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5G/mmWave Capacity Improvements: A Systems Perspective

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Research Question

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What is the fundamental trade-off between "sensing" & "communication"?

- At microwaves: learn & leverage *interference* → cognitive radio and dynamic spectrum sharing
- At millimeter wave: learn *mobility and geometry* → beam alignment protocol design, beam alignment vs communication?

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Drivers of 5G

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Keywords:

Flexibility

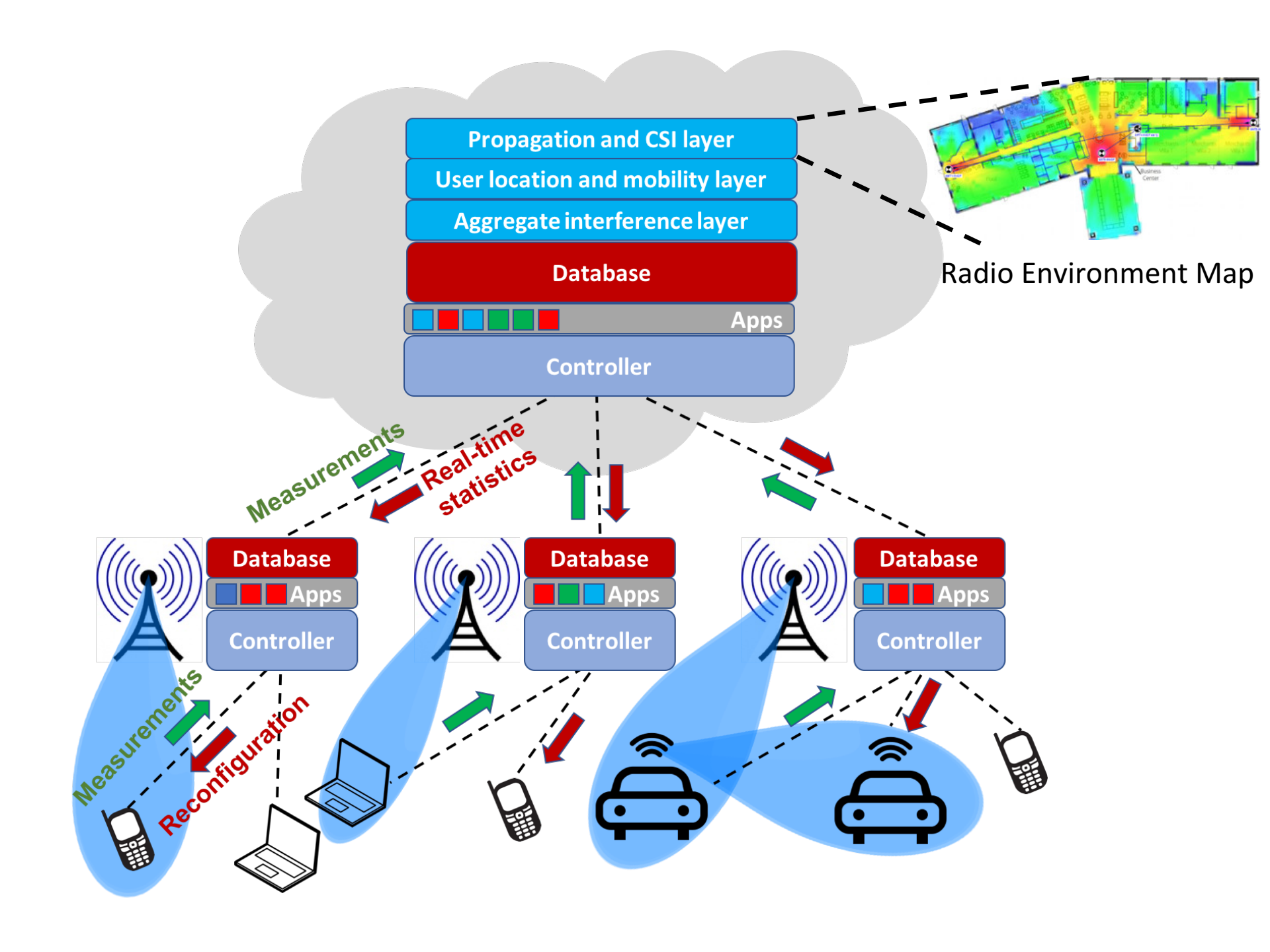
Situational awareness

Tools:

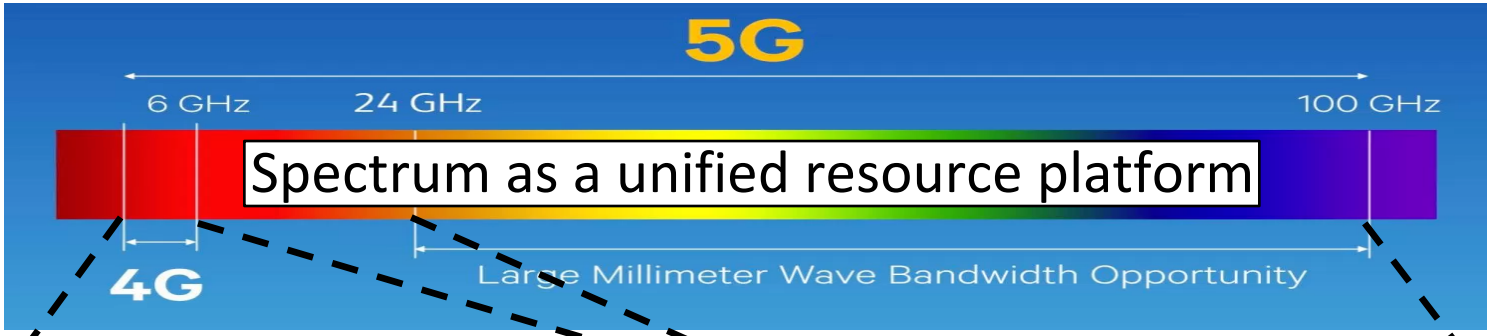
Software Defined Networking

Machine Learning

Cloud computing


Propagation and CSI layer
User location and mobility layer
Aggregate interference layer
Database
Apps
Controller
Radio Environment Map
Measurements
Real-time statistics
Database
Apps
Controller
Database
Apps
Controller
Database
Apps
Controller
Measurements
Reconfiguration

Spectrum mining?



Microwave	Mm-wave
Better penetration	Blockage/absorption
Ubiquitous channel	Sensitive to mobility
Low capacity	High capacity
Interference	Low interference
…	…
Massive IoTs	*Mobile broadband*
Control plane	*Mission critical IoTs*

Grand Challenges

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Rethink communication systems to leverage situational awareness via more flexible design

- How much more can we squeeze at microwaves?
  - Limits not reached (yet!)
- Fundamental limit of mm-wave: sensing – communication trade-off?
- Abstractions?

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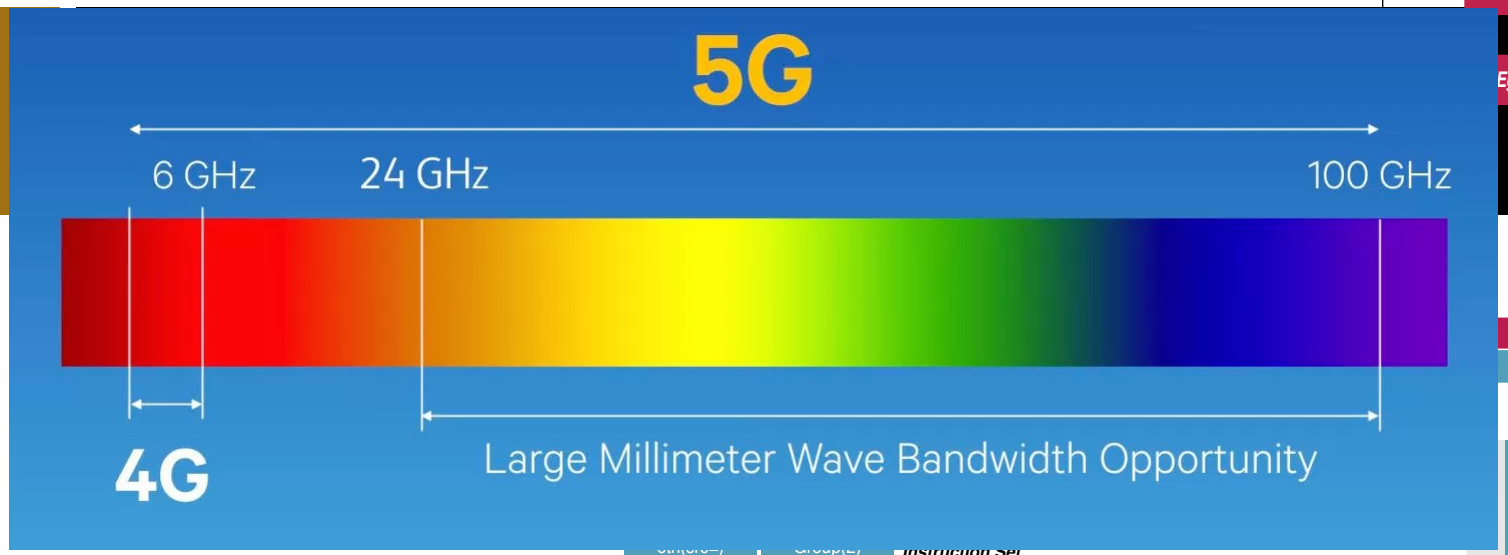
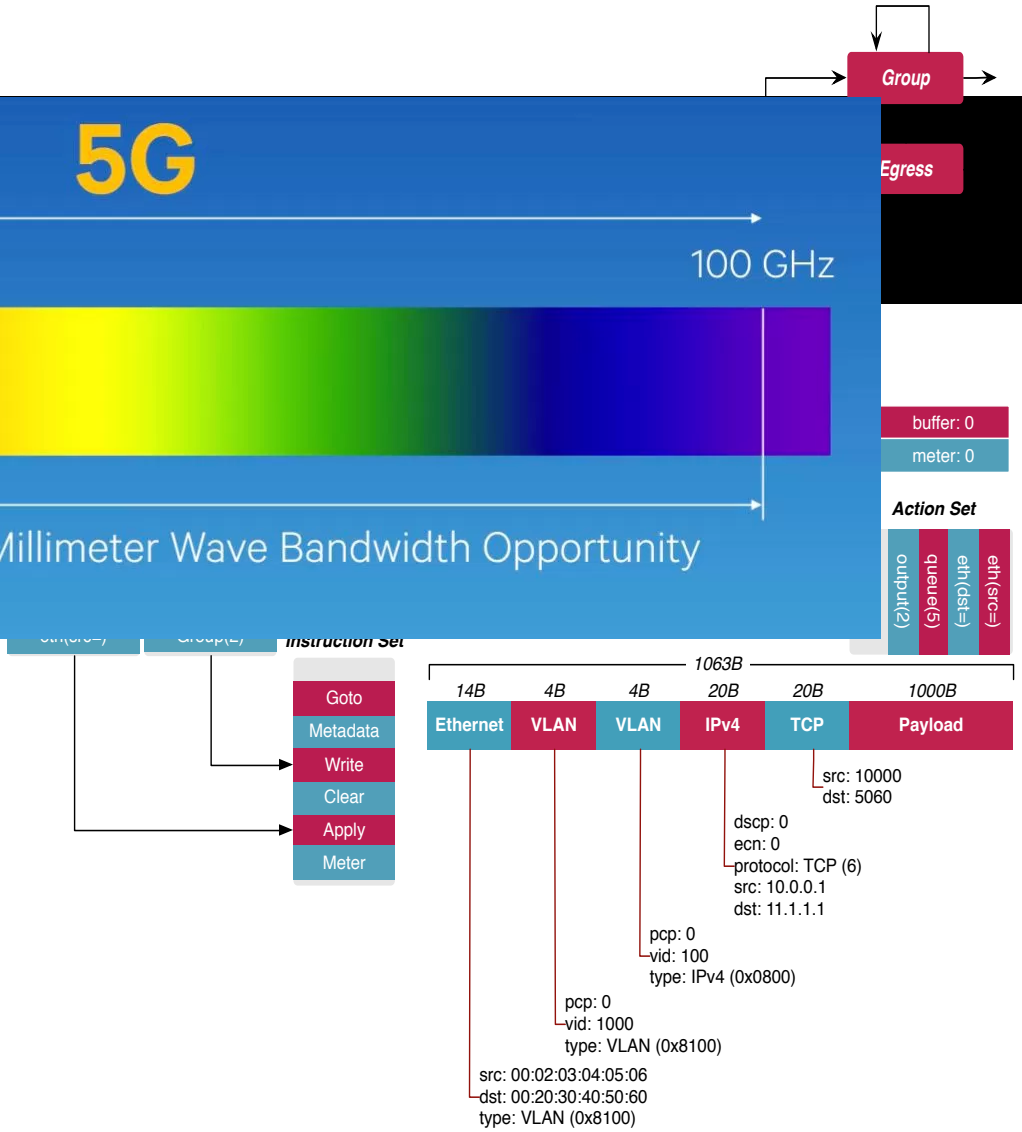
SDN framework goals



[Source: National Instruments]



SDN Framework Goals

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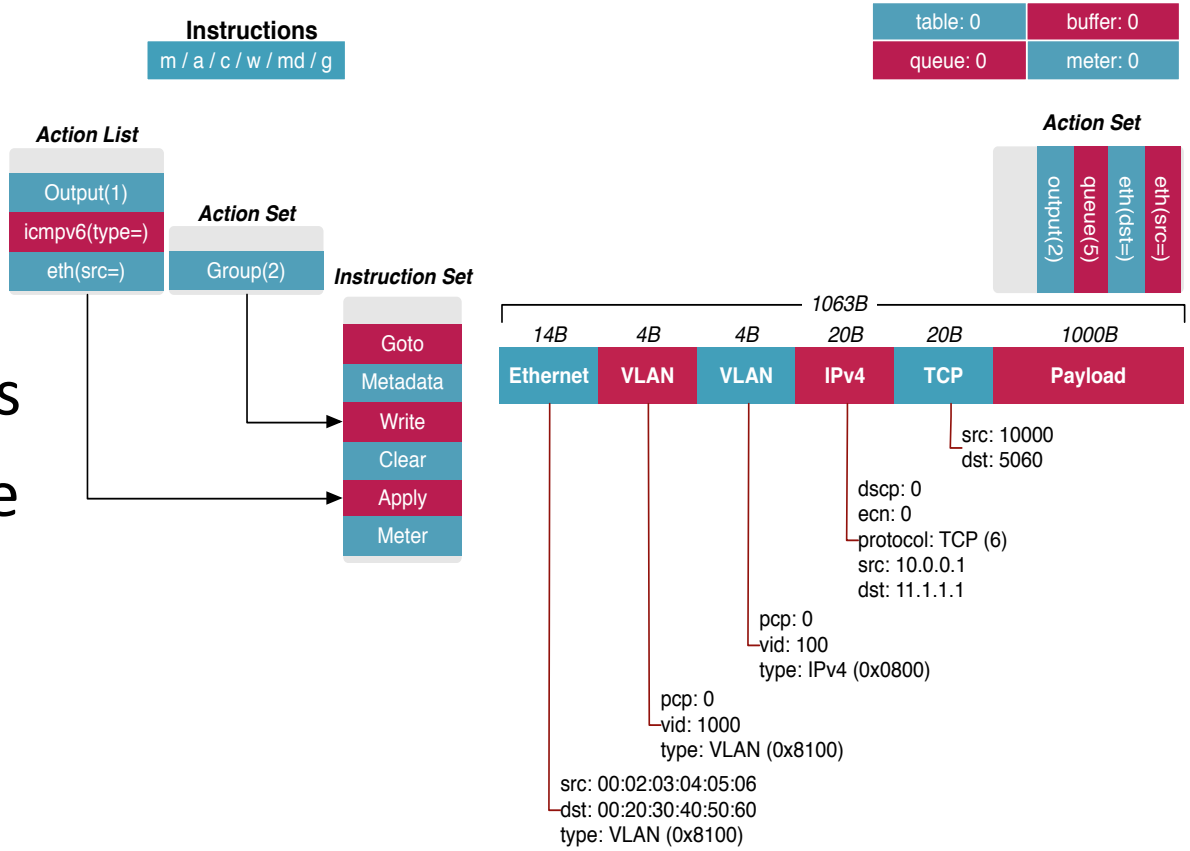
- Enable programmability at MAC & PHY layers
- Enable different per-packet behaviors
- Define & incorporate wireless primitives
- Abstractions?