi-mode device availability), then 32 and 42 GHz

- Various performances (coverage, rate, capacity) yield different frequency bands

Today		2019/2020	From 2021
< 1 GHz	1 < F < 6 GHz	6 < F < 24 GHz	> 24 GHz

- Need to avoid 4G saturation from 2020/2023

# 5G Challenges are Manifold

- **Automated, secure-by-design**, 5G service engineering, delivery and operation
  - From dynamic 5G service parameter exposure and negotiation to delivery and operation
  - AI techniques can help
  - Feedback mechanisms are critical to assess how what has been delivered complies with what has been requested and negotiated
- **Spectrum harmonization**
  - To accommodate 5G operators' roadmaps with vendors' roadmaps
- **Standardization**
  - Completion of effort is not foreseen before early 2020 (Rel. 16 publication), meaning that every 5G-labelled experiment/deployment remains “pre-5G” before this milestone (*e.g.*, Verizon's 5G Technical Forum)

A tricky equation is yet-to-be-solved, mixing **costs** (frequency, new 5G gear), **regulation** (frequency availability, net neutrality) and **revenues** (mass-market 5G monetization pattern, new business models, wholesale)

# Thank You!