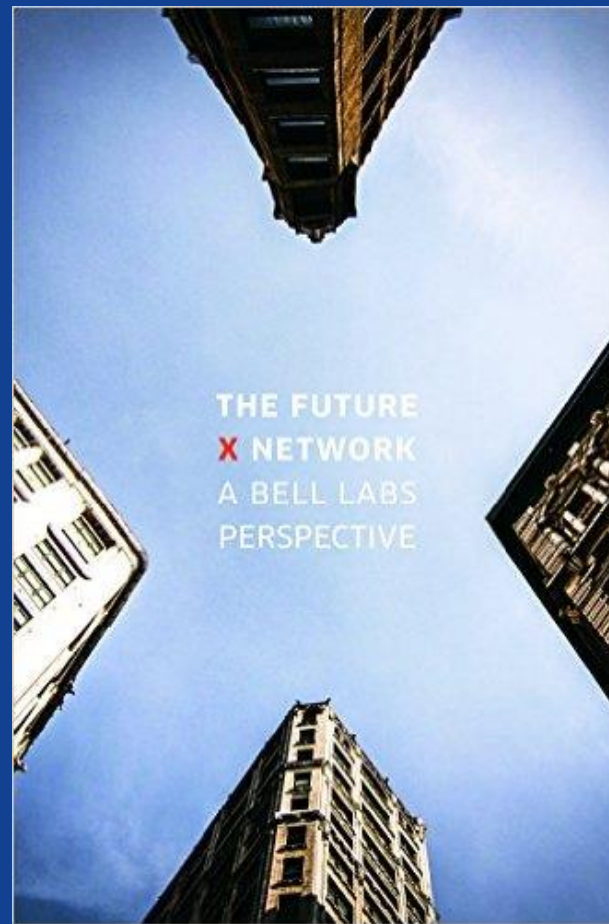


# The Future X Network: Digital fabric of the future

Marios Nicolaou  
Senior Director, Bell Labs Consulting





# The Future after the Future

# Central Thesis – A once-in-100-years inflection point in network design

100X more capacity; 100X lower latency; new value creation enablers

- Networks are at the heart of all technology revolutions
- Today's networks not designed to meet the needs of the new technology revolution
  - Connecting people vs. Understanding everything to enable remote control and automation
- Challenge to fill the gap is further compounded by three barriers
  - Physics (latency limited by speed of light barrier for signal propagation)
  - Mathematics (channel capacity limited by Shannon limit)
  - Economics (monetization from consumer segment limited by consumer wallet)

**Radically new architecture is inevitable for the FutureX network**

# How do we prepare for the new technology revolution – lessons from the past

Technology Revolution	Enabling Technology Innovations	Network
Agricultural & Financial (1600 – 1740)	Stocks & Bonds	Banking & Stock Market Infrastructure
1 <sup>st</sup> Industrial (1780 – 1840)	Steam Engine & Iron Production	Rail and Shipping Networks
2 <sup>nd</sup> Industrial (1880 – 1920)	Steel & Chemicals	Extended Transportation Networks Electricity & Telecom Networks
Scientific-Technical (1940 – 1970)	Analog & digital signal processing	Digital Communications networks
Information (1985 – 2015)	The Web, Cloud computing & Mobile devices	Internet & Broadband Access
Automation of Everything (2015 –)	Digital interfaces & Data analysis	<b>Cloud Integrated Network</b>

**We need to re-think the role of our networks (public and private) for the new era**



1

**Rise of the Machine**



2

**Emergence of the Enterprise**



3

**Move to the Edge Cloud**



4

**Evolution to Cognitive Operations**



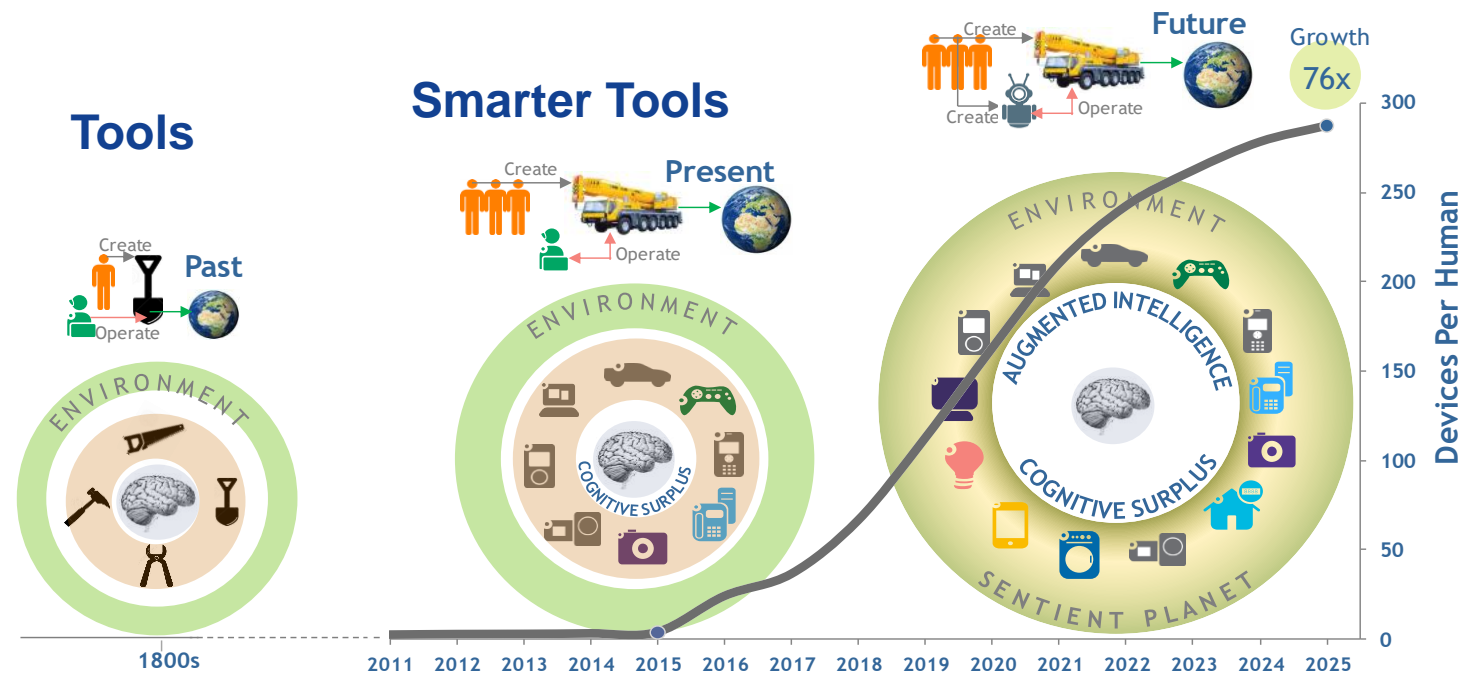
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**Confluence of Networks**



# Rise of the Machine is inevitable to defy Malthusian prophesies again

## Ever Smarter Autonomous Tools

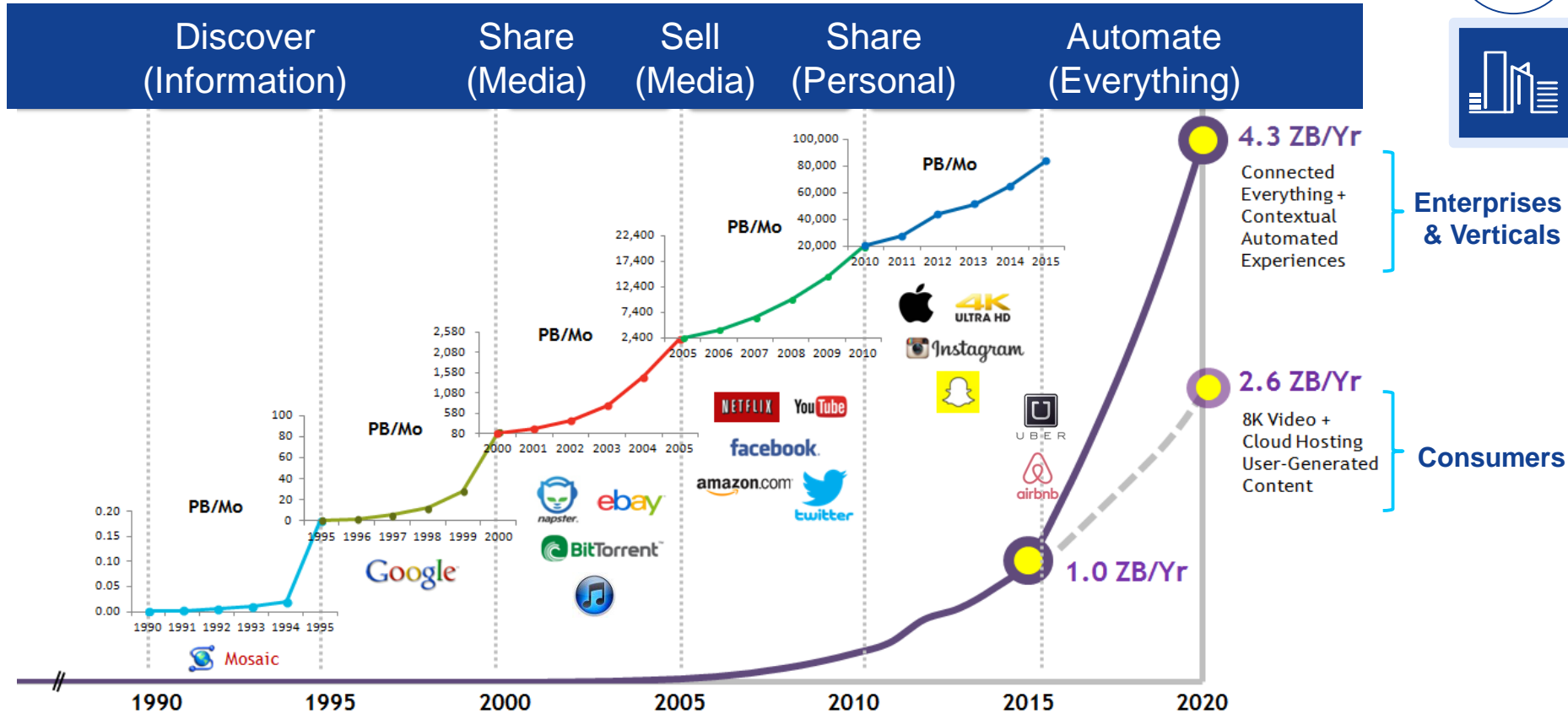


 **Bell Labs Innovation: DeepX**

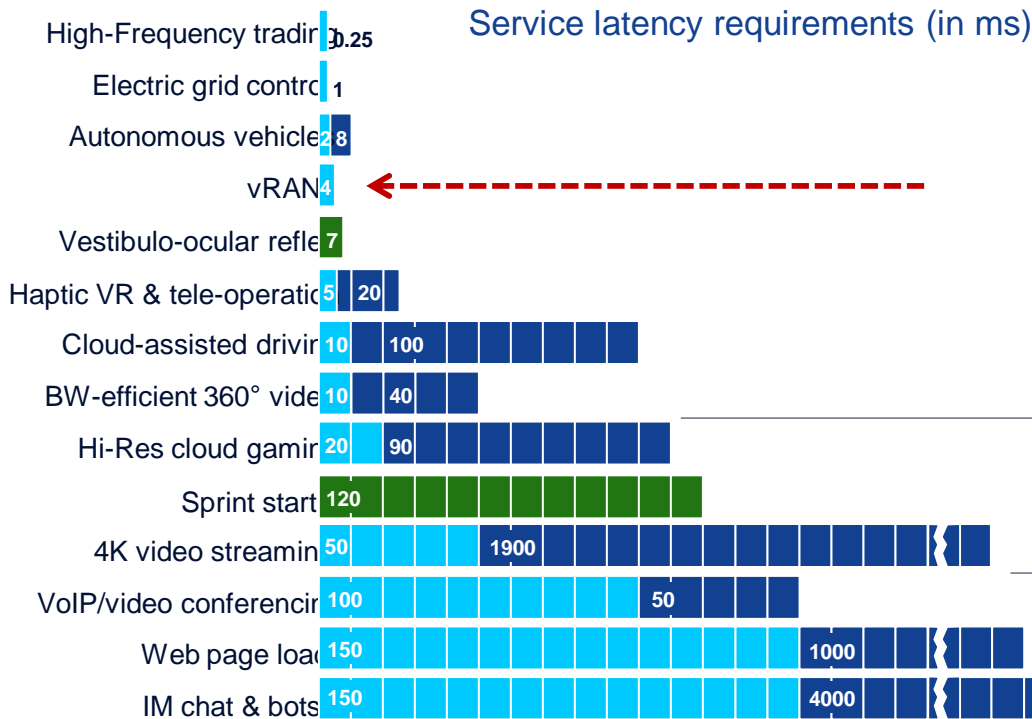
**From Mechanical Advantage to Cognitive Advantage**



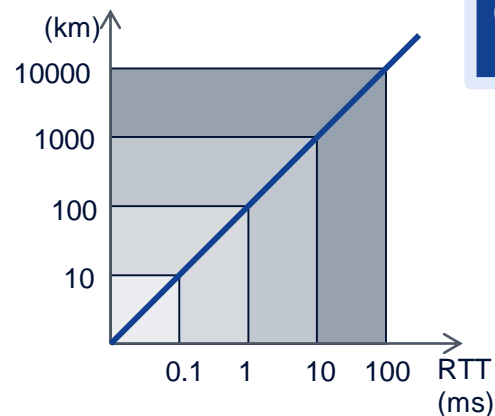
# Emergence of Enterprise as the new growth engine



# FutureX Network – Latency matters



Light propagation time

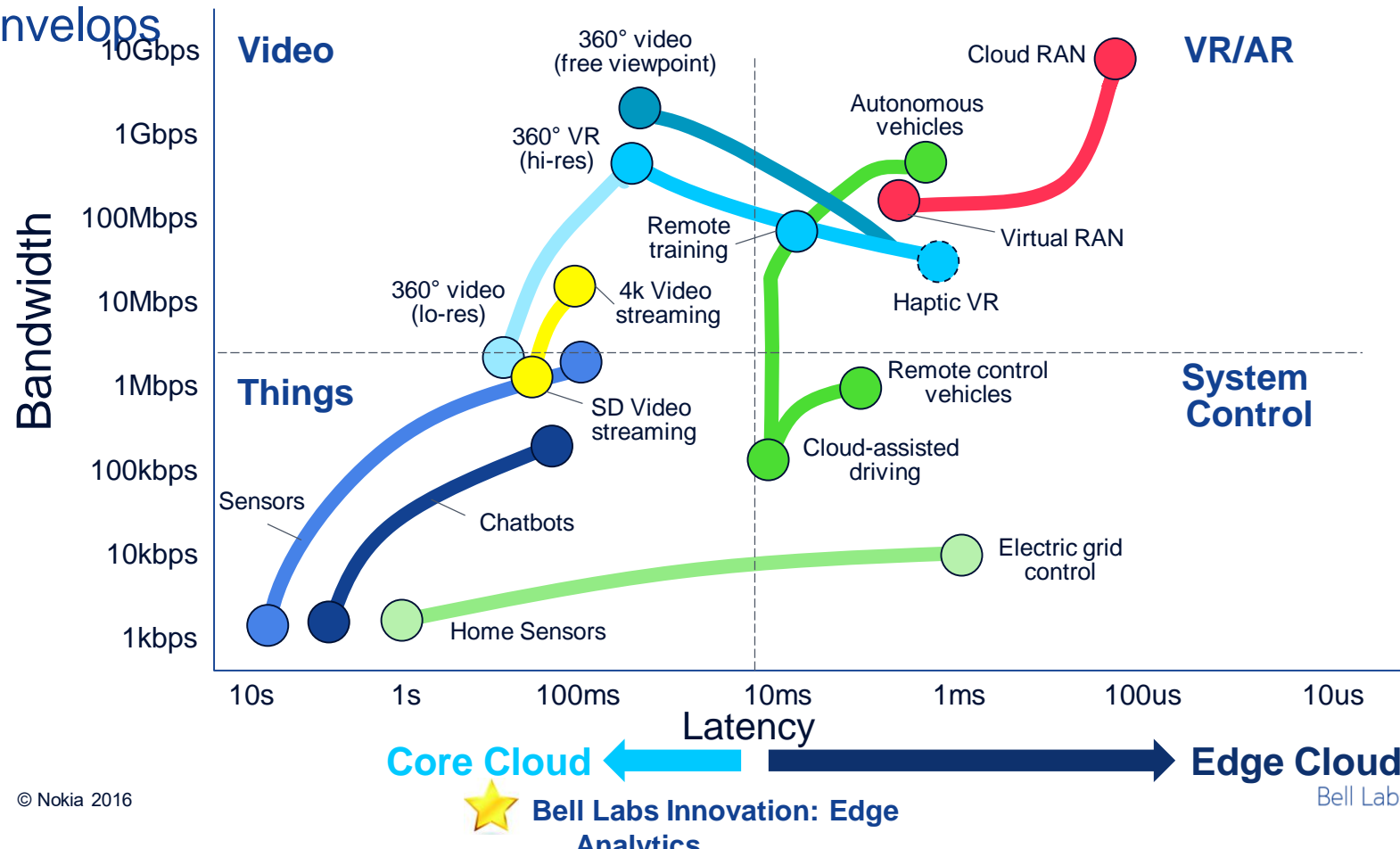


- Max tolerable networking delay
- Max application delay for processing
- Human response times (for reference)

**Laws of Physics → the need for a more distributed cloud**

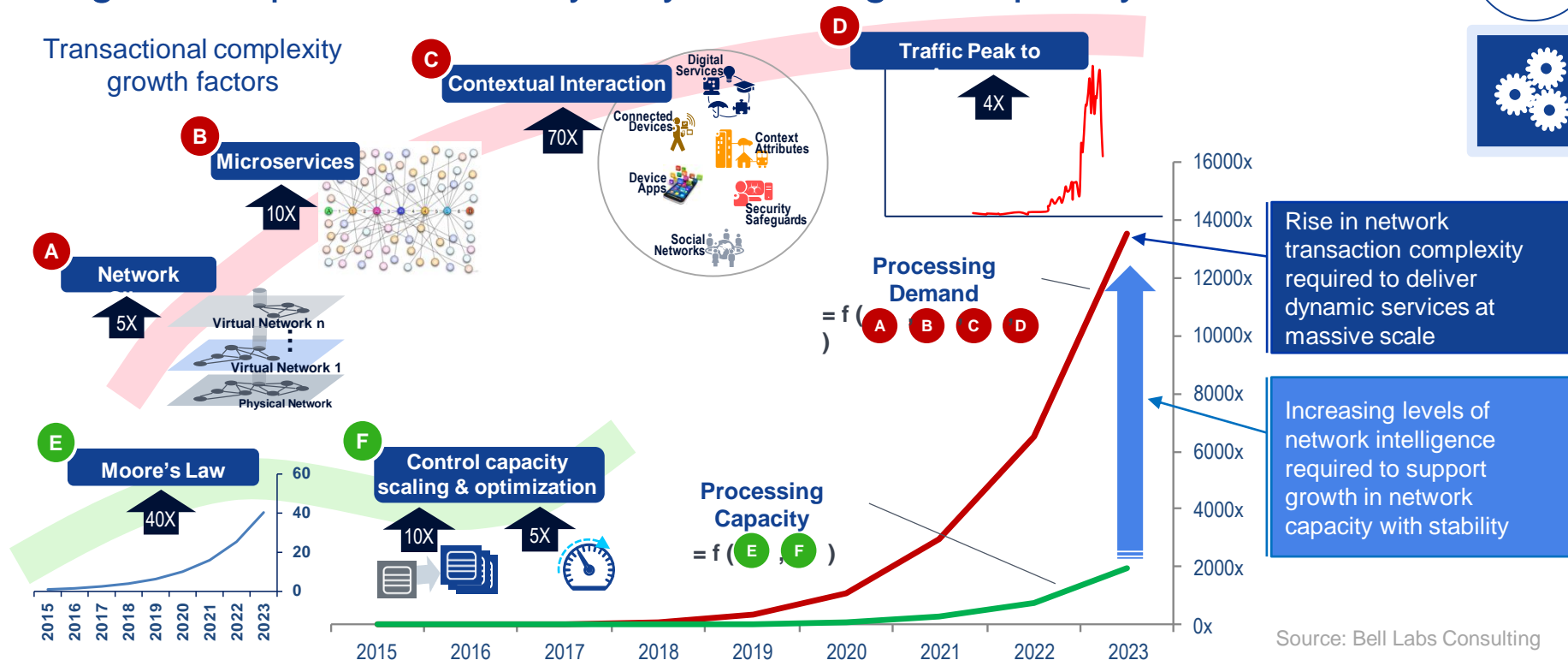


# New applications and demands – stretching bandwidth and latency envelopes



# Cognitive Operations – only way to manage complexity

Transactional complexity growth factors

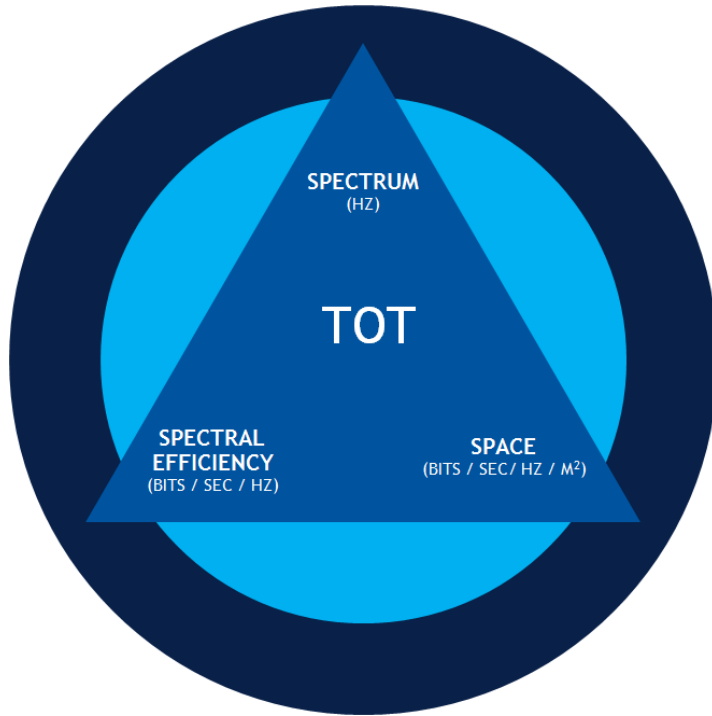


**Smart Digital Network Fabric = Predictive and Proactive Operations**

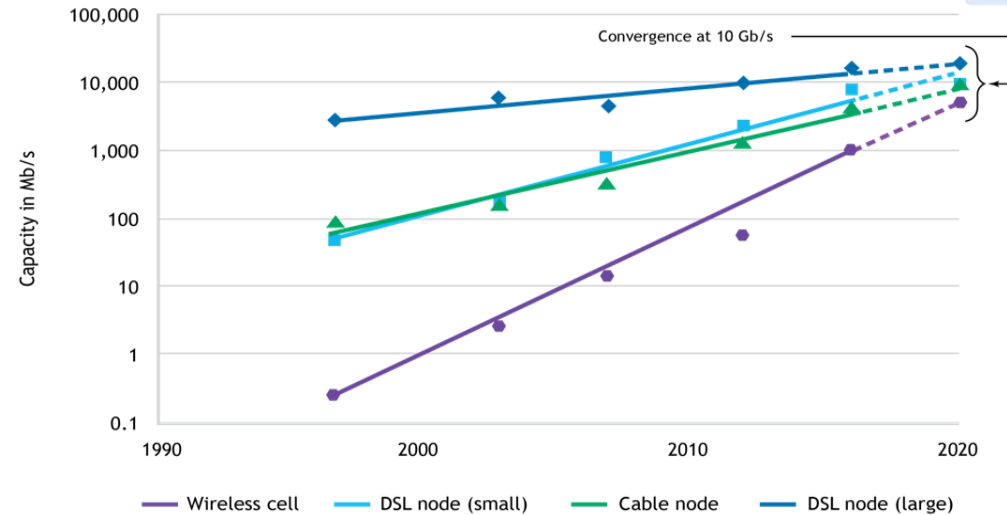


# Confluence of Networks – A techno-economic inevitability

5



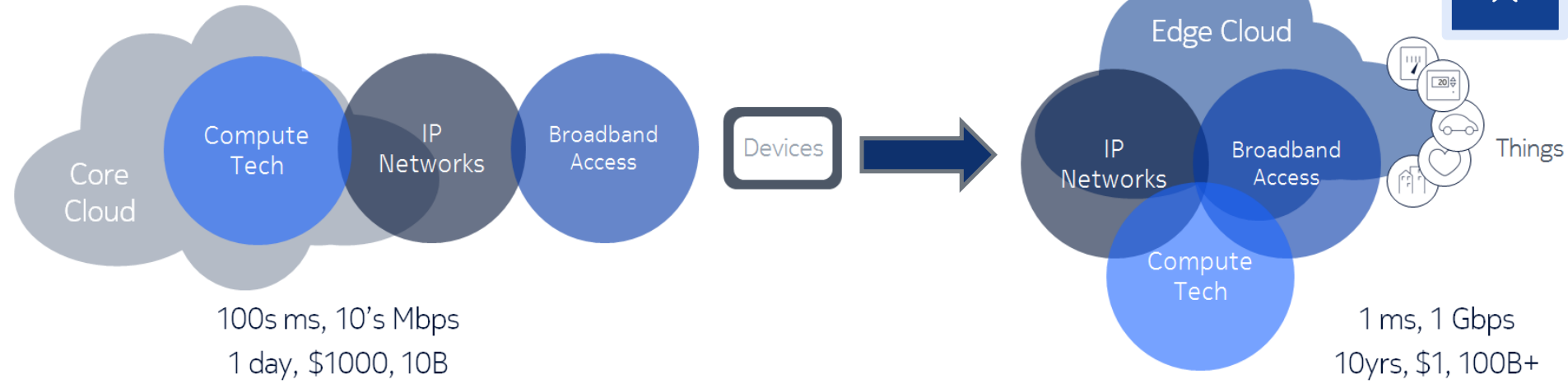
## Example – Converged Distributed Access Network



**Network Confluence – fixed and wireless; IP and Optical; consumer and enterprise; ...**

# Confluence of Networks – A techno-economic inevitability

5



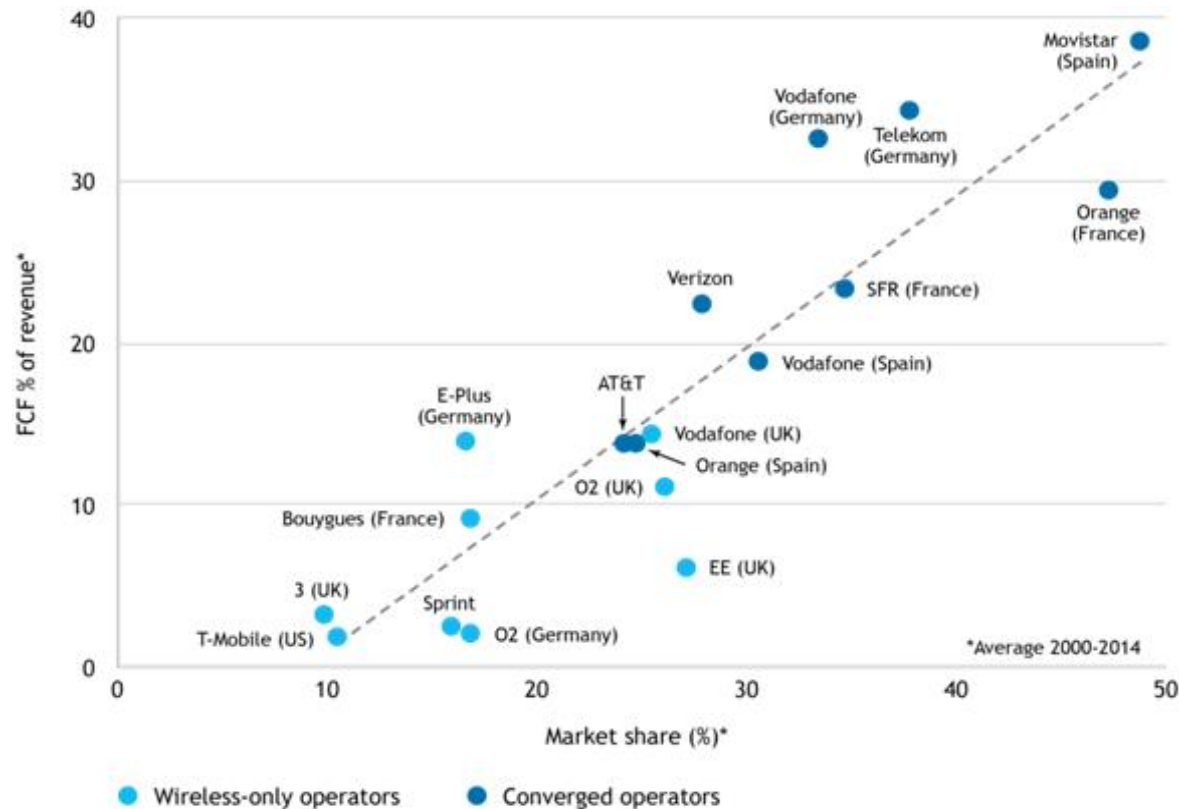
Aided by Virtualization and  
Software Defined Networking

**Cost + Performance + Agility → Confluence of Networks (& Cloud)**

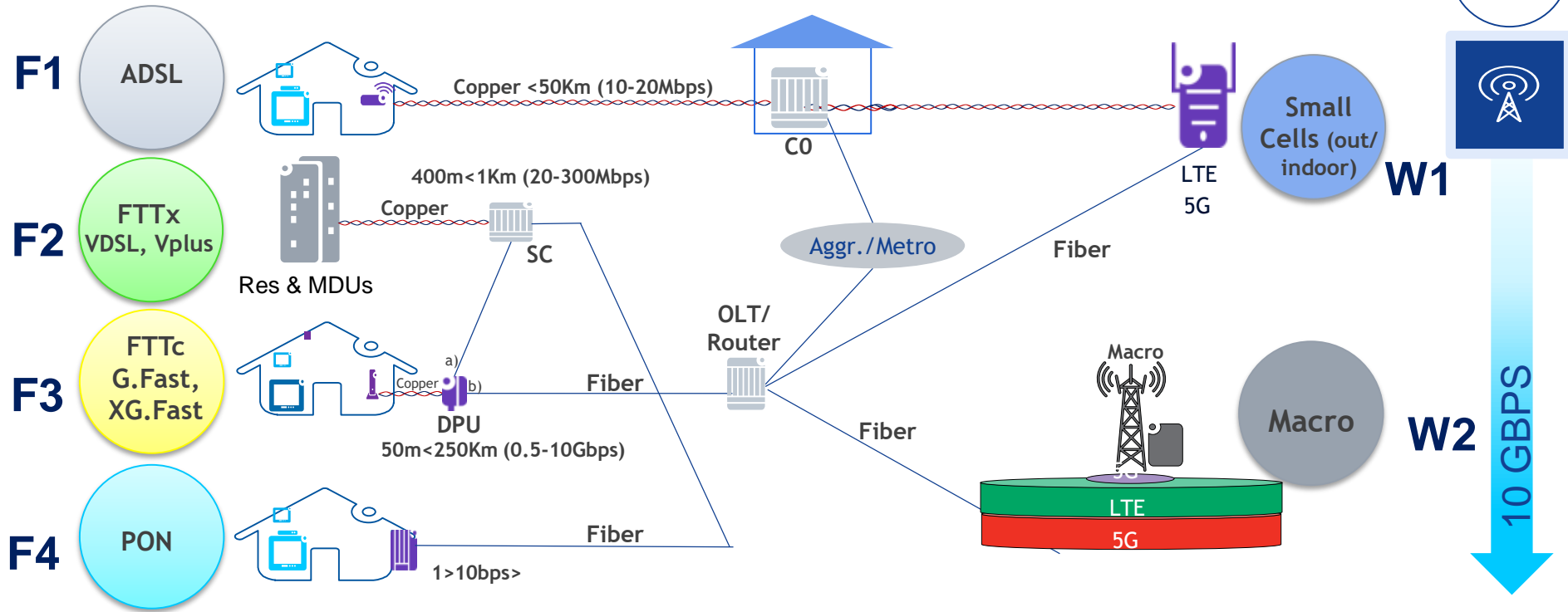


### Recent M&A Activity

Mobile Network Operator	Consolidation / Convergence
O2 Telefónica (Germany)	E-Plus
VF (Germany)	KDG
VF (Spain)	Ono
EE (UK)	BT
3 (UK)	O2 UK
Orange (Spain)	Jazztel
Liberty Global	Base
Charter	Time Warner
Altice	Suddenlink
Altice	Cablevision T-Mobile ?



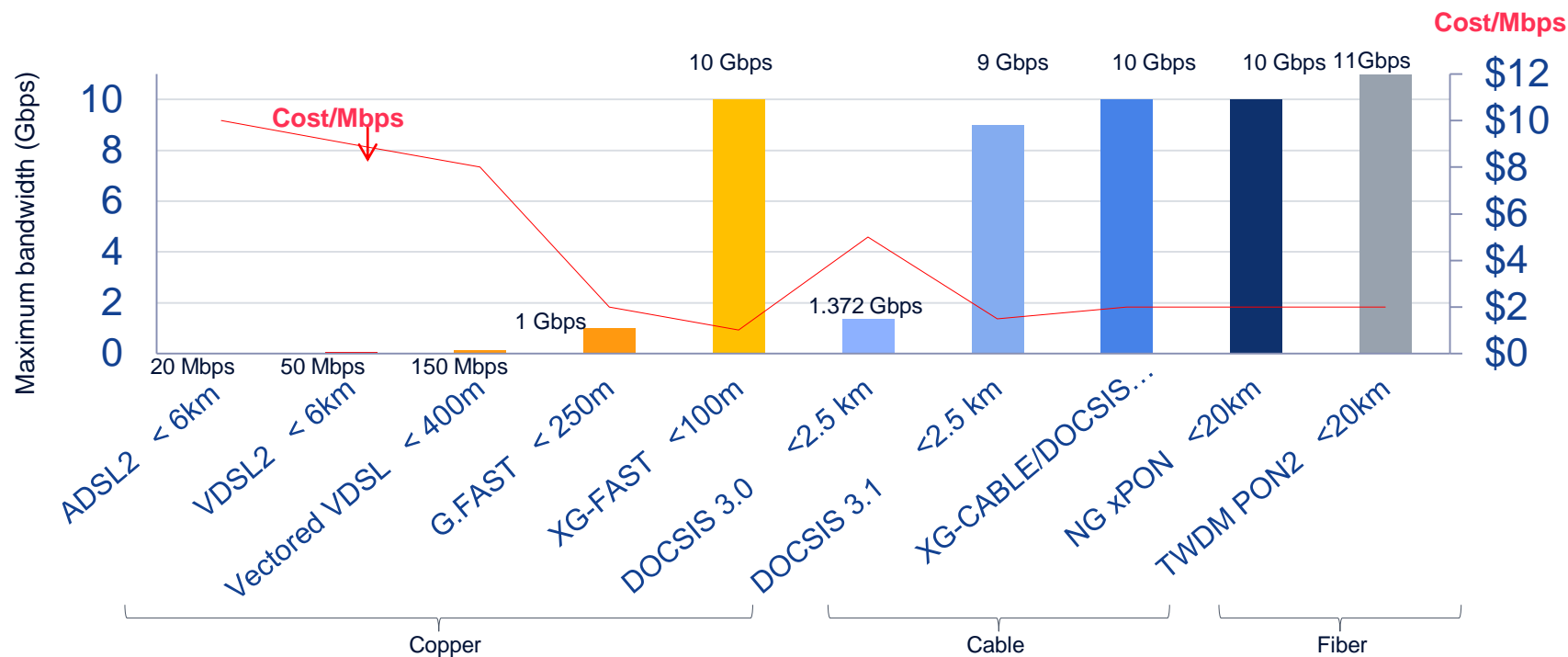
# Hybrid-Access network vision for the 2020 Telco



Selection of Technologies is Driven By Economics



# Comparing maximum cable, fiber, copper data speeds (downstream) and cost

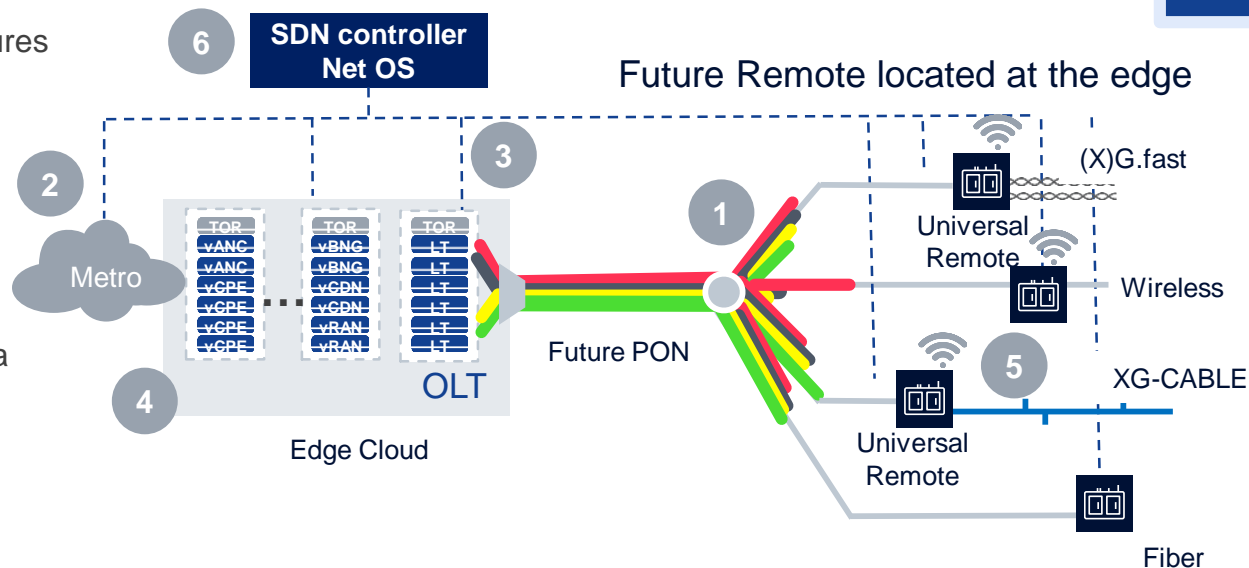


# Evolution to future converged access architecture

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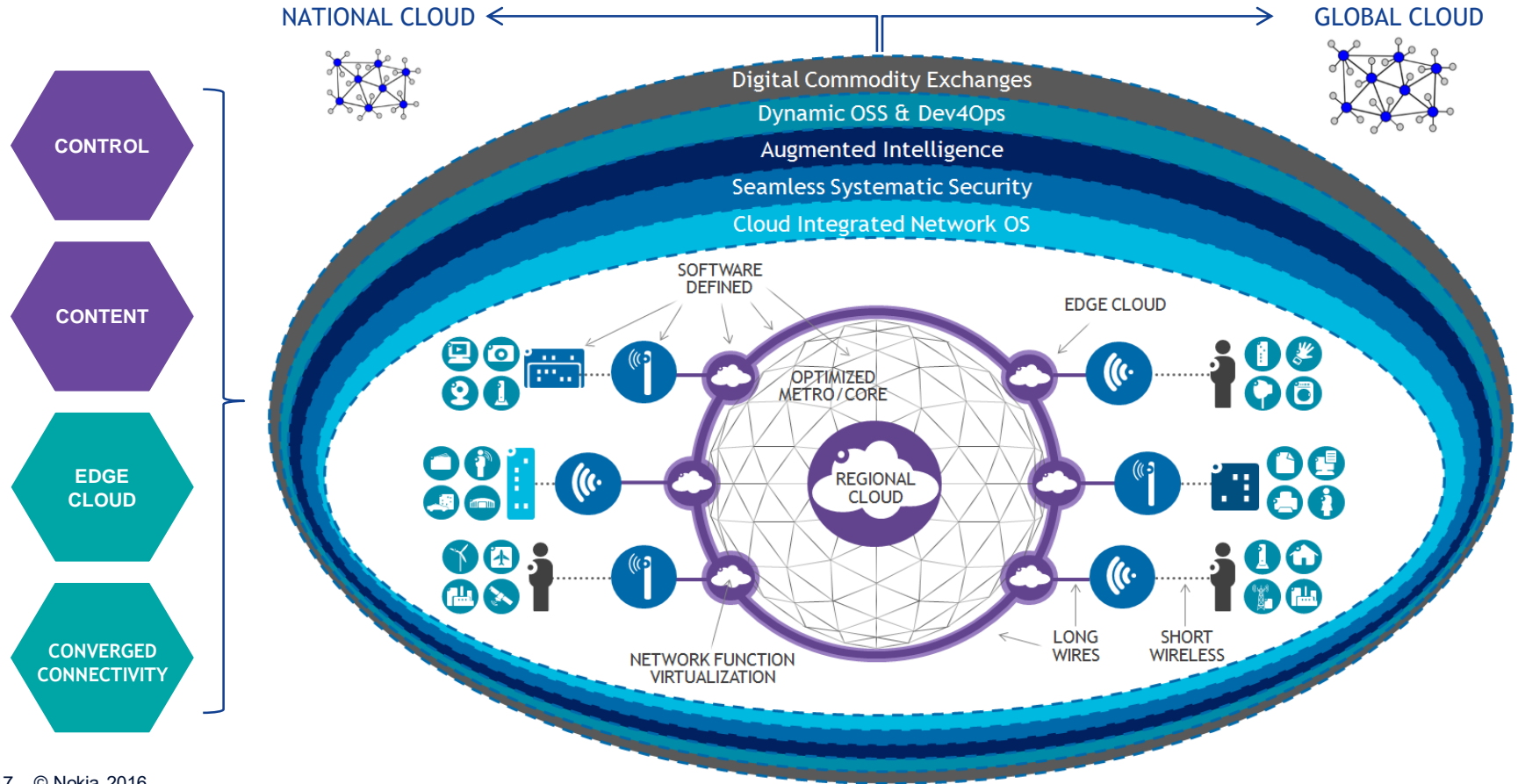
- 1 Deploy deep fiber DAA architectures
- 2 Transform to all IP services
- 3 Virtualize access functions
- 4 Move to edge clouds
- 5 Deploy wireline and wireless on a common platform
- 6 Automate operations



**DAA platform is consistent with Future X vision and Bell Labs' Future Remote**



# Future X : The Value Vectors for the Winning Architecture



**NOKIA** Bell Labs