OCP SUMMIT ’17 ENG. WORKSHOP:
5G: Redefining the Telco Data Center

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OUTLINE

• A Brief Introduction to 5G
• A Brief Introduction to SDN/NFV
• The Telco Data Center
• 5G is Changing the Landscape
• A Power Play
• CONCLUSIONS
• Q & A
A Brief Introduction to 5G

- Market / Motivations
  - The Winds of Change: Global User Shifts = Network Processing Shifts
A Brief Introduction to 5G

• Market / Motivations
  - The Winds of Change: Global User Shifts = Network Processing Shifts

Middle East and Africa will see a dramatic shift from 2G to a market where almost 80 percent of subscriptions will be for 3G/4G.

90 percent of subscriptions in Western Europe and 95 percent in North America will be for LTE/5G by 2021.
A Brief Introduction to 5G

• Why 5G?
  o The Perfect Storm
    ▪ Software-Defined Networking (SDN) / Network Function Virtualization (NFV) / Software-Defined Radio (SDR)
    ▪ cm- & mm-wave Bands with Lots of Bandwidth (BW)
    ▪ Massive Multi-Input Multi Output (mMIMO) / Beamforming
    ▪ Consumer-Driven Hunger for Cheap, Fast Data
    ▪ Hot-Spot Density
    ▪ Intelligent Power Management (IPM)
A Brief Introduction to 5G

• Why 5G?
  o The Benefits Speak for Themselves

Figure 2. Heterogeneous use cases – diverse requirements

IMAGE CREDIT: "5G masterplan - 5 keys to create the new communications era," Nokia, 2016.
A Brief Introduction to 5G

- What is 5G?
  - Everyone Has Their Own Definition

A Brief Introduction to 5G

- What is 5G?
  - Everyone Has Their Own Definition
    - Jury is still out and will be until 2020.
    - South Korea 2018 Winter Olympics
    - Japan 2020 Summer Olympics
  - EXAMPLE: EU 5GPPP’s “Roadmap” to 5G

![5G Roadmap Diagram]

**IMAGE CREDIT:** "The 5G Infrastructure Public Private Partnership: the next generation of communication networks and services," 5G Infrastructure Association, February 2015.
A Brief Introduction to 5G

- What is 5G?
  - In a Nutshell
A Brief Introduction to 5G

- Heterogeneous Networks (HetNets)
  - Small Cells

![Bar chart showing the percentage of small cells deployed in various levels of density from 2013 to 2020.](image)

**Figure 3.** Percentage of small cells deployed in various levels of density 2013-2020

A Brief Introduction to 5G

• Disaggregation
  o Enables Densification
  o Commodity Where You Need It
  o Optimize, Optimize, Optimize

• Mobile Edge Computing (MEC)
  o Bringing Compute to the Edge
  o Buffering Common / Bandwidth Intensive Loads (i.e. – Video Streaming)

• Lots of Cool RF Stuff (outside scope for today)
  o mm-wave
  o mMIMO
  o SDR
A Brief Introduction to SDN/NFV

- The Software-Defined Data Center
  - Pretty self-explanatory, right?

A Brief Introduction to SDN/NFV

- The Software-Defined Data Center
  - Ok, a little more realistically.


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A Brief Introduction to SDN/NFV

- Software-Defined Networking (SDN)

A Brief Introduction to SDN/NFV

- Network Function Virtualization (NFV)

A Brief Introduction to SDN/NFV

• 5G Application: Nice or Necessity?
  o An Absolute Necessity
  o Seamless Sharing Across Base Stations & Networks
  o Network Slicing = Network-as-a-Service (NaaS)
  o Software-Defined Radio (SDR)
  o Service-Based Optimization
The Telco Data Center

• Differentiation from Typical Data Center
  o DC Distribution
  o Back-up Power (i.e. – Uptime)
  o Network Equipment – Building System OR NEBS Requirements (i.e. – More Ruggedized HW)

• Where are the watts being consumed?
  o Intelligent Power Management (IPM)
  o ...more on this later.

• Base station, data center, or both?
The Telco Data Center

• Really Simplified Version
The Telco Data Center

- Really Simplified Version

**Figure 5-4**  **WAN service connectivity to enterprise remote branch network**

5G is Changing the Landscape

• 4G-LTE Has Already Brought SDN/NFV to Telco Networks

• Small Cells
  o Cell Network Virtualization?!? (i.e. – Bunch of Small Cells Become a Giant HetNet)
  o Network Slicing

• MEC Shifts Utilization
  o Buffering at the Edge...more on this in a moment.
A Power Play

• MEC Potential for Massive Power Savings
  o Base Station Caching
  o Tricking the Consumer Into Footing the Bill
  o EXAMPLE: Is Grandma okay?

“Don’t worry, I’m 1. Oh wait, or am I 0?!?”
A Power Play

- Small Cells Yield Energy Independence
  - Microgrids
  - Fault-Tolerance
  - Energy Harvesting

- Disaggregation Simplifies Optimal Utilization
  - Bringing Steady-State to Dynamic Load Schemes
  - Put Stuff to Sleep
CONCLUSIONS

• There is a lot of agreement on what 5G should be, but not as much on what it is and when it will fully come to fruition.

• The base station is becoming the data center.

• IPM is the key to enabling 5G!

• SDx / Vx is an integral part of the 5G data center / network and is here to stay.

• Architectural & operational shifts to the telco network will yield many paradigm shifts in power utilization.
Q & A

Thanks for your attention!!!

Questions/Comments???
REFERENCES

• "5G masterplan - 5 keys to create the new communications era.," Nokia, 2016.
• "5G: 5 keys for creating the new communications era," Nokia, 2016.
• "The 5G Infrastructure Public Private Partnership: the next generation of communication networks and services.," 5G Infrastructure Association, February 2015.