

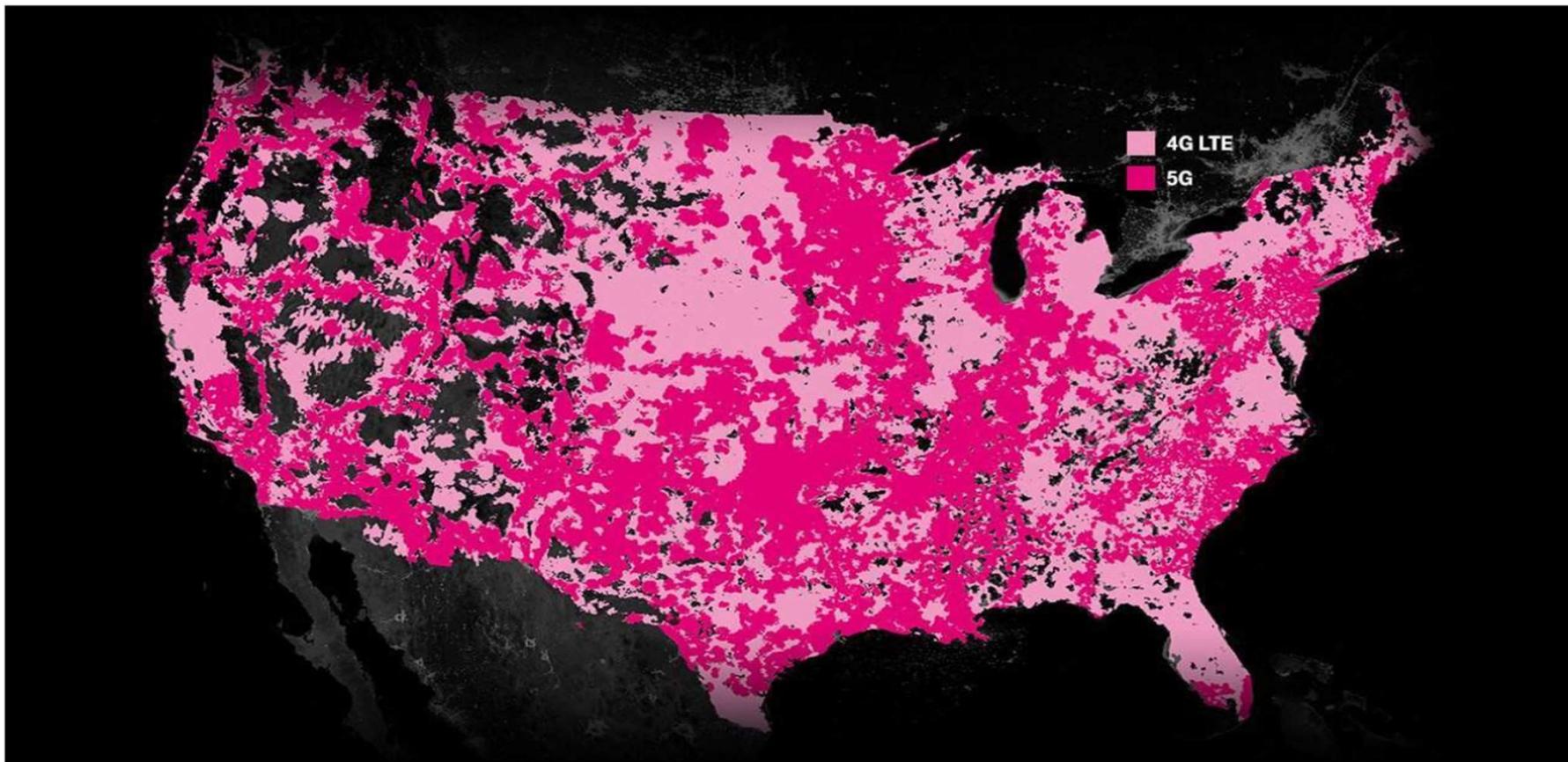
A nighttime photograph of a city skyline with several illuminated skyscrapers. In the foreground, a multi-lane highway is shown with long-exposure light trails from cars, creating a sense of motion. The sky is dark, and the city lights provide a warm, glowing atmosphere.

# The Road to 5G

Presenter: Richard Pelupessy

T-Mobile®

# T-Mobile's LTE & 5G Coverage



# T-Mobile's Coverage Map Portal

<https://www.t-mobile.com/coverage/4g-lte-5g-networks>

# 5G EVOLUTION

5G will not only be an evolution of mobile broadband networks, it will also enable new unique network and service capabilities

- Gbps speeds
- Virtual reality and augmented reality
- Industrial automation, eHealth, V2X
- Autonomous vehicles

## NEXT-LEVEL BROADBAND

Higher speeds and lower latency enabling a next-generation of services

# 5G

## MASSIVE CONNECTIVITY

Moving from Millions to Billions of connected devices

## CRITICAL COMMUNICATION

Systems requiring very high reliability and/or low latency

# 5G STRATEGY

## INCREASED DATA RATES

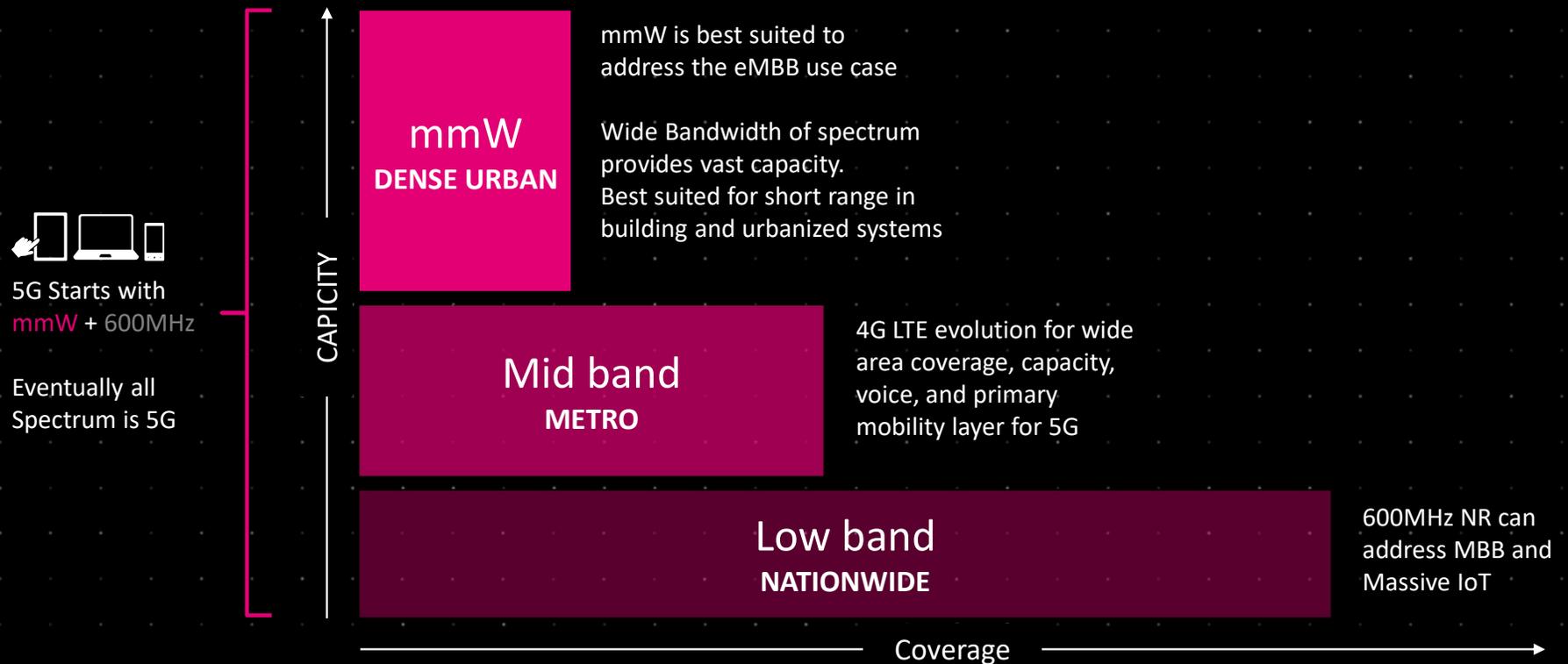
### INCREASE IN EFFICIENCY:

- ENERGY
- FREQUENCY
- SPECTRUM
- DEVICE

## TECHNOLOGIES

- Massive MIMO
- Cloud - RAN
- Network Function Virtualization – NFV
- Mobile Edge Computing - MEC
- Software Defined Networking – SDN
- 5G CORE
- Network Slicing
- Chipset Roadmap

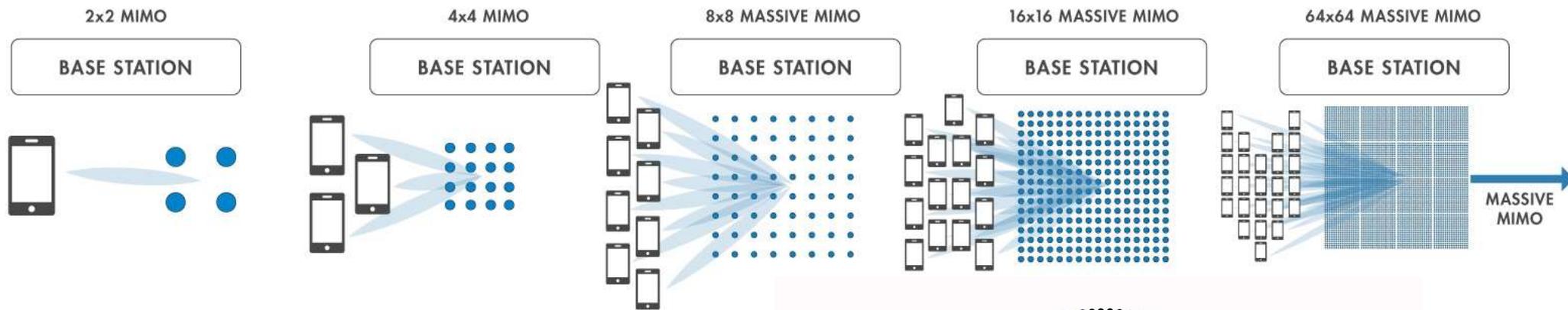
# All Spectrum will be needed for 5G over time



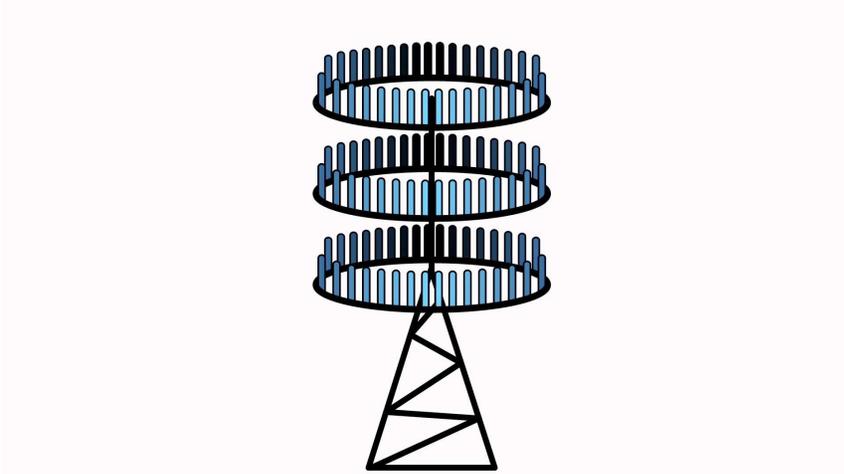


# Massive MIMO

# Massive MIMO



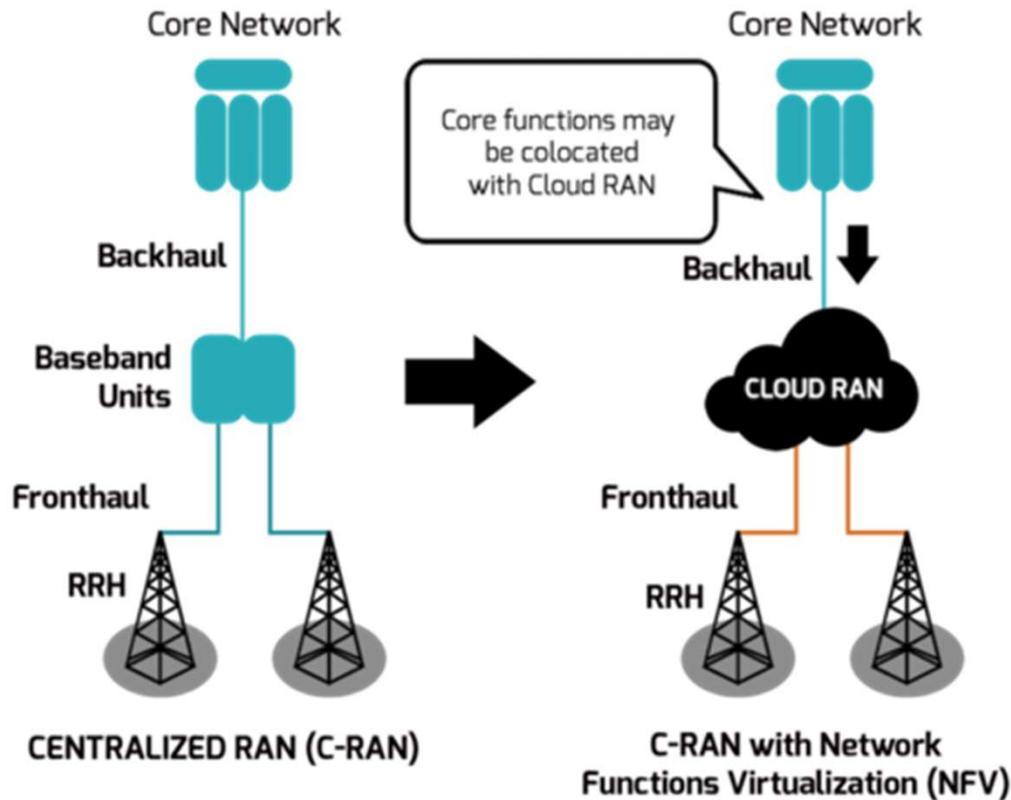
- **Large Scale Antenna Systems**
  - Low Cost Power Components
  - Reduced Latency
  - Simplifies Resource Allocation



An aerial photograph of a wind farm is shown, with a semi-transparent pink rectangular overlay covering the middle portion of the image. The text "C - RAN" is centered within this pink area in a white, bold, sans-serif font. The background shows several wind turbines in a field under a clear sky.

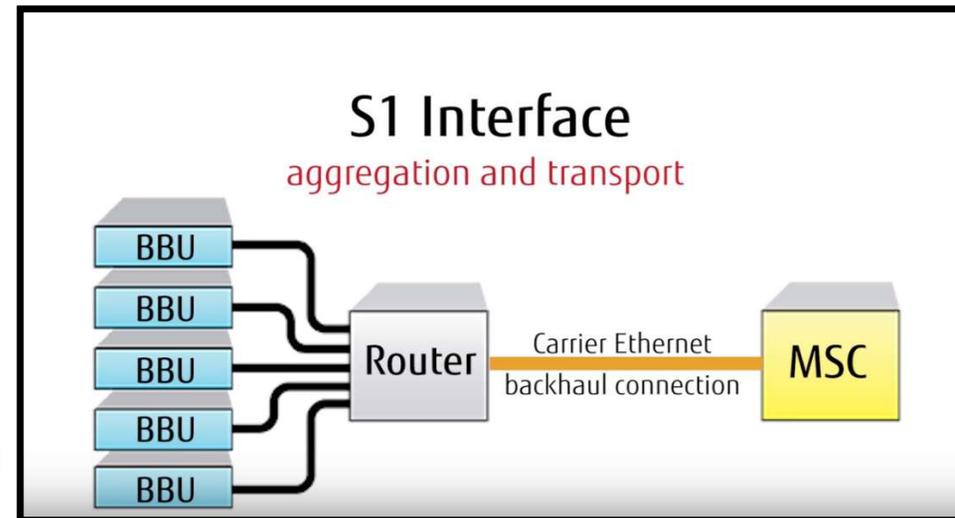
C - RAN

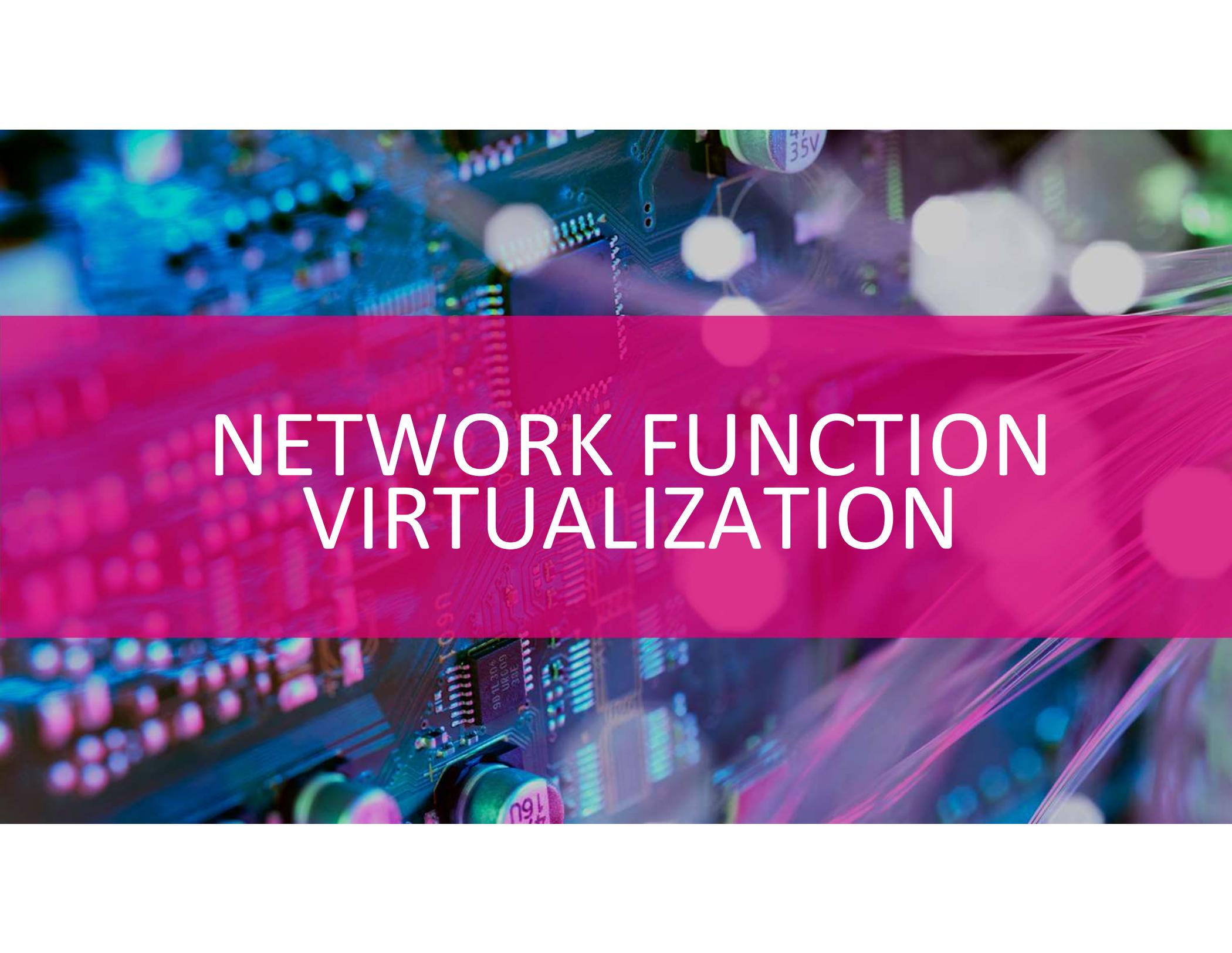
# Centralized - Cloud : Radio Access Network



## ■ C-RAN Architecture Offers:

- Increased Performance
- Enhanced Flexibility
- Lower Costs



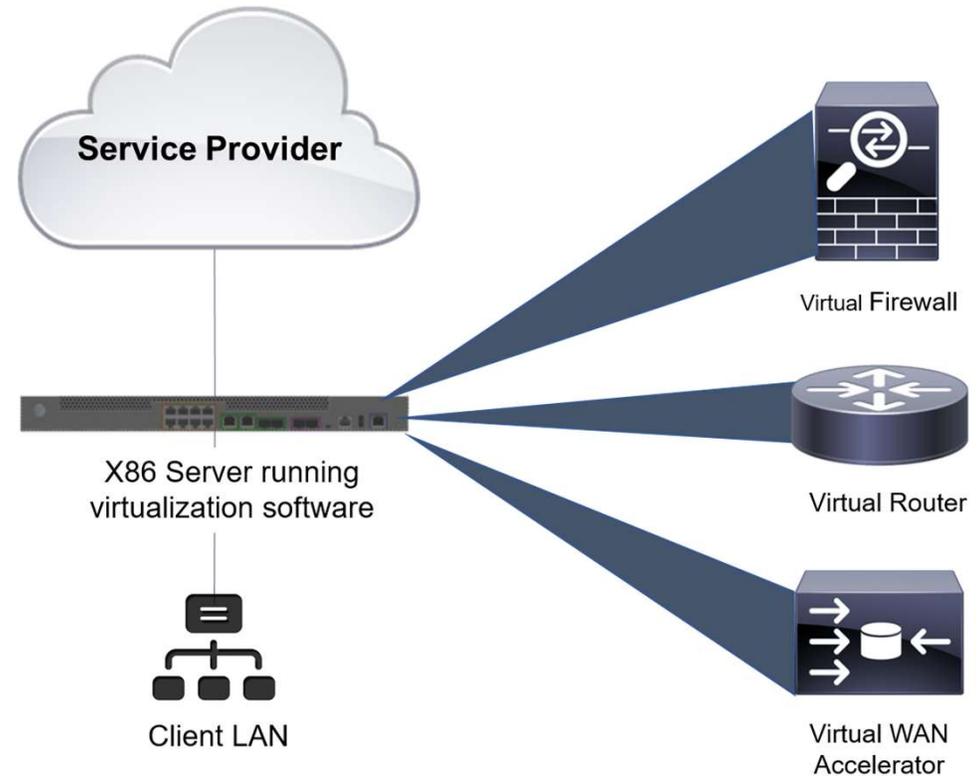


# NETWORK FUNCTION VIRTUALIZATION

# NFV – Network Function Virtualization

## ■ NFV Benefits

- Reduce Costs & Consumption
- Speed to Market
- Sharing Resources
- Lower Risks

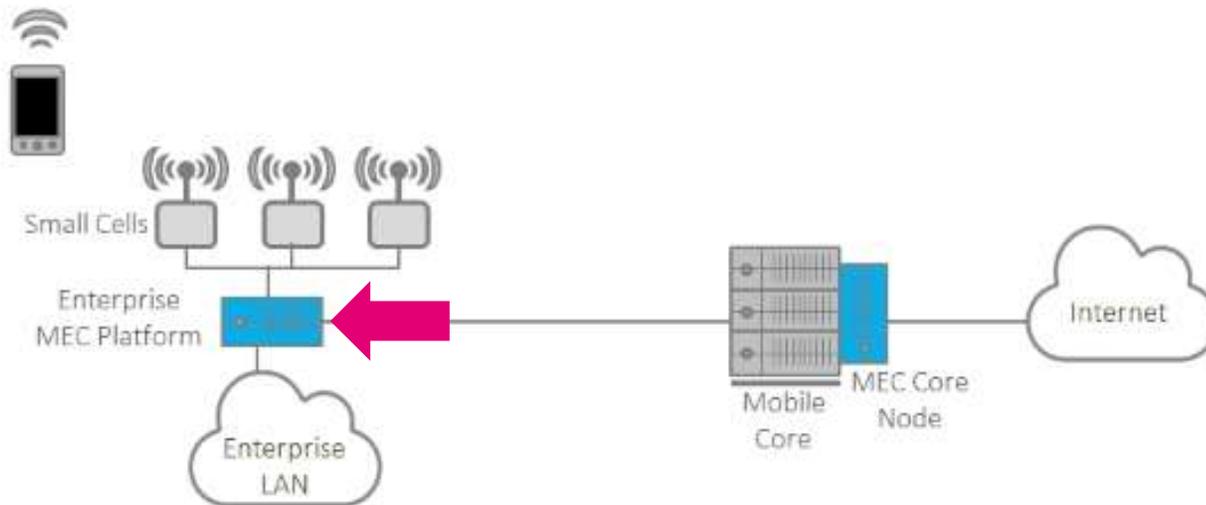


**Network Function Virtualization WAN**



# MOBILE EDGE COMPUTING

# Mobile Edge Computing - MEC



## MEC - Highlights

- Small Cloud Centers at Edge
- Traffic Monitoring
- Content Caching
- Local Data Aggregation
- Perform Core Network Functions

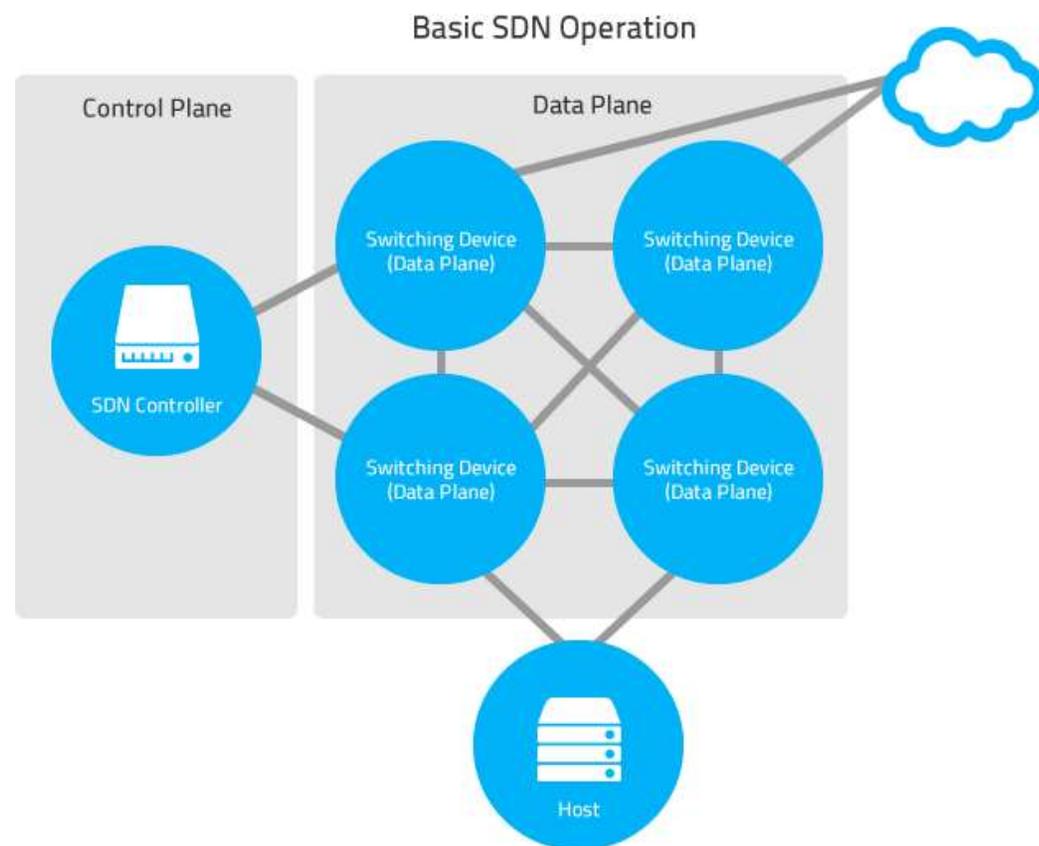


# SOFTWARE DEFINED NETWORKING

# Software Defined Networking - SDN

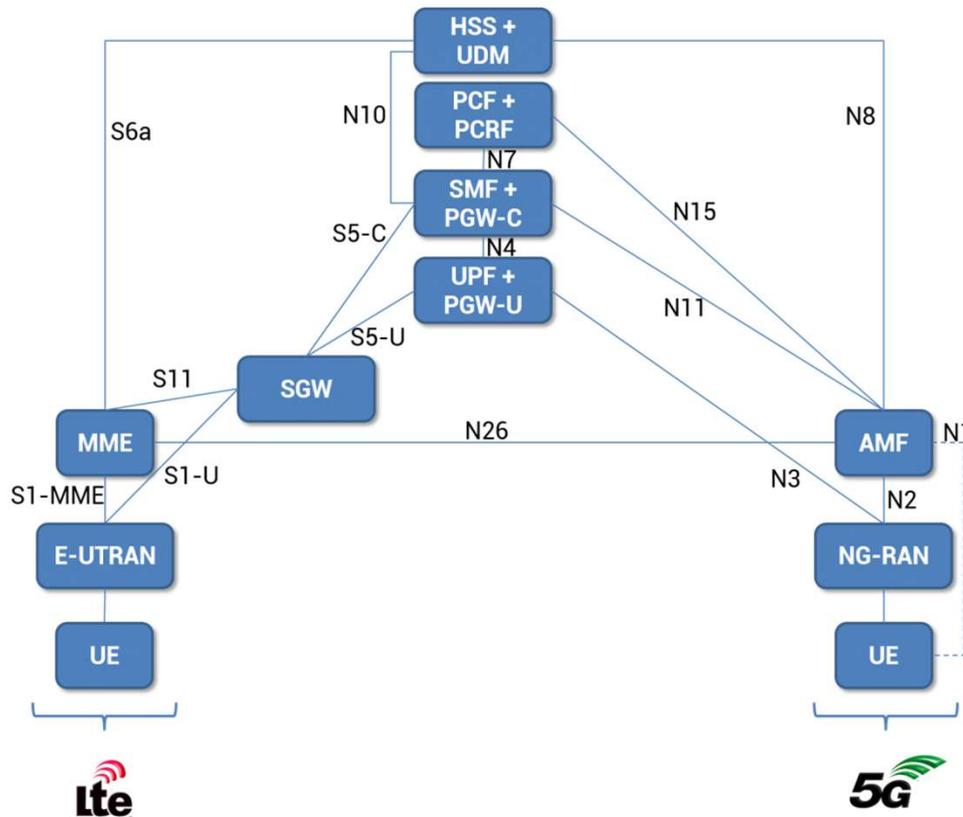
## ■ SDN Provides:

- Separation of Control + Forwarding Plan
- Control is Programmable
- Creates Adaptable Network Hierarchy





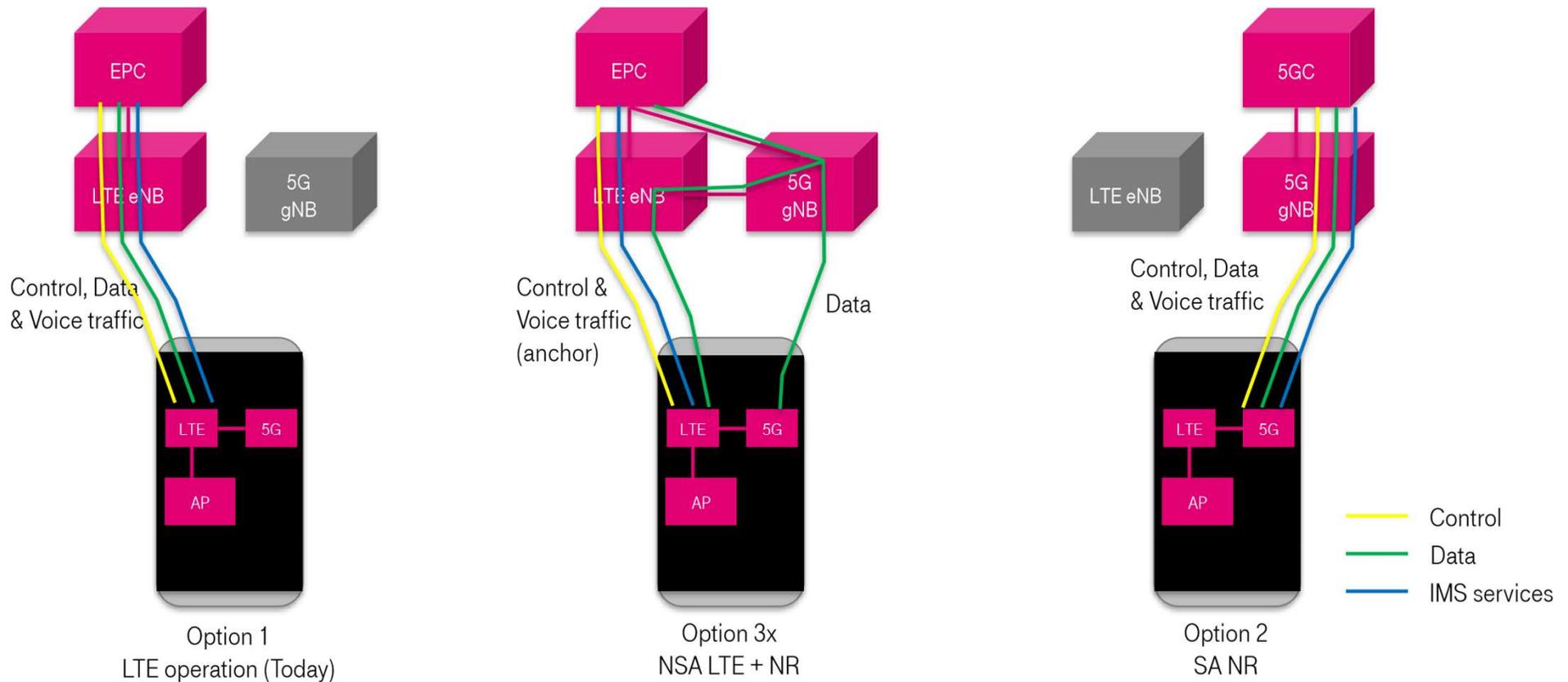
# 5G CORE



## 5G CORE

- HSS Home Subscriber Server
- UDM Unified Data Mgmt
- PCF Policy Control Function
- PCRF Policy Control Rules
- SMF Session Mgmt Function
- UPF User Plan Function
- AMF Access and Mobility Mgmt
- NG Next Generation - RAN

# How is traffic handled in architecture 1, 2, 3 ?

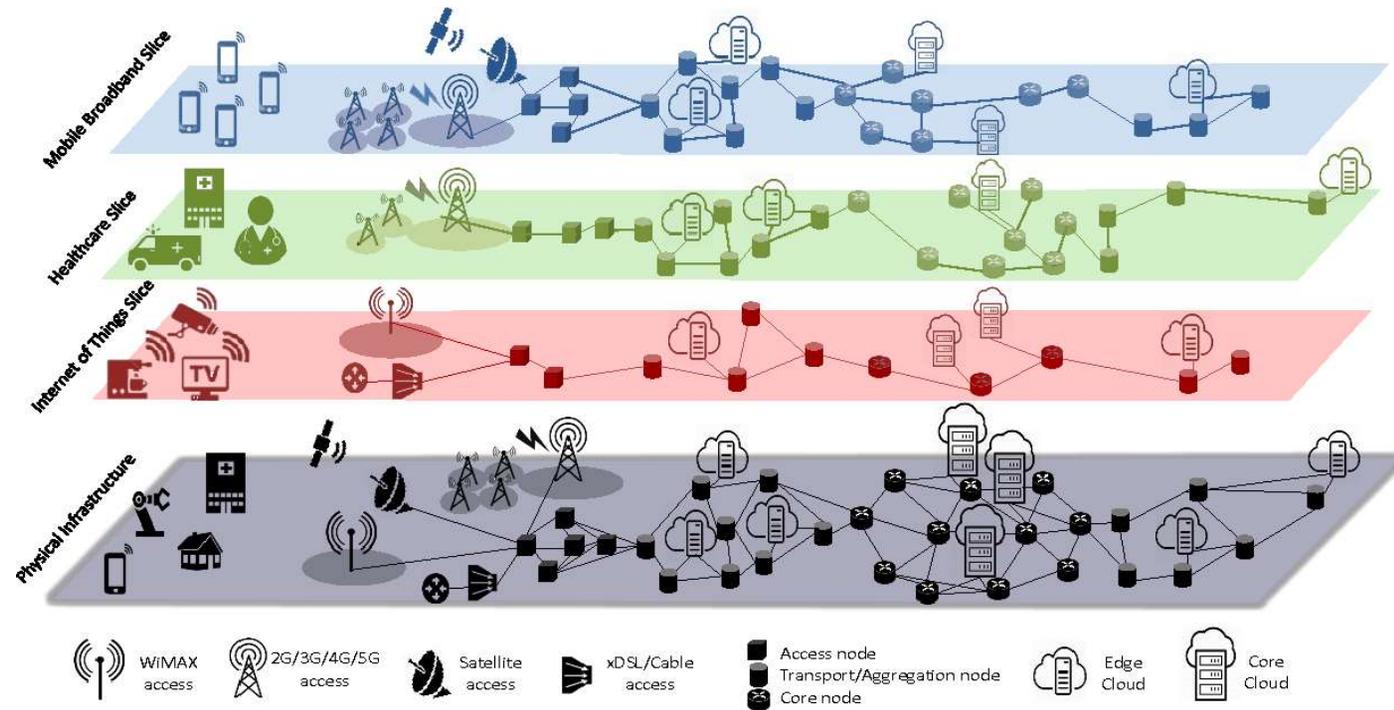


# 5G NETWORK SLICING

# Network Slicing

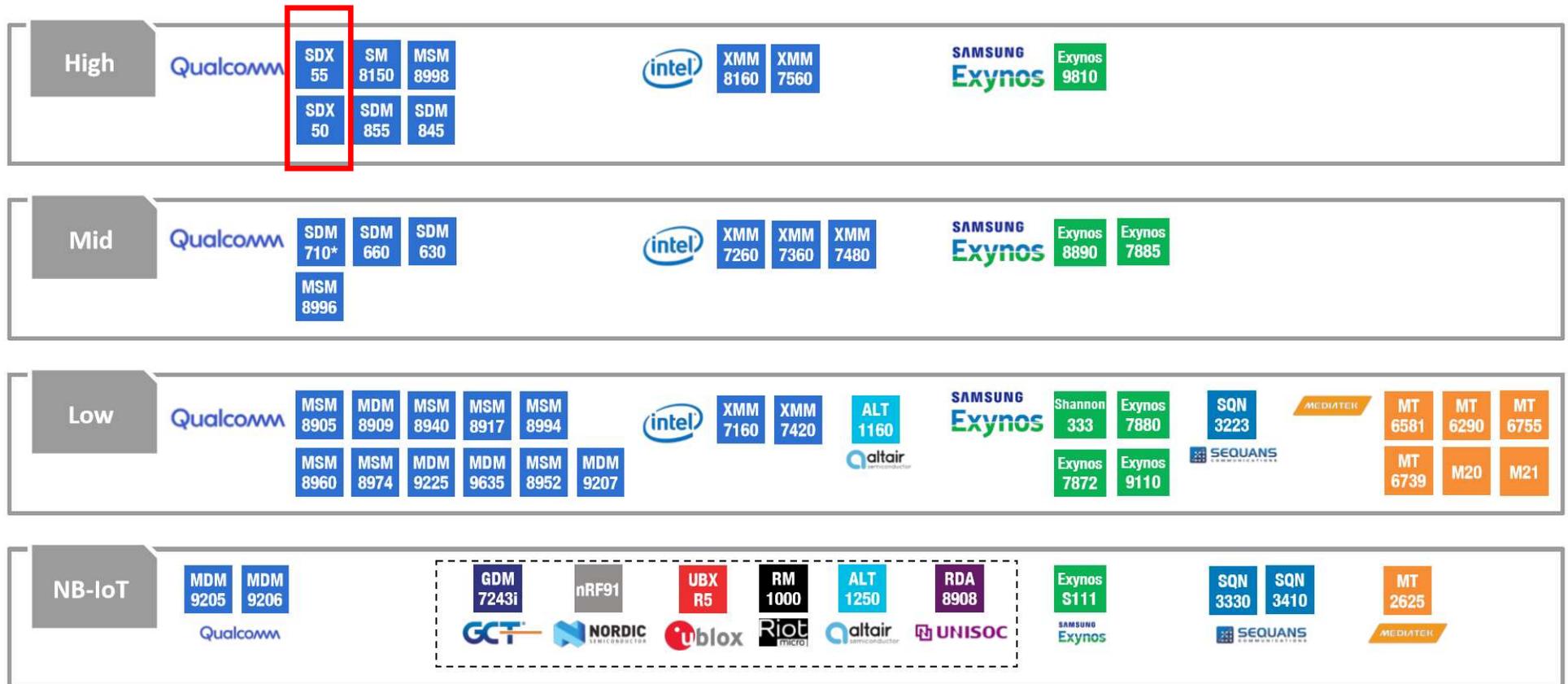
## 5G RAN Slicing:

- Flexible creation and placement of function instances
- UE can use multiple network slices at the same time
- Can treat traffic differently depending on customer requirements



# CHIPSET ROADMAP

# Chipset Ecosystem in T-Mobile Devices



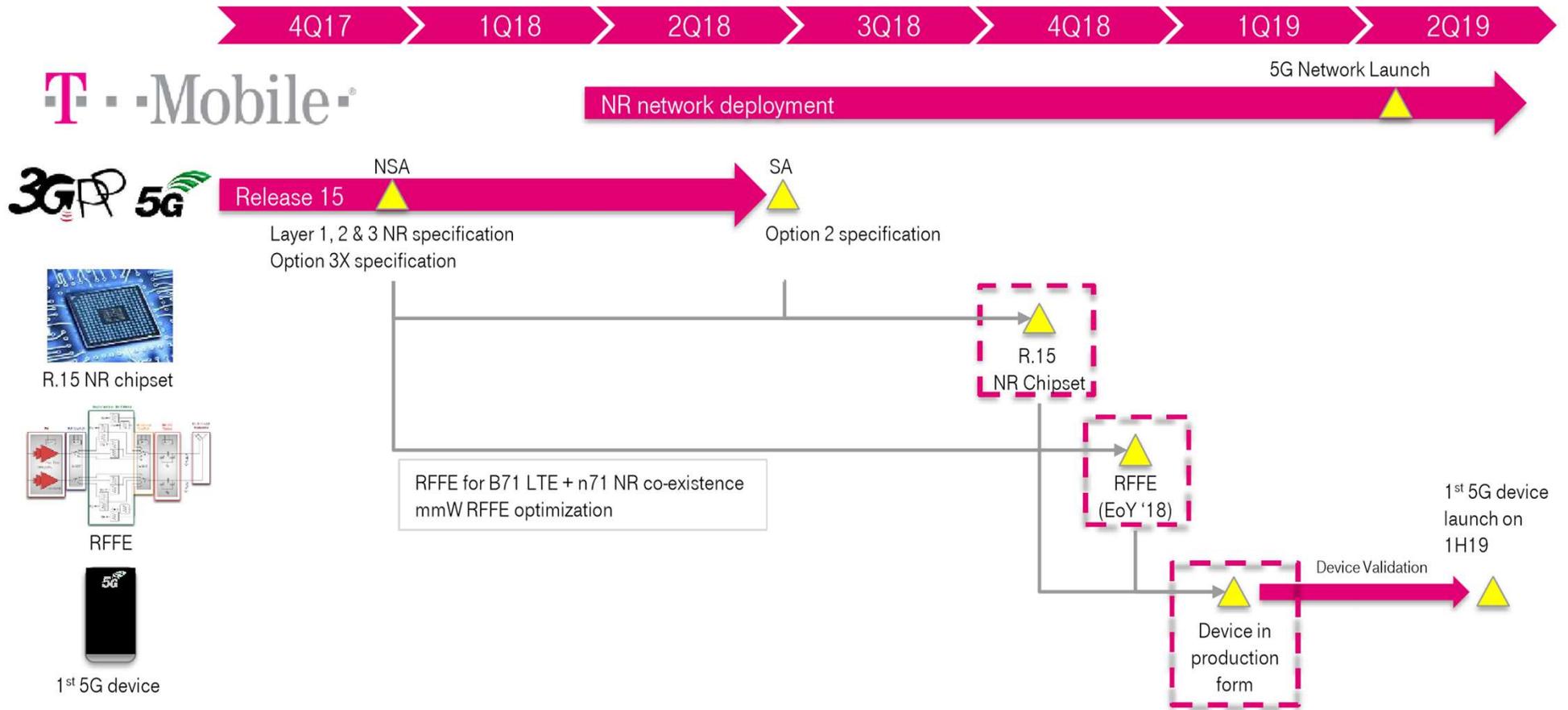
\*SDM 710 – formerly called SDM670

5G

Still in Negotiation

# Target 5G device with 600 MHz launch in 1H '19

Legend:  
NSA: Non-standalone  
SA: Standalone



IoT & 5G



## NETWORK

# Networks to power the future of IoT are here

Built to meet the demands of today and into the future:

- Efficient high and low bands
- Lower costs with more power
- Covers all of North America seamlessly

**2G**

Supported until 2020

### CAT-1

**CAT 1 will allow customers :**

- Up to 10 mbps
- Supports VoLTE and Connected Mobility

### NB-IoT

**Narrowband IoT will allow customers :**

- Deliver products fast
- Provide better coverage
- Vastly improve battery life
- Provide cost savings

### CAT M

Late 2018

**CAT M will allow customers :**

- Up to 1 mbps
- Supports Connected Mobility

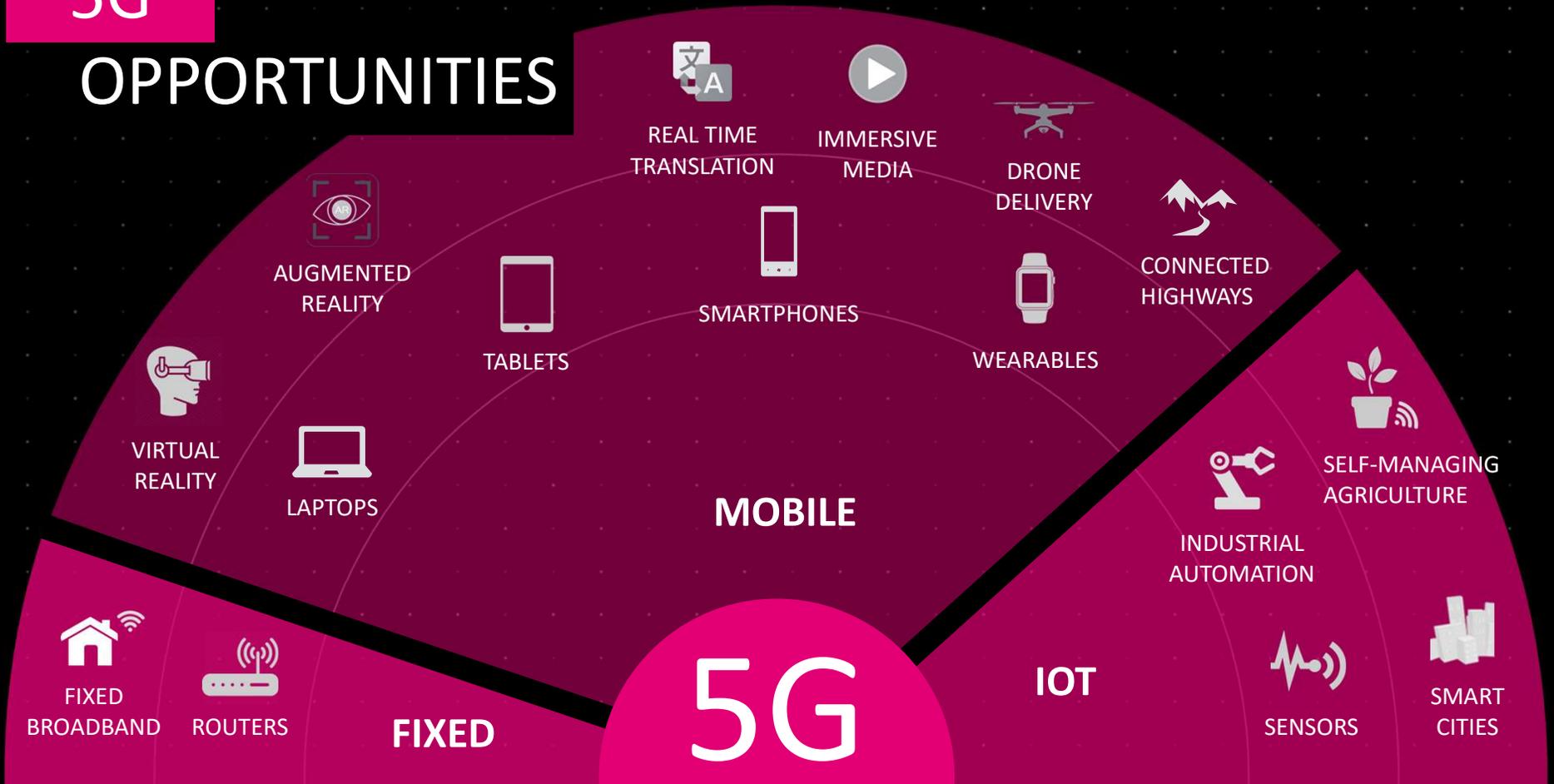
### 5G

**A nationwide 5G mobile network will mean:**

- Lower latency
- Increased battery life
- More simultaneous connections

5G

# OPPORTUNITIES



THANK YOU

T-Mobile®