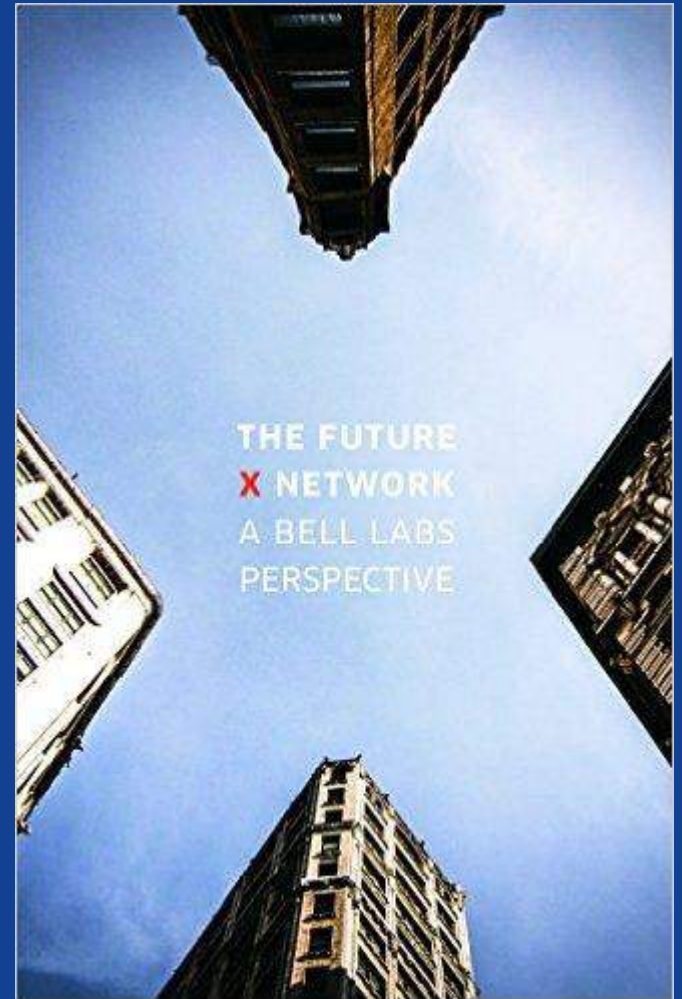


Future X: Building the digital networks, systems and platforms for the automation of everything and the creation of time

Marcus Weldon

President of Bell Labs & CTO of Nokia



The revolution

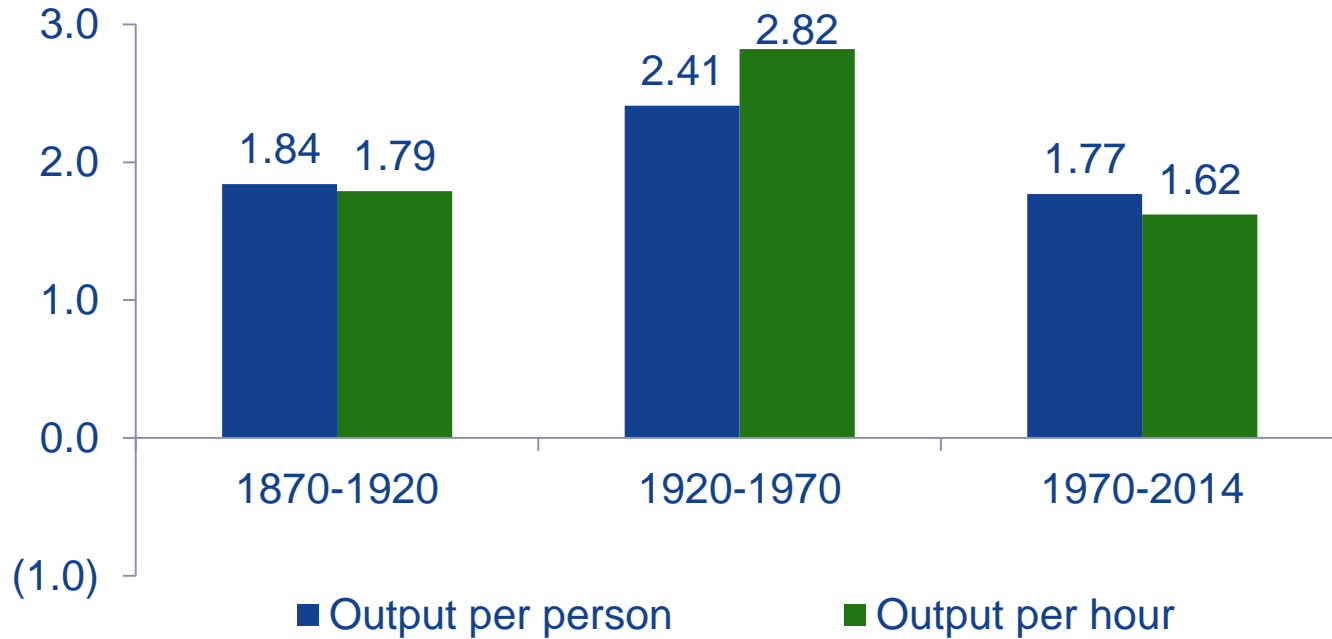
Technological Revolution (def):

Interconnection of new systems and technologies + capacity to profoundly transform economies & society

Tech. Revolution	Enabling Technology	Connectivity
Financial (1600 – 1740)	Stocks & Bonds	Banking & Stock Market Infrastructure
1 st Industrial (1780 – 1840)	Steam Engine & Iron Production	Rail and Shipping Networks
2 nd Industrial (1880 – 1920)	Steel & Chemicals	Extended Transportation Networks Networks
Scientific-Technical (1940 – 1970)	Analog & Digital Signal processing	Digital Communications Networks
Information (1985 – 2015)	The Web, Cloud computing & Mobile	Internet & Broadband Access
Automation of Everything (2015 –)	Digital interfaces & Data analysis	Future X Network

We are
here

The quest for digital value



Source: Robert Gordon, The rise and fall of American growth

The end and the beginning

		Past/Present	Future
Business	Solutions	Technology-driven	Human/Business-driven
	Driver	Consumer (GB)	Industry (BW, Latency, SLA)
	Innovation Speed	Per decade (new services)	Per day (new apps)
Technology	Architecture	Heavily Centralized (100ms, 10M)	Massively Distributed (1ms, 1G)
	Flexibility	Limited (Provisioned)	Large (Software definable)
	Sharing	Static and Limited (HW VPNs)	Dynamic and Infinite (SW Slices)
Industry Dynamic	Investment	Singular (Operator only)	Multiple & Cooperative (Many contributors/new players)
	Standards	Definitive	Iterative
	Partnership	Limited w/APIs	Co-design w/Open specs

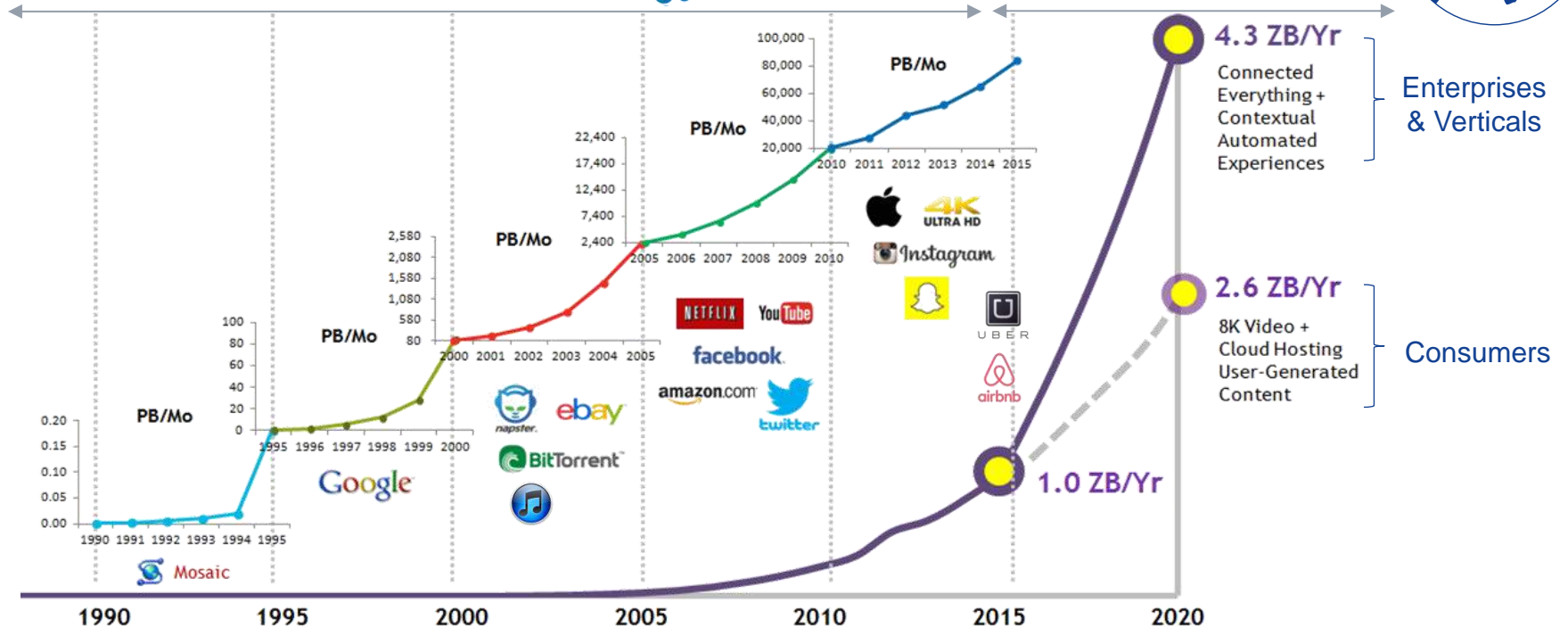
We are here

The new digital era

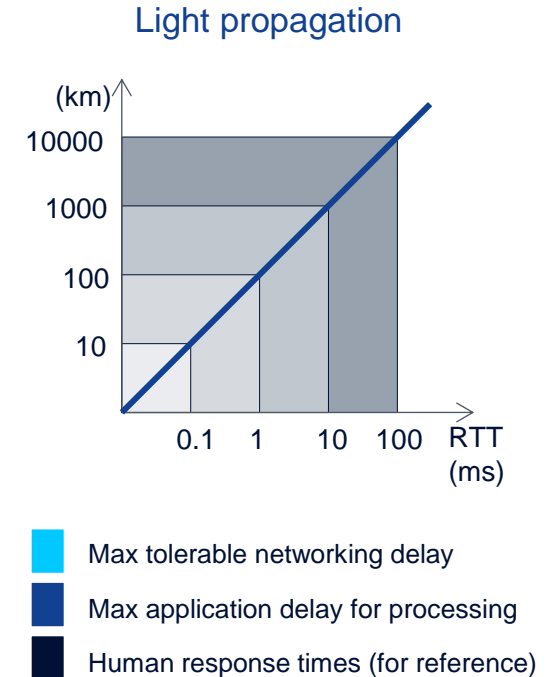
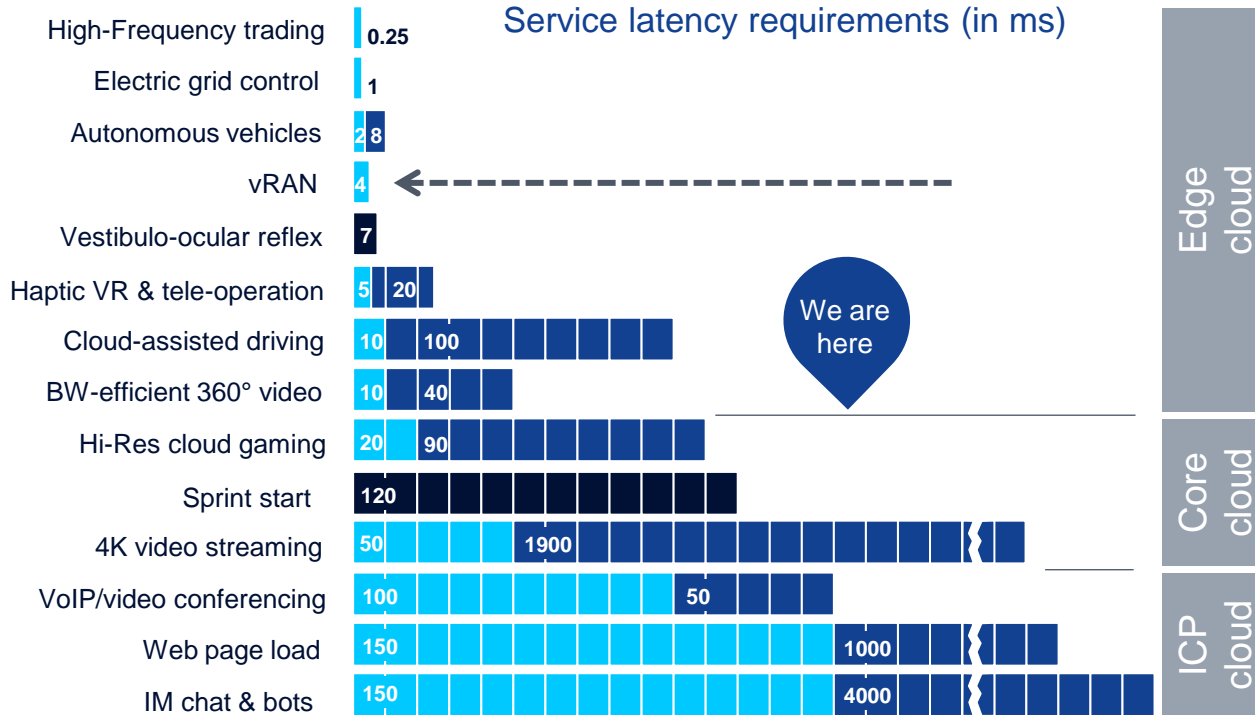
Digitization, delivery & sharing of:



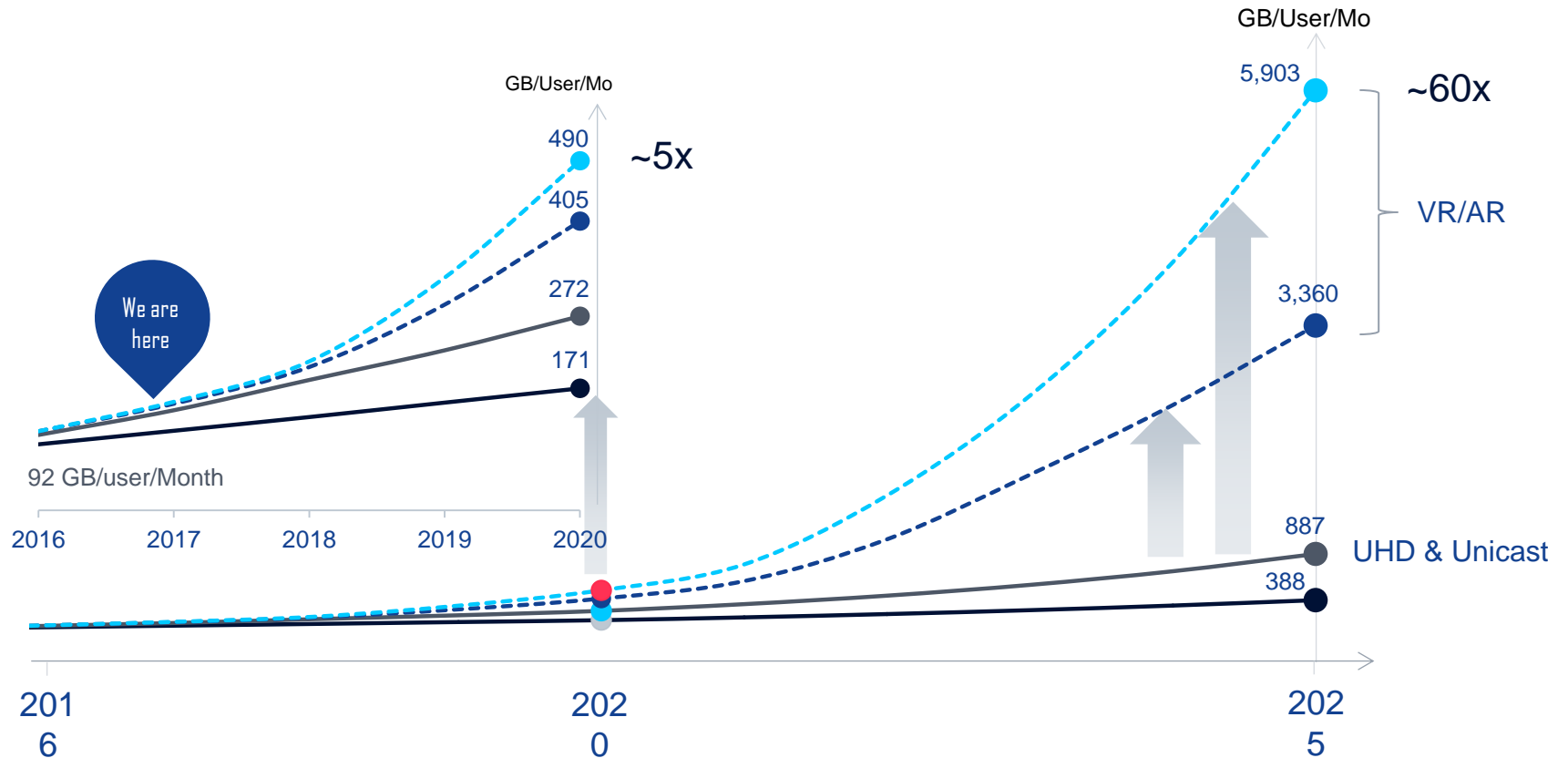
Digitization, distribution & optimization of:



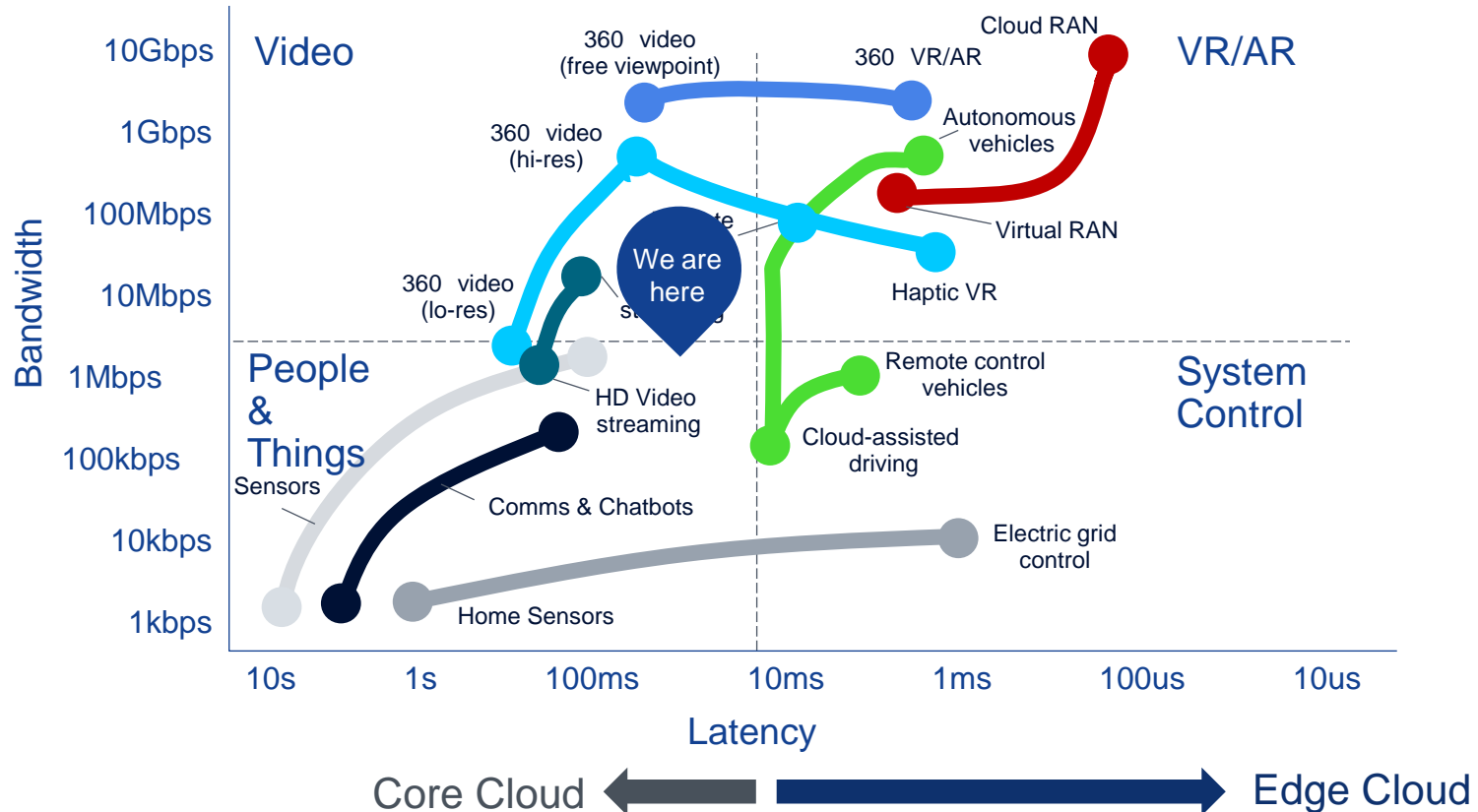
Latency matters ...



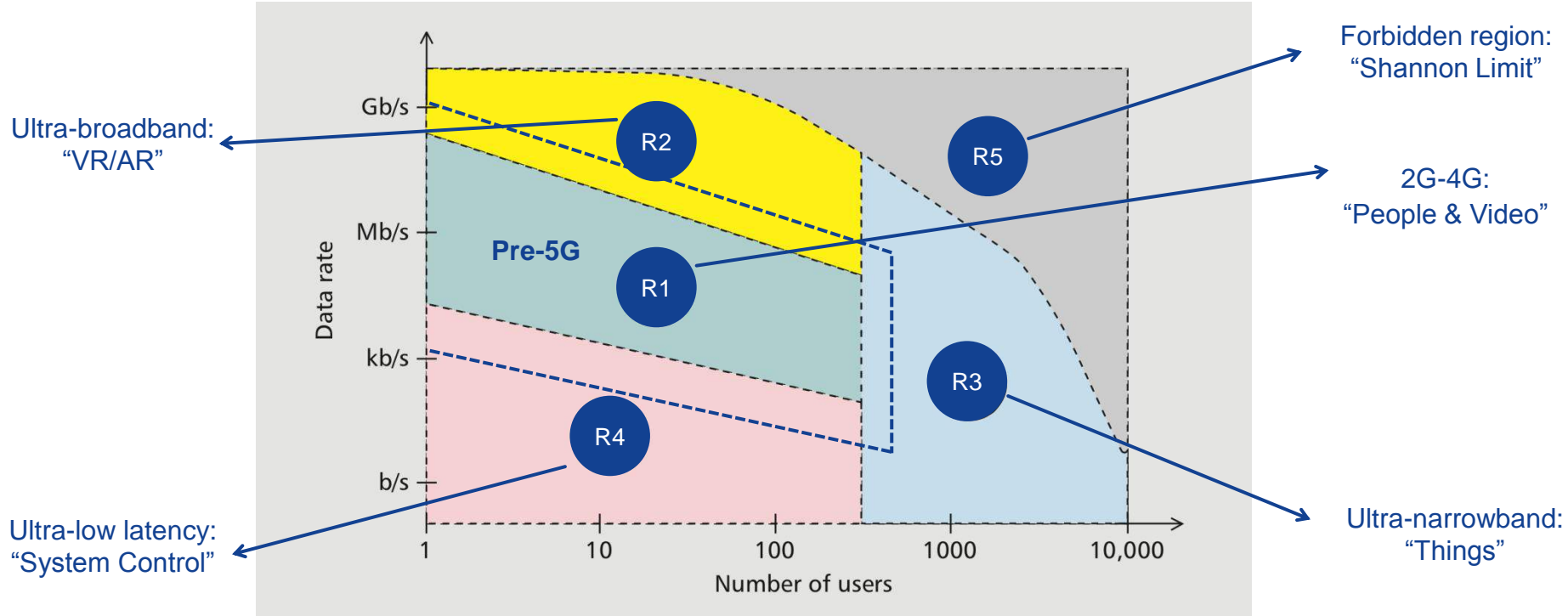
Bandwidth matters ...



Latency & bandwidth matter ...



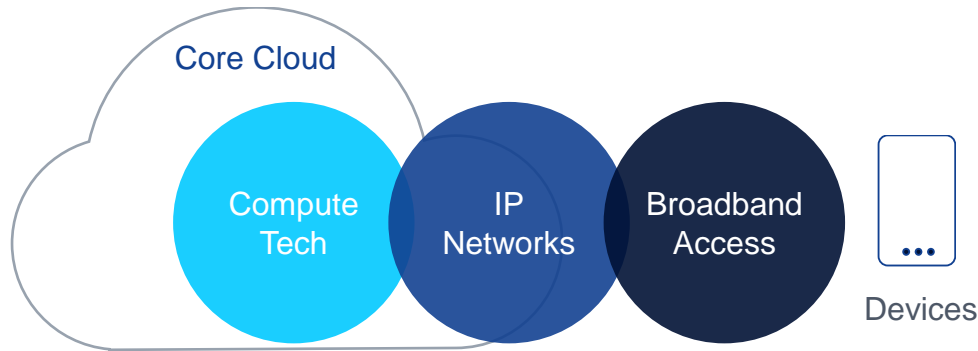
A word on 5G ...



F. Boccardi, Bell Labs, IEEE Comms. Magazine, 201402

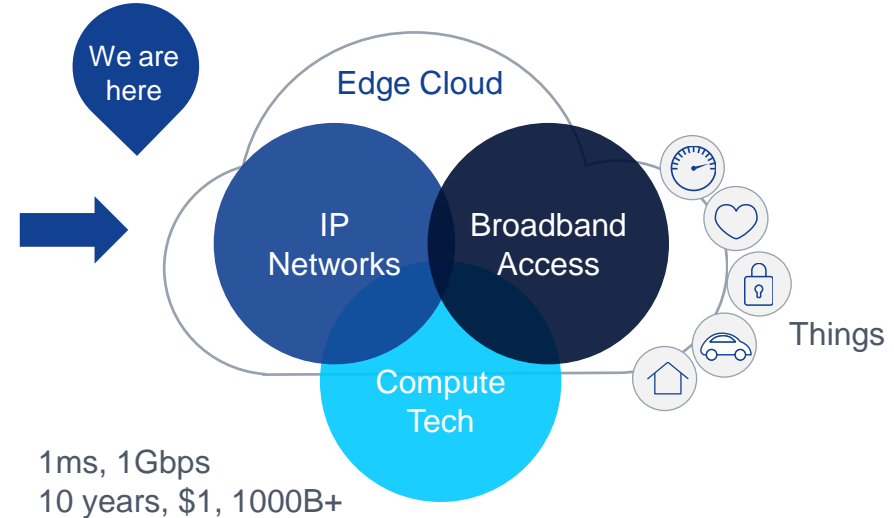
Summary: The 100yr, 100x shift

Enabled by: Global reach and power; SW platforms for business model disruption, stability, non-privacy preserving & inadequately secure



100s ms, 10's Mbps
1 day, \$1000, 10B

Enabled by: Local real estate, fiber, trust, optimized HW/SW network platforms, programmability, privacy preserving, & secure




1ms, 1Gbps
10 years, \$1, 1000B+

The 8 domains of the new digital reality

Massive Scale Access

1

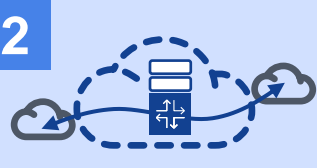


Massive MIMO
Scalable Remote

The creation of ultra-small and ultra-close access nodes

Converged Edge Cloud

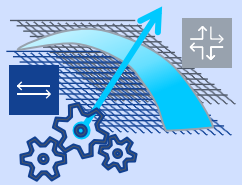
2



The emergence of the edge cloud for low latency and high performance

Smart Network Fabric


3



Creating dynamically reconfigurable IP + optical metro and core networks

Universal Adaptive Core

4

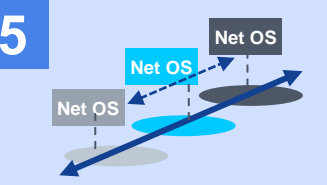


Access-agnostic core for seamless user experience

Network attach
Session mgmt.
Policy control

Programmable Network OS


5



The emergence of the network OS to enable programmability and network federation

Augmented Cognition Systems

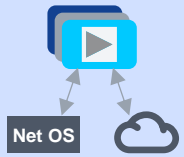
6



Pervasive cognitive capabilities for operating networks & systems

Digital Value Platforms

7



Digital value platforms augmented by advanced network capabilities

Dynamic Data Security

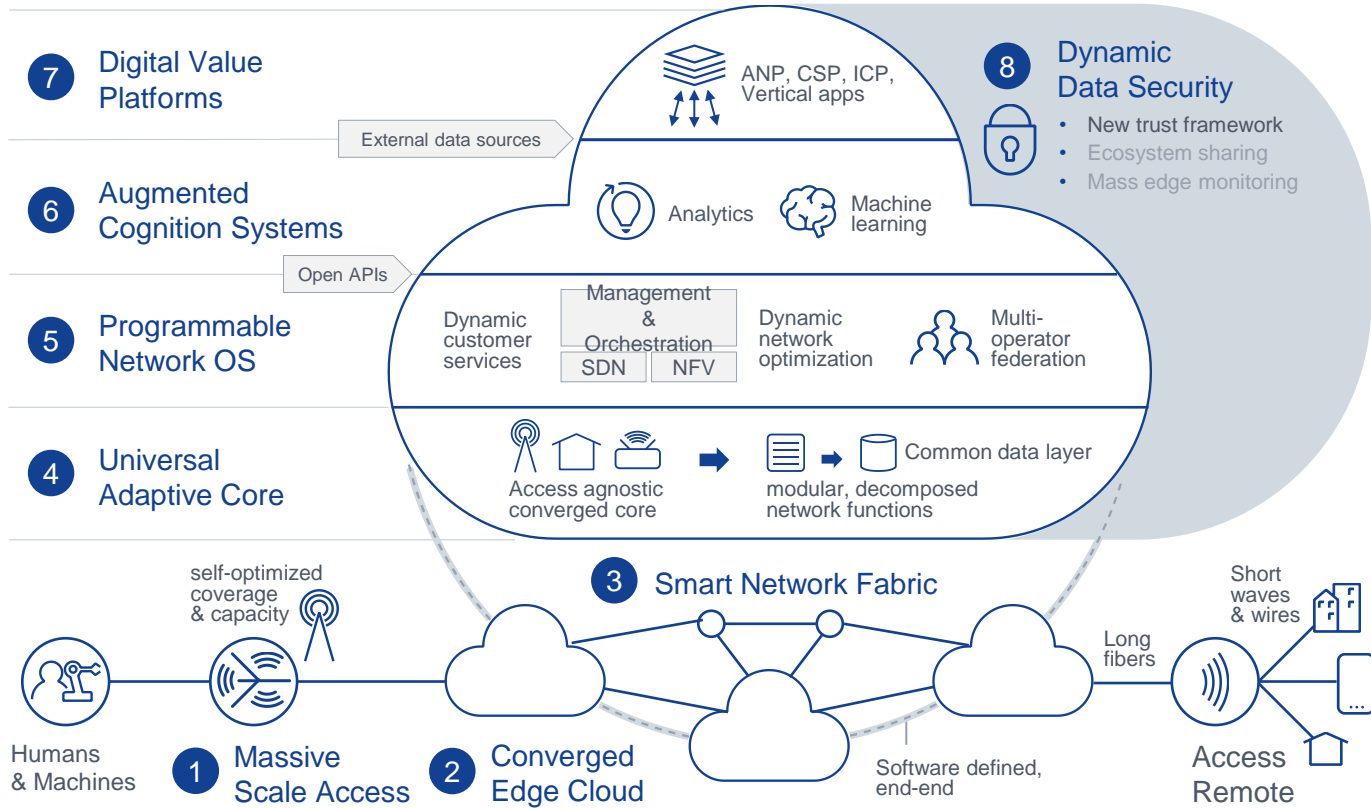
8



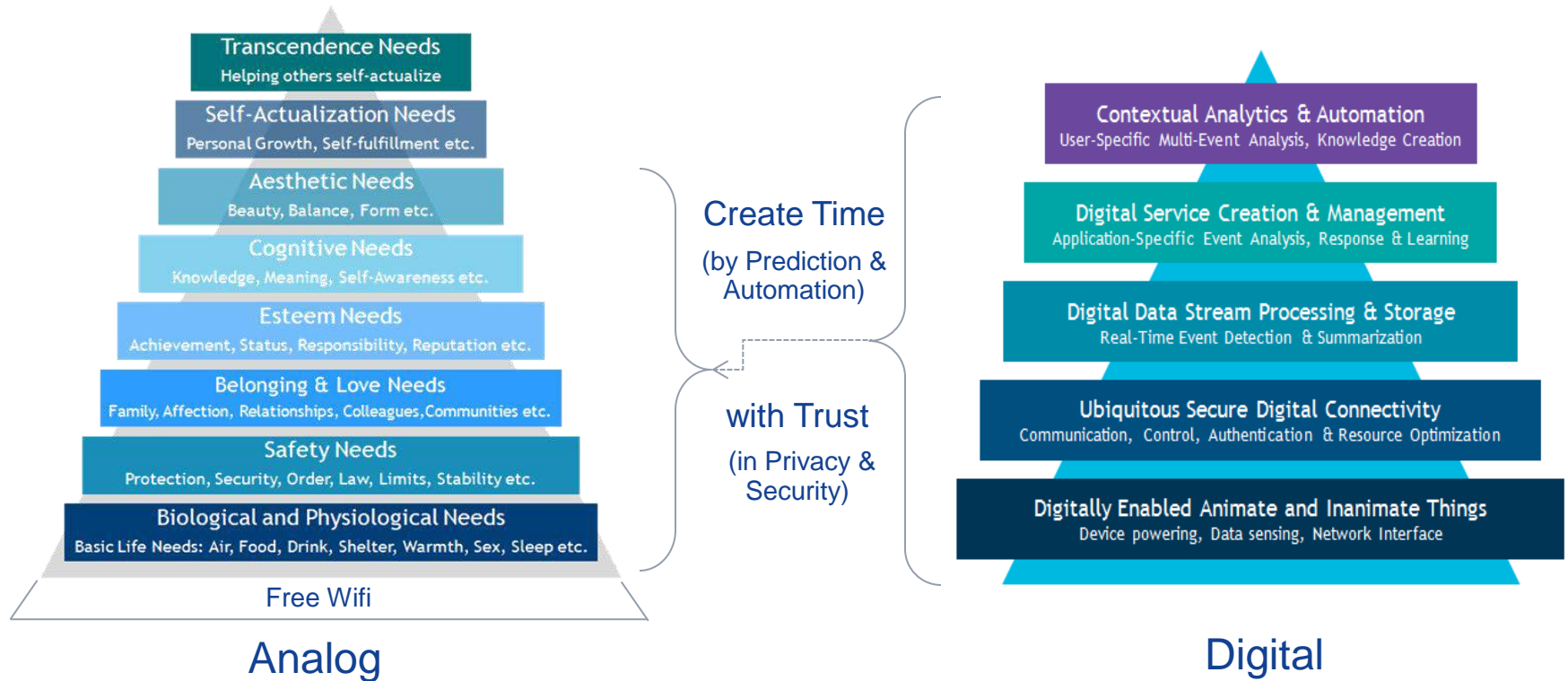
The emergence of new trust models & security architectures

Adaptable Security
Digital Trust

The New Architecture



The New Value (1): Time (& Trust)



The New Value (2): Global-Local Equilibrium

Local Forces

Optimized **Delivery** of
Digital Content

Trusted Brand
Relationship

Personalization

Personal **Privacy**
Protection

Economies of **Secure**
Network Platform



Global Forces

Optimized **Discovery** of
Digital Content

Massive
Brand Power

Generalization

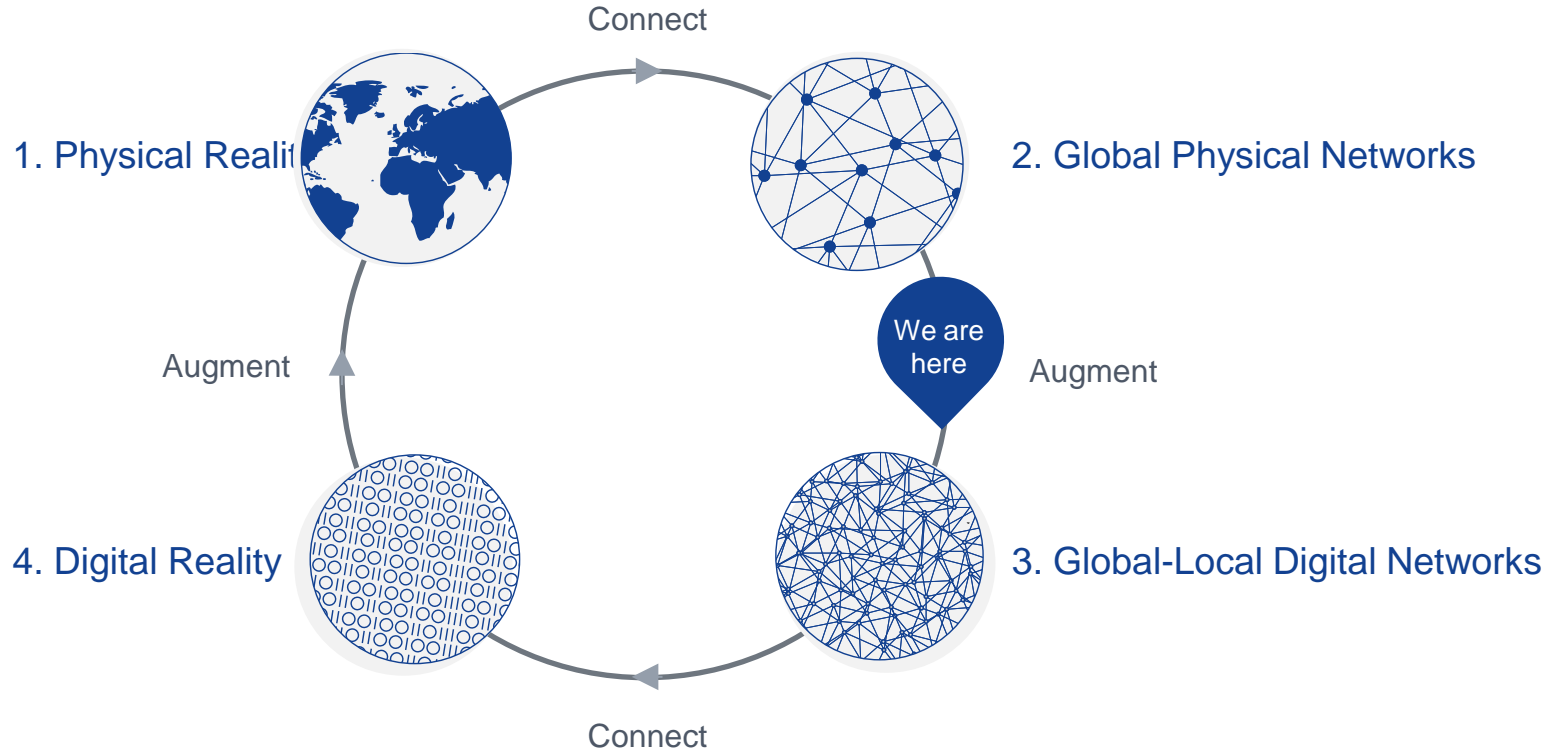
Personal **Data**
Monetization

Economies of **Cloud**
Platform Scale

The New Value (3): Digital Value Platforms

<p>Media & entertainment</p>  <p>Needs</p> <ul style="list-style-type: none">- Massive scale content delivery- Dynamic bandwidth control	<p>Data & knowledge discovery</p>  <p>Needs</p> <ul style="list-style-type: none">- Global network coverage- Immediate response	<p>Comms, commerce, context & Content</p>  <p>Needs</p> <ul style="list-style-type: none">- Global network coverage- Uplink capacity for sharing	<p>Vertical & infra automation</p>  <p>Needs</p> <ul style="list-style-type: none">- Tera-scale access and core- Network slicing for verticals
<p>VR/AR</p>  <p>Needs</p> <ul style="list-style-type: none">- Massive access capacity- Low latency edge processing	<p>Expert assistance</p>  <p>Needs</p> <ul style="list-style-type: none">- Global network coverage- Immediate response	<p>Supply-demand matching</p>  <p>Needs</p> <ul style="list-style-type: none">- Global network coverage- Network-enhanced trust	<p>Critical control platforms</p>  <p>Needs</p> <ul style="list-style-type: none">- Latency/reliability constraints- Control systems in edge cloud

The human (networked) revolution



NOKIA