Research directions beyond 5G, and Vertical applications for 5G

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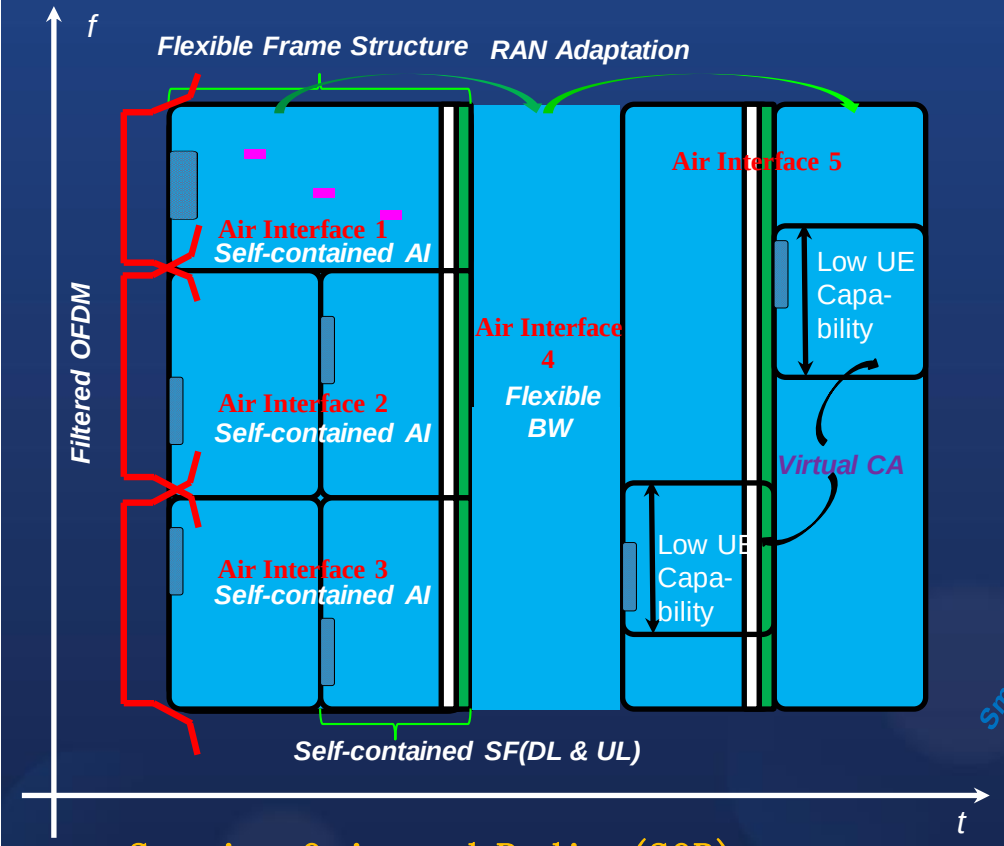
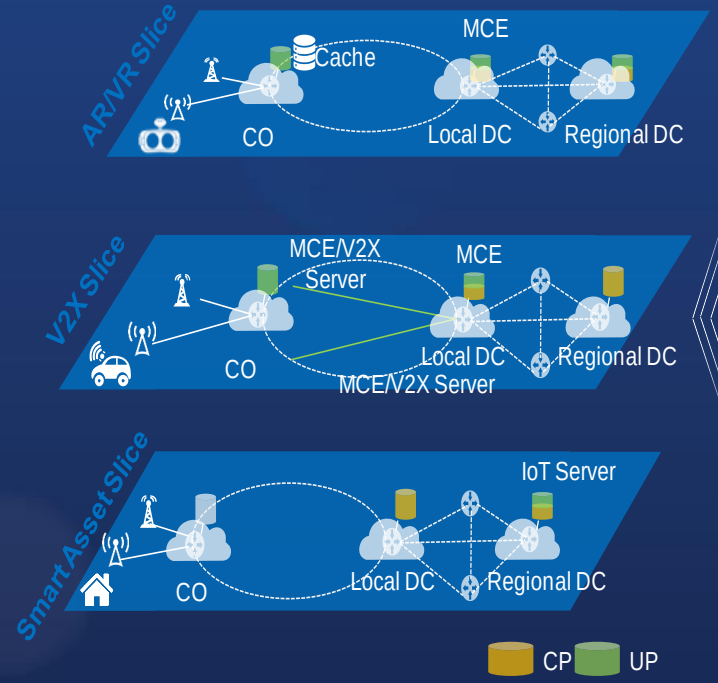
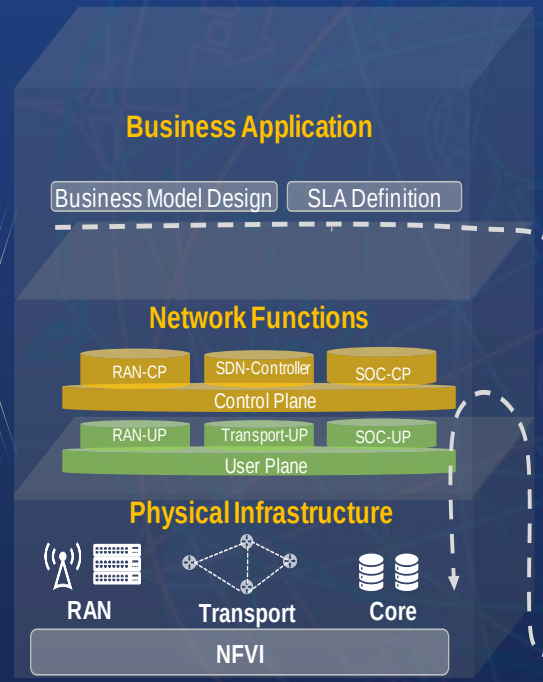
Service Oriented Radio and Cloud-Native Architecture



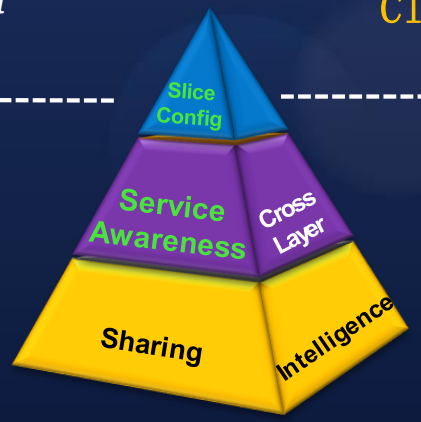
Service Oriented Radio (SOR)





Cloud-Native Architecture for E2E slicing

5G Air Interface ⟵ ⟶ 5G Architecture



"5G-Beyond" with service awareness and sharing?

e.g. "Video" RAN Slice w/ cross layer?

e.g. Network/Spectrum Sharing?

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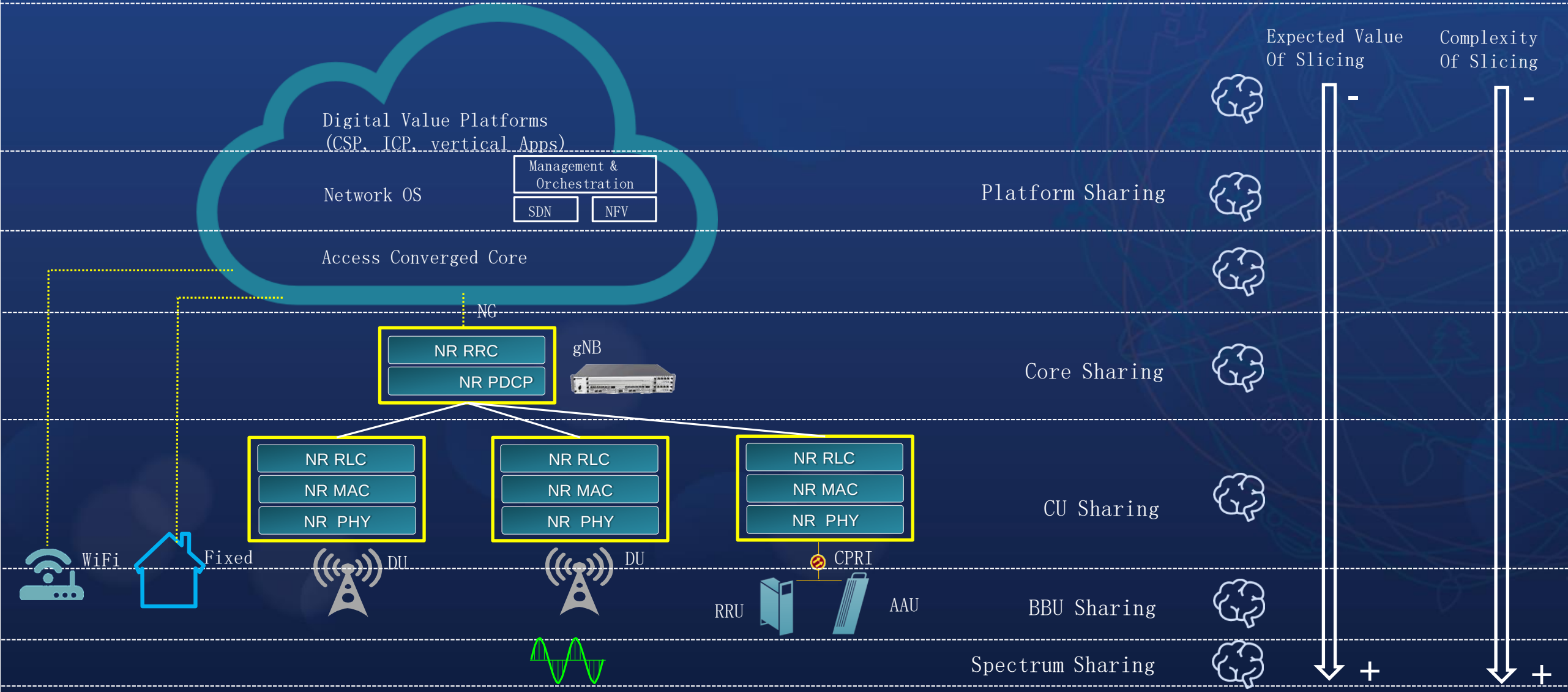
Layered Slicing/Sharing and Layered Intelligence

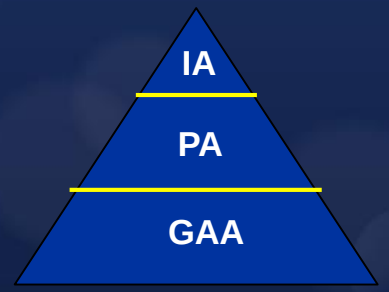


Network/Spectrum Sharing for reasonable performance/cost tradeoff

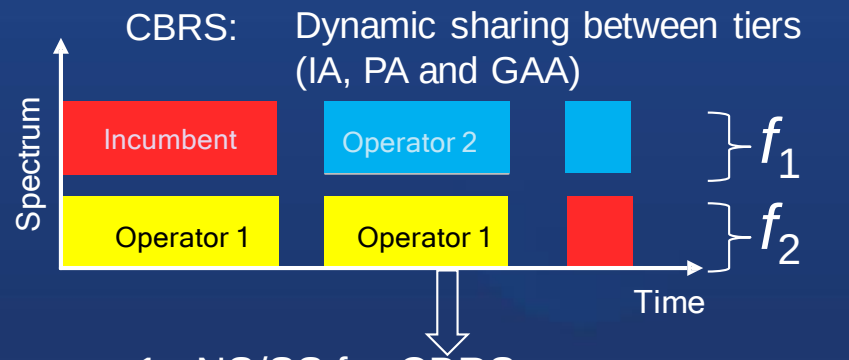
Licensed spectrum
Exclusive use

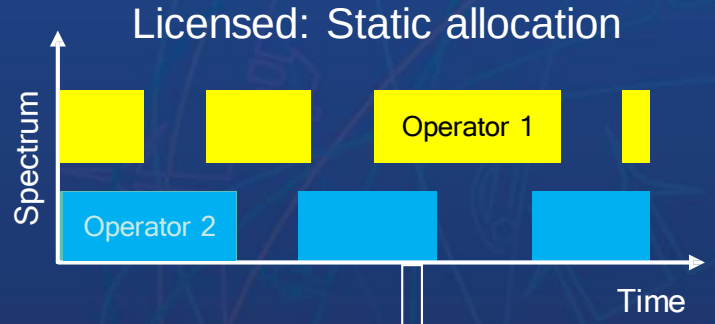
Unlicensed spectrum
Shared use
Example: 2.4 GHz / 5 GHz / 60 GHz

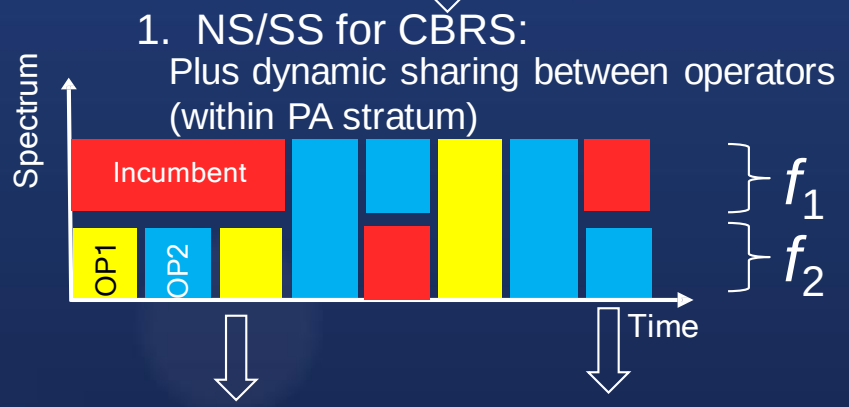
Shared spectrum
New spectrum sharing paradigms
Example: 2.3 GHz Europe (LSA) / 3.5 GHz USA (CBRS[1])

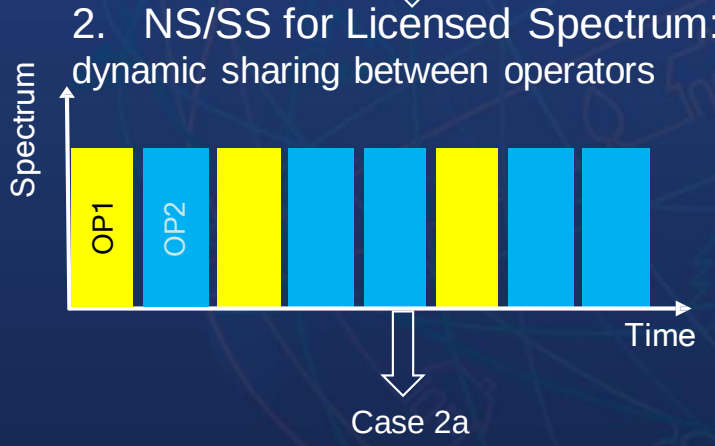


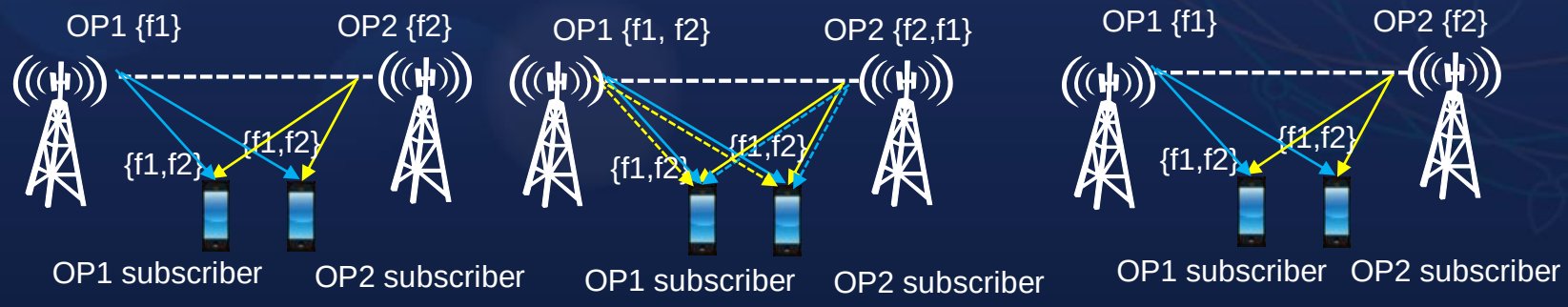
[1]: 3 tiers model of CBRS











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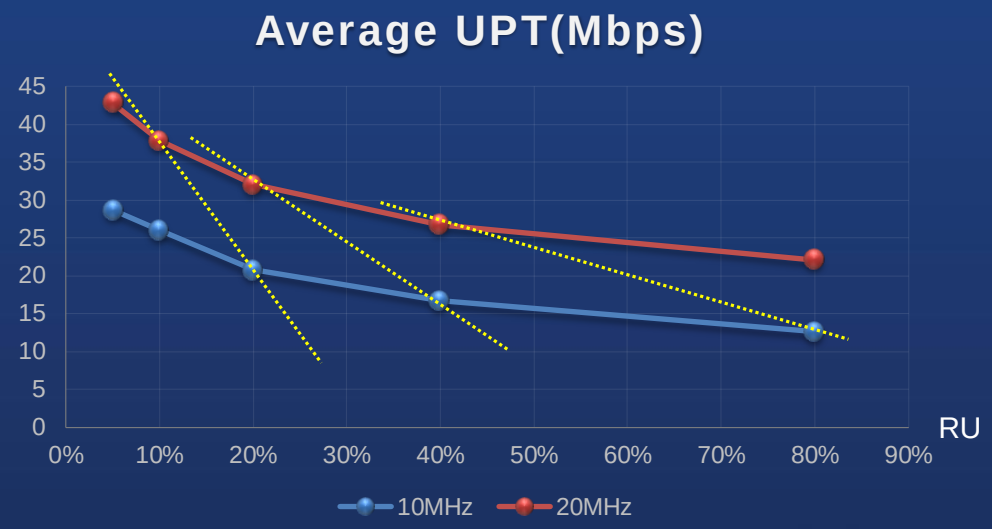
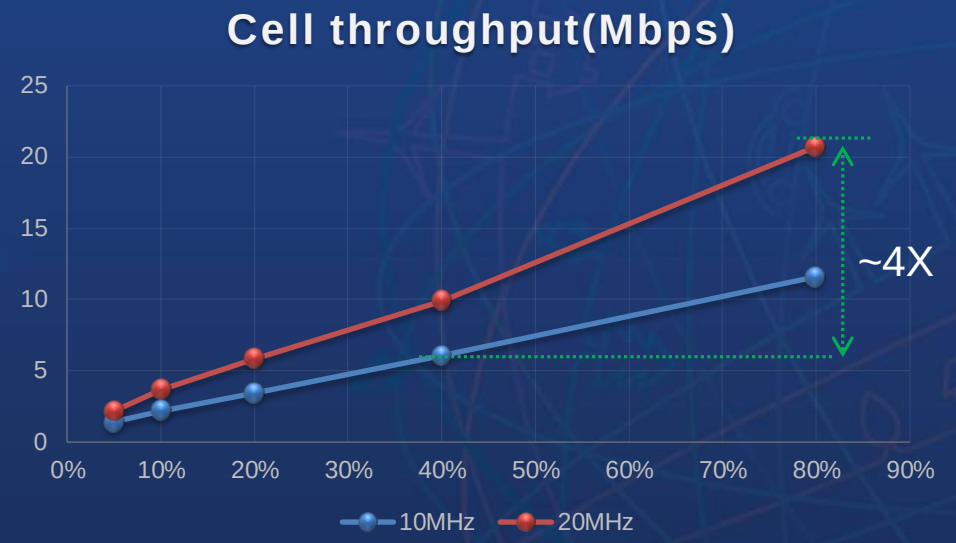
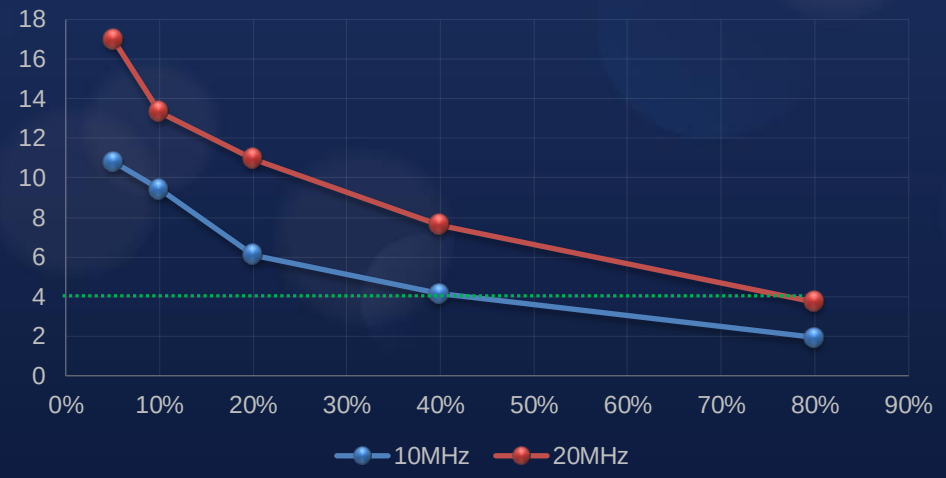
Rethink “Spectrum Efficiency” with QoS constraint







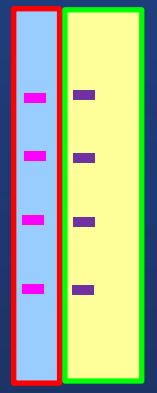
“Spectrum Efficiency” Changes with Bandwidth
- e.g. if 4Mbps 5% UPT required, 20MHz cell throughput is 4 times of 10MHz (i.e. SE is 2 times)

User Perceived Throughput normalized with used resource Changes with Bandwidth
- 20MHz UPT/Hz is approximately 2 times of 10MHz (a.k.a Trunking gain)

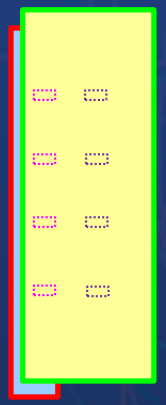
Observations: “SE” gain ≈ UPT gain?

Rethink "Spectrum Efficiency "with Joint Pilot and Data

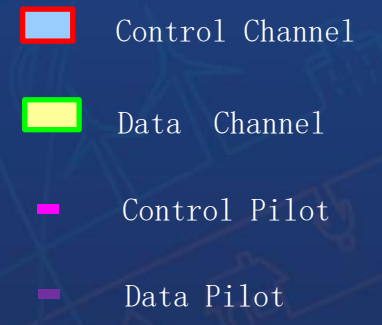
Control /Pilot/Data separately optimized



Self-contained transmission (short duration) for analog switching(mmWave) /Interference agility (unlicensed spectrum) /URLLC



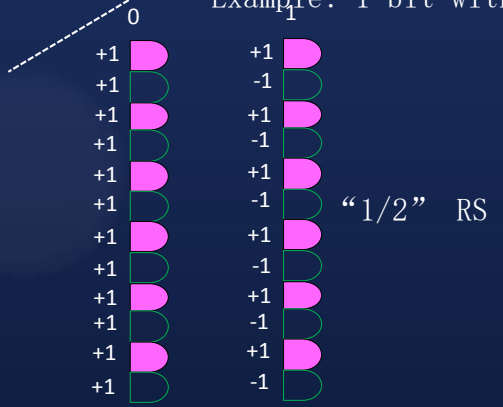
Self-contained transmission with overlaid data/pilot/control (Joint Optimization of data/pilot)



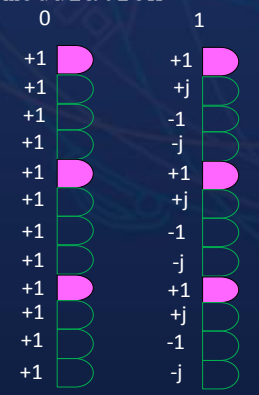
Experiments show better performance of "1/2" RS against "1/4 RS" for 1 bit data; but "1/4" RS is better than "1/2" RS for 2 bit data

How to achieve the best "Spectrum Efficiency" with joint Pilot and Data?

Example: 1 bit with sequence modulation



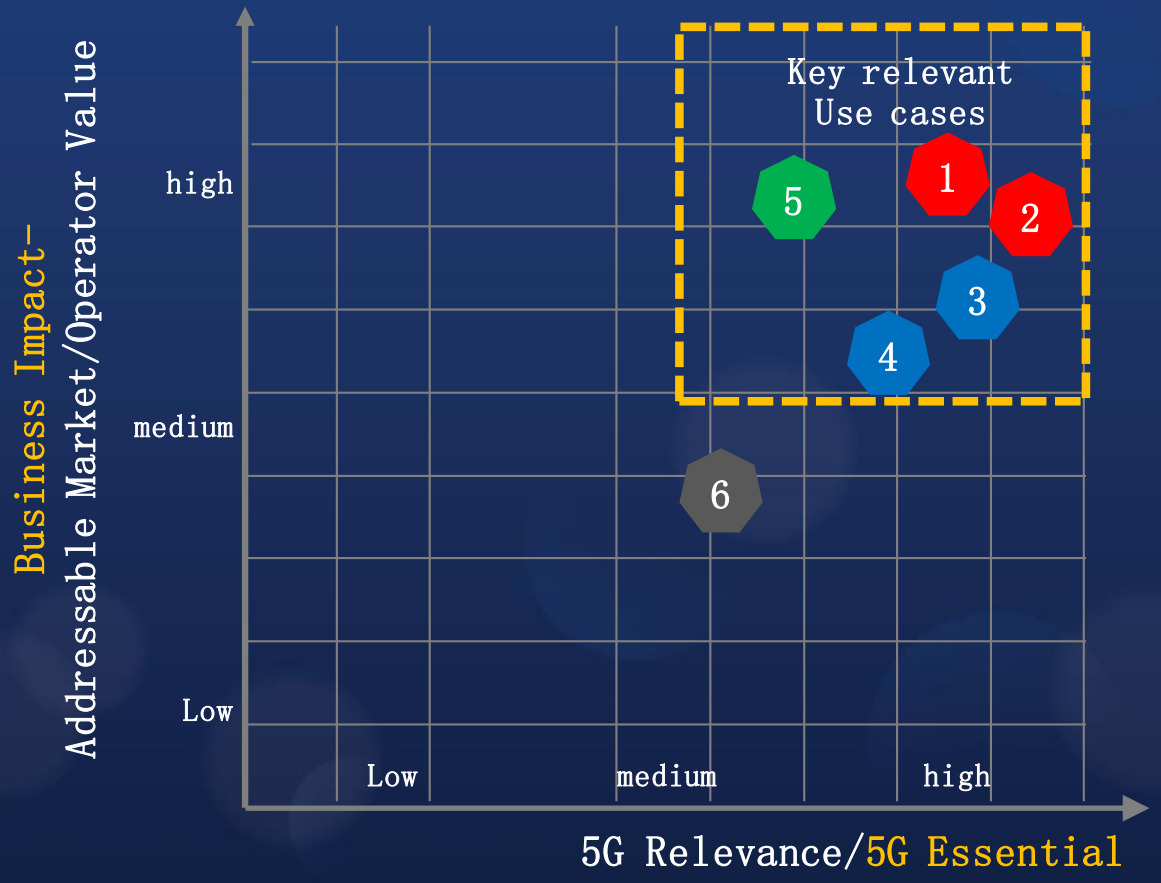
"1/2" RS



"1/4" RS

5G Use Cases Evaluation & Prioritization

Use Case Evaluation



Use Case Example

1. UHD/3D/Holo… Video
2. AR/VR
3. Connected Vehicle
4. Smart Manufacturing
5. Fixed Wireless Access
6. Delivery Drone

Source: Huawei wireless X Labs

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