



Network Futures: Faster, Closer, Smarter, Greener

Rod Wilson

Chief Technologist, External Research
Ciena Research Labs, Ottawa, Canada

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Ciena's R&D External Research Team

Investigate promising new technology
Look out, beyond product trajectories
Learn via experiment and be curious
Path find, explore, qualify, & engage experts



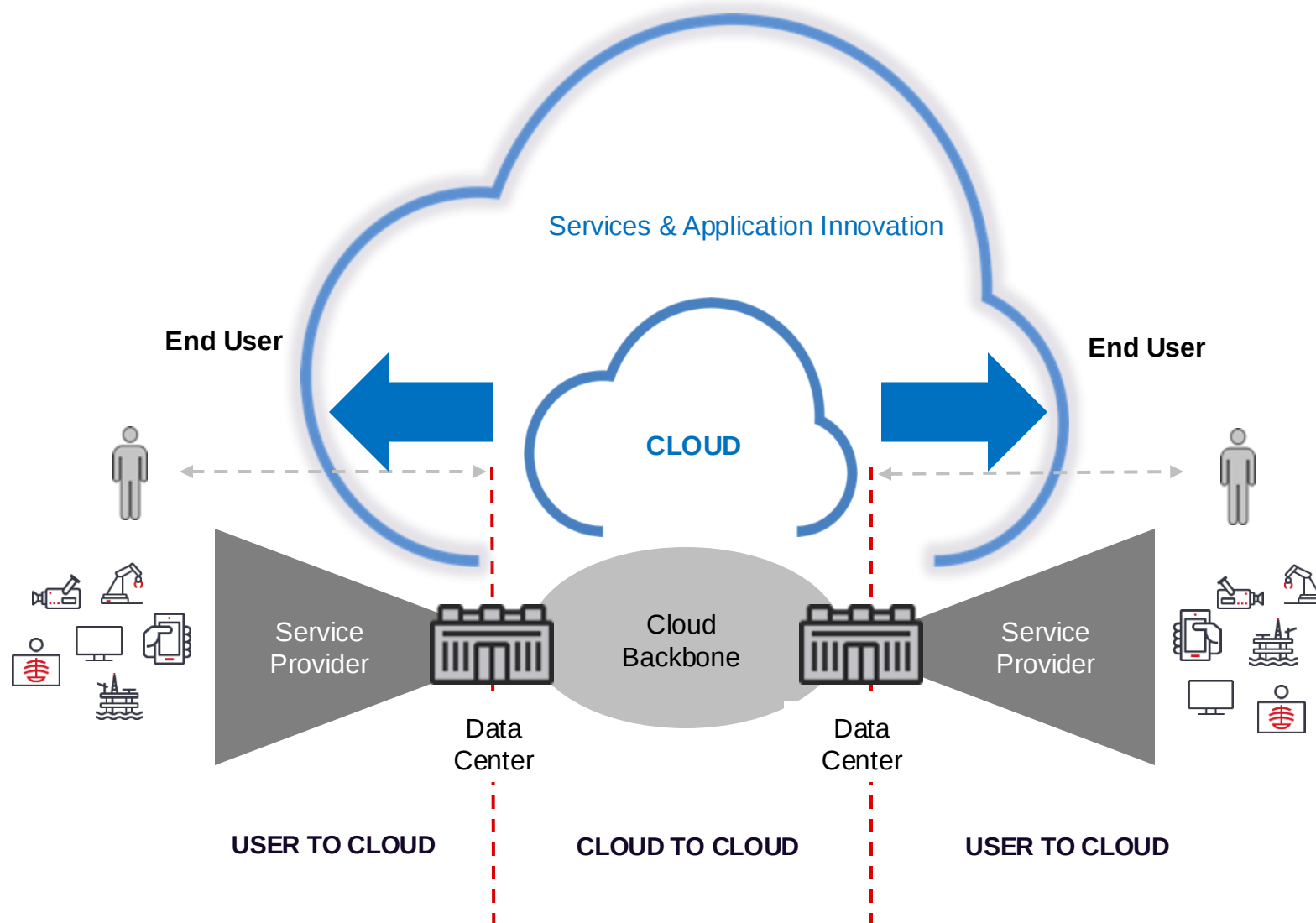
Image ©Tourism New Zealand, Cape Egmont Lighthouse

Rodney G. Wilson; Chief Technologist, External Research.
Marc Lyonnais: Director

Industry insights



Networks are Bringing the Cloud Edge Closer to the User



Global Content Providers are Building out their Edge



Edge Computing

For premise

AWS Outposts

AWS Wavelength

Bring AWS infrastructure and services closer to customers at the edge of 5G networks

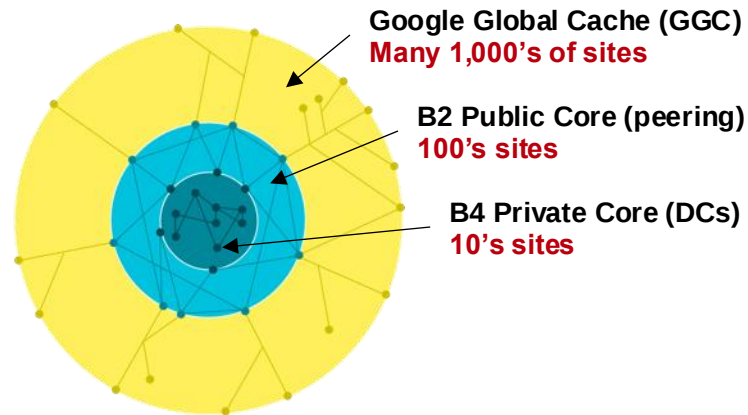


Growth in adoption of AWS Outposts and AWS Wavelength with edge compute

Announced 100G Direct Connect Service



Interconnection Edge Sites

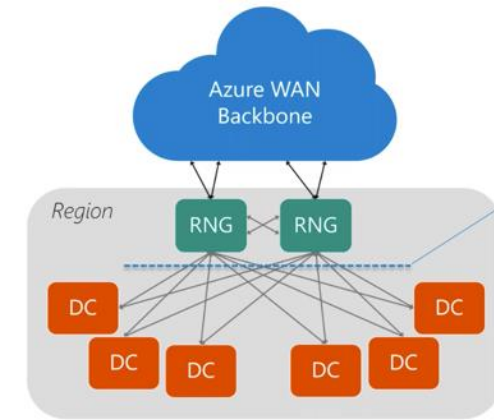


Expanding GGC locations

Opportunity for private interconnection



Expanding Metro/Regions



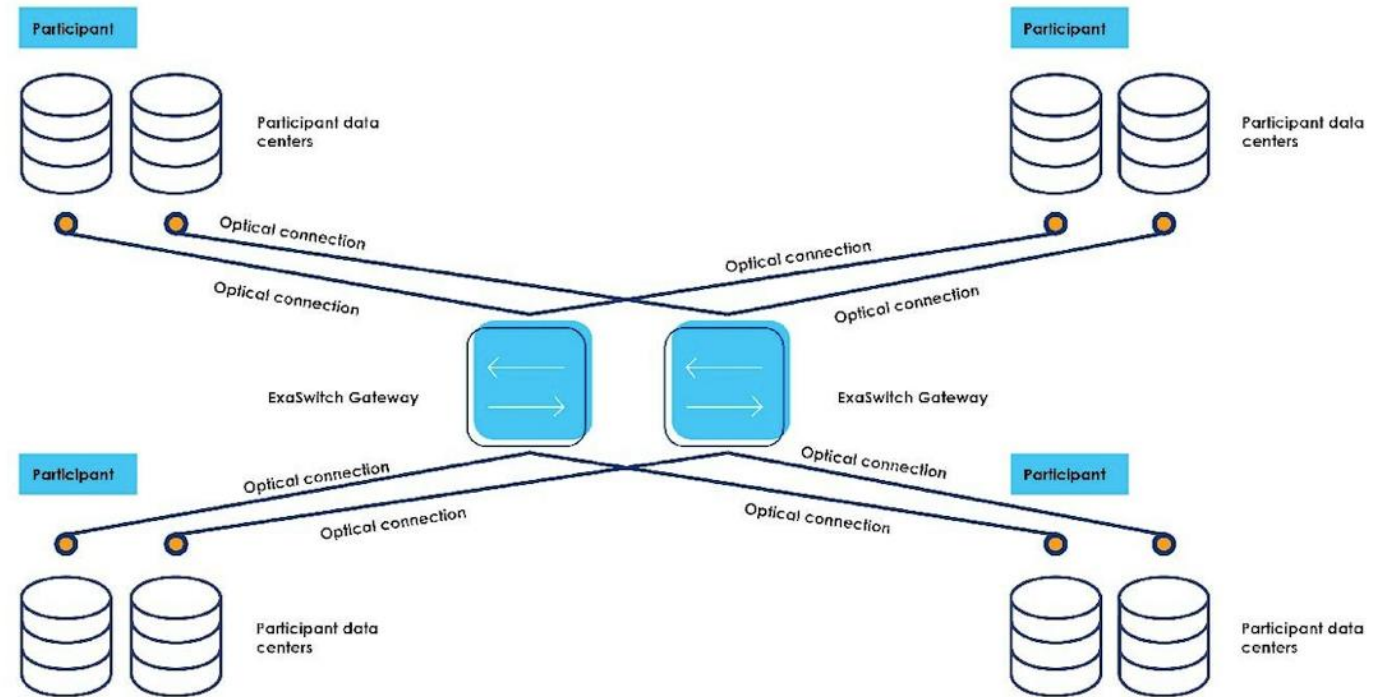
Microsoft expanding cloud connectivity fabric across multiple metros & regions

Cross-section capacity rapidly increasing

Purchased Lumenisity – Hollow-core fiber

Lumen, Google and Microsoft develop Exaswitch optical interconnection ecosystem

With ExaSwitch:



June 2023 Claim: “1st Optical ecosystem to automate, scale and manage high-value interconnects”

ExaSwitch removes latency and provides real-time capacity deployment due to its distributed ecosystem design and automated interconnect provisioning.

<https://exaswitch.net>

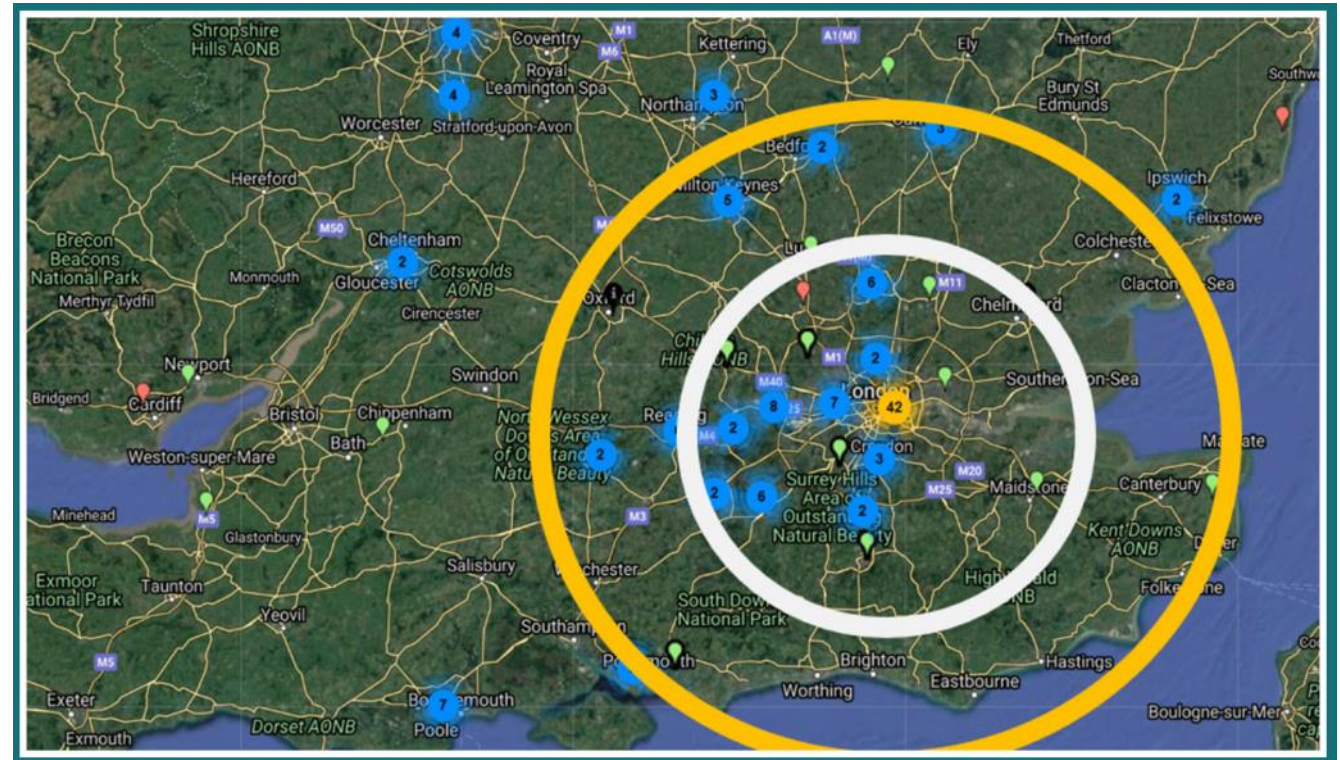
Microsoft acquires Lumenisity®, an innovator in hollow core fiber (HCF) cable

Dec 9, 2022 | [Girish Bablani, Corporate Vice President, Azure Core](#)

30% Reduction in Latency

Doubles the Useful Geography for DCI

Supports Higher Optical Powers



London

Key Drivers of Increased Cloud Adoption



Machine Learning
Artificial Intelligence



Multi-Cloud



Edge
Computing



Internet of
Things



Usage-based
consumption
per GB



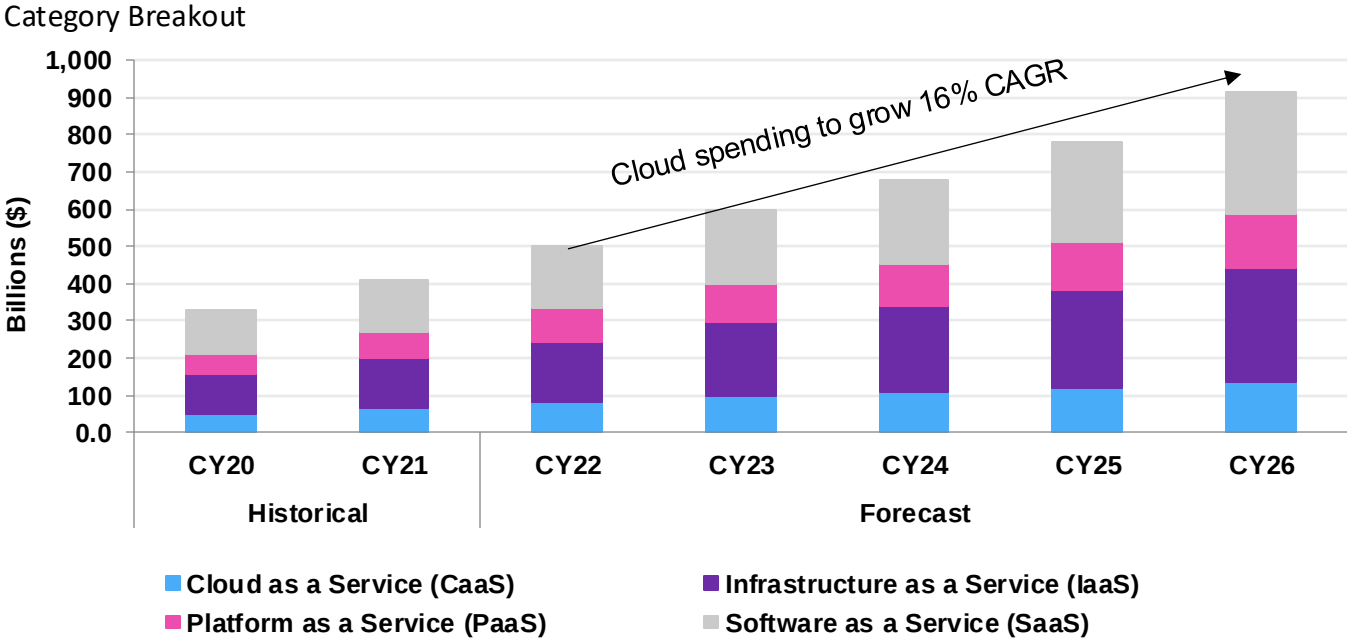
Cloud native
applications



5G vRAN
Telco Cloud

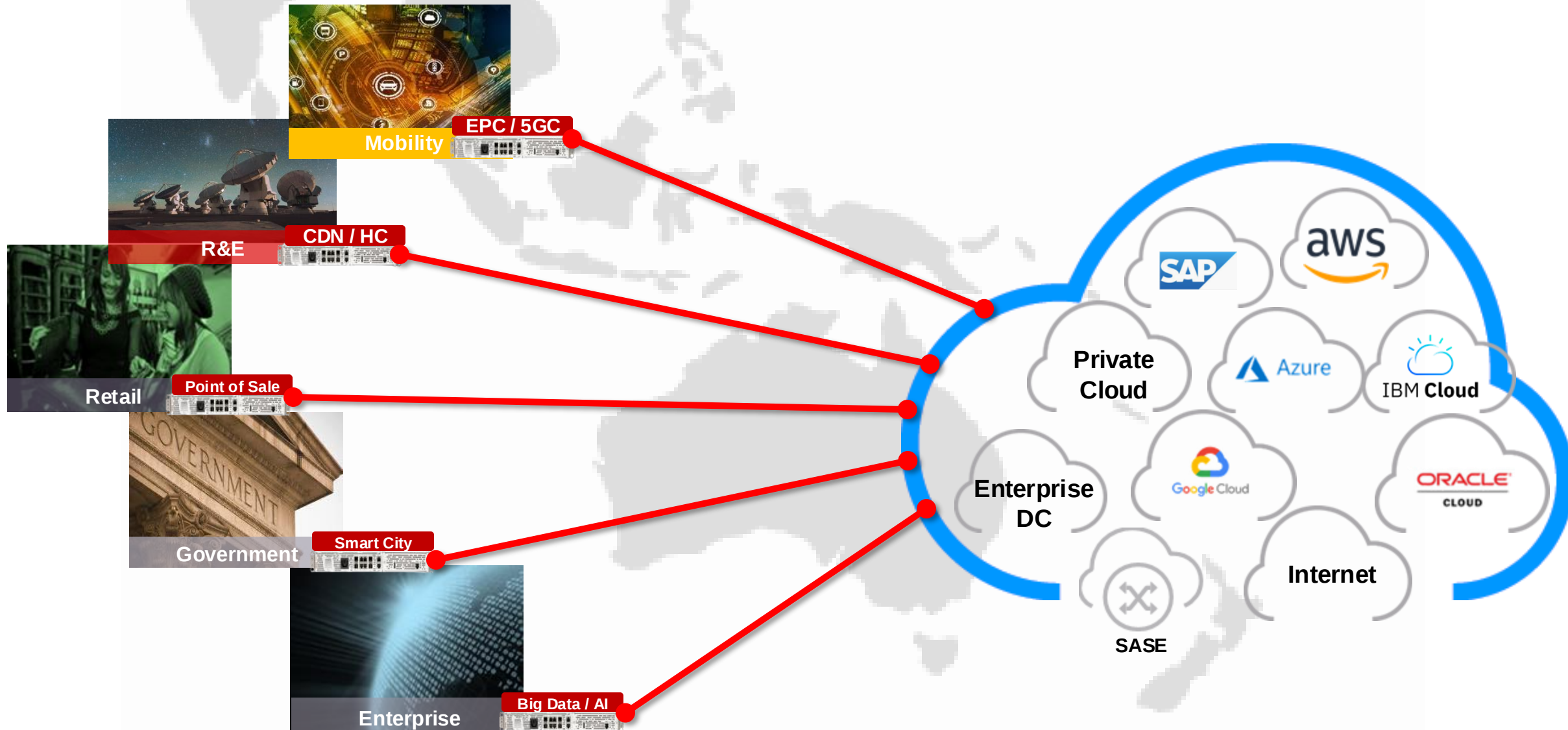


New data center
construction

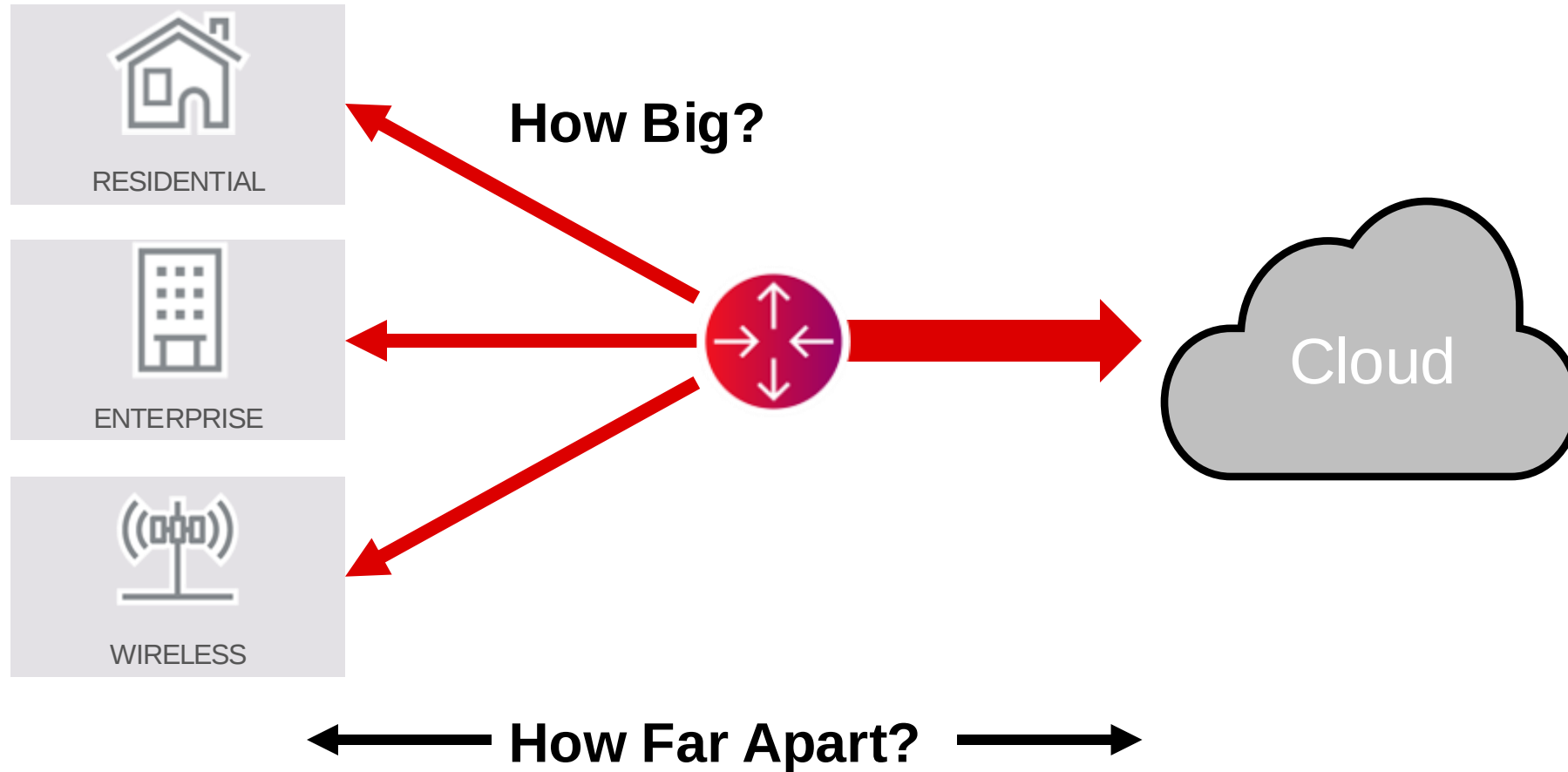


Source: Omdia, Cloud & Colocation Services Market Tracker, 1H22

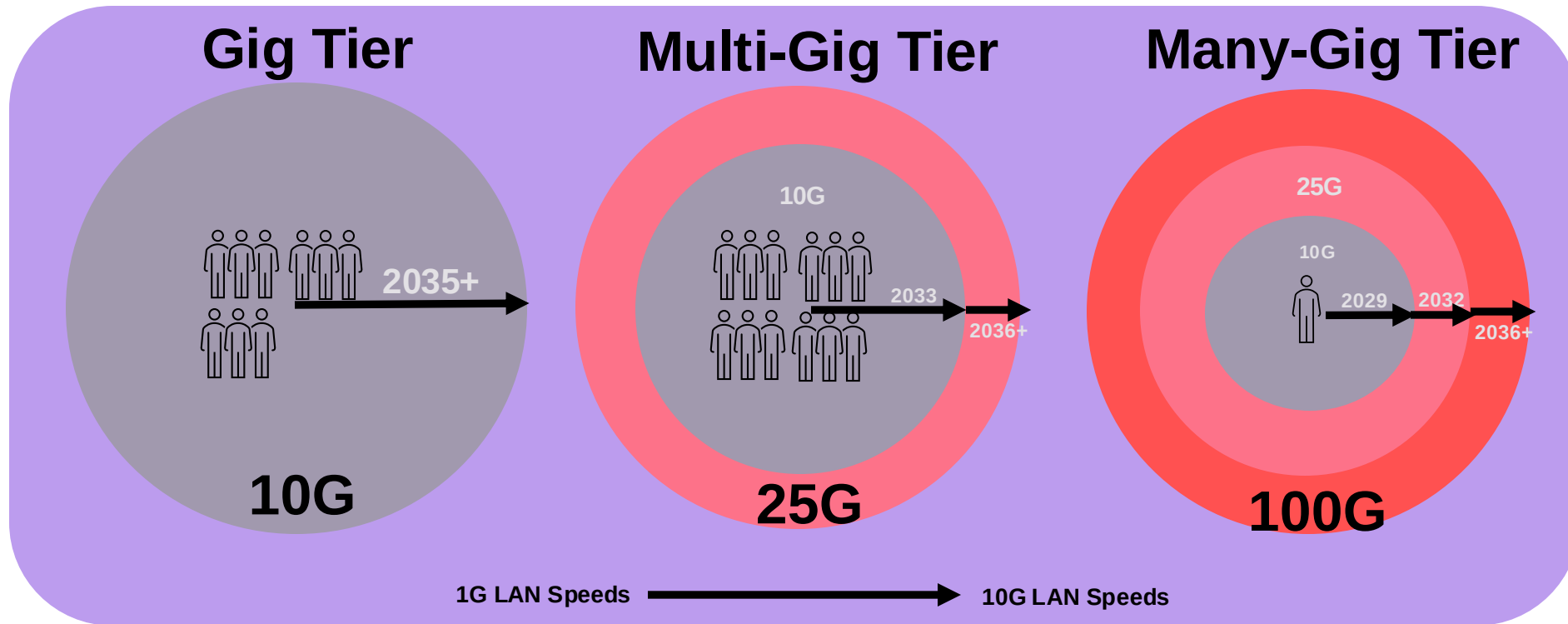
A Multi-Service Multi-Cloud World



A Simple Construct



How Big? - Broadband Access



Low Bandwidth Tier

30% CAGR

10G until 2040

25G until 2045

Mid Bandwidth Tier

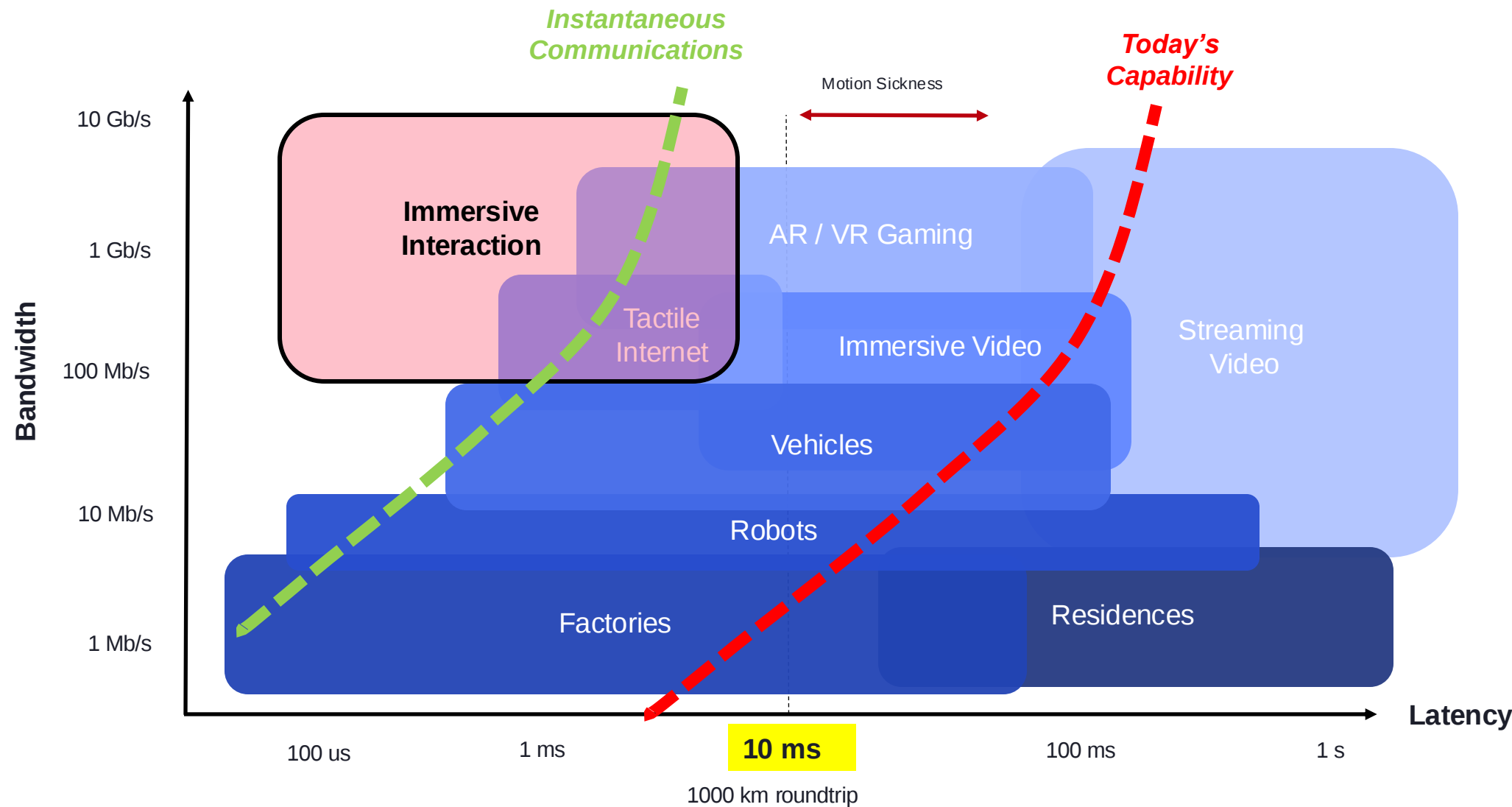
- 35% CAGR

- 25G until 2036+

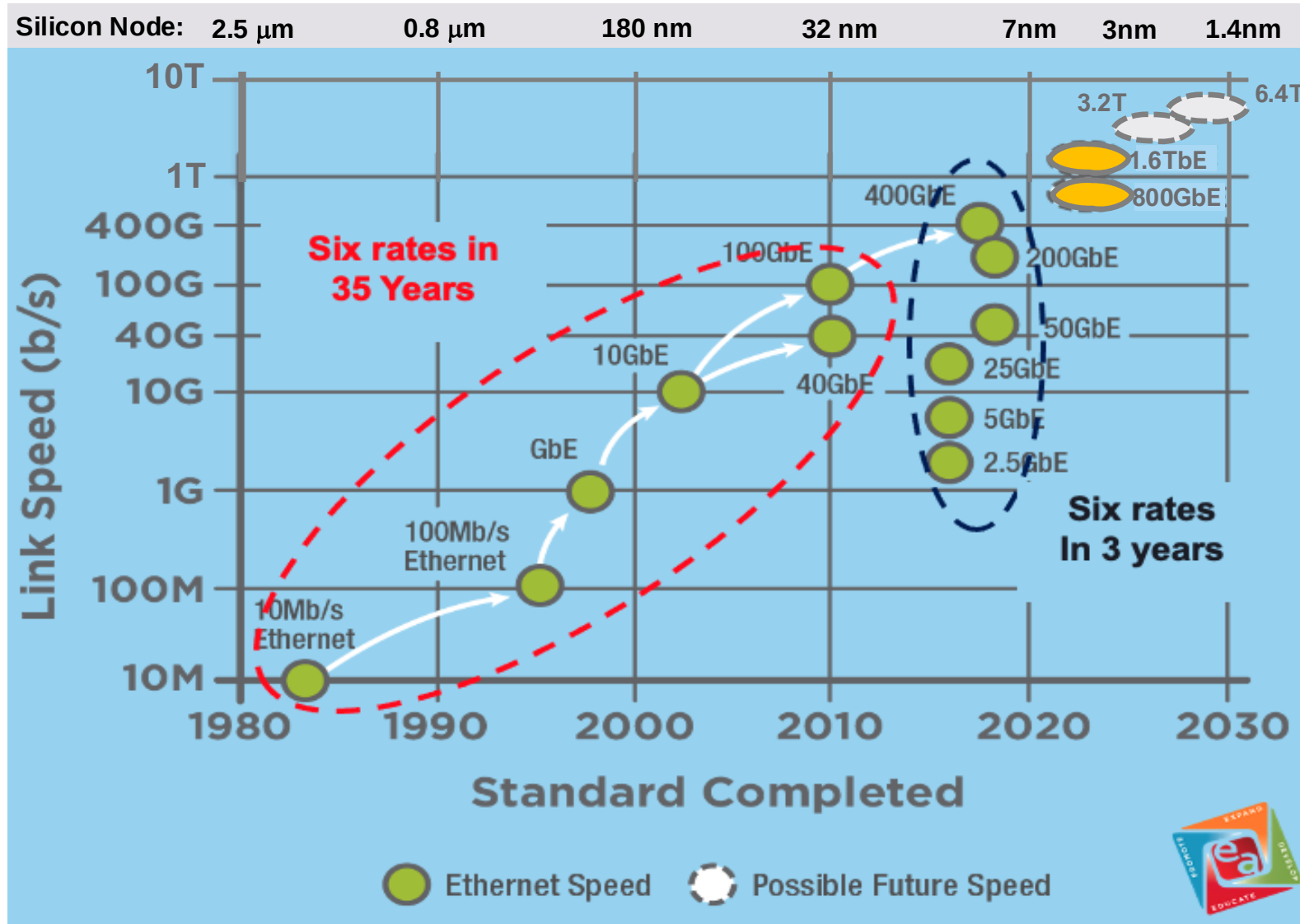
High Bandwidth Tier

- 40% CAGR

How Far? - “Mean-Time-to-Cloud”



Network Edge - Speed & Acceleration



Source: Ethernet Alliance & Ciena



Driving Dramatic Reductions in Space & Power

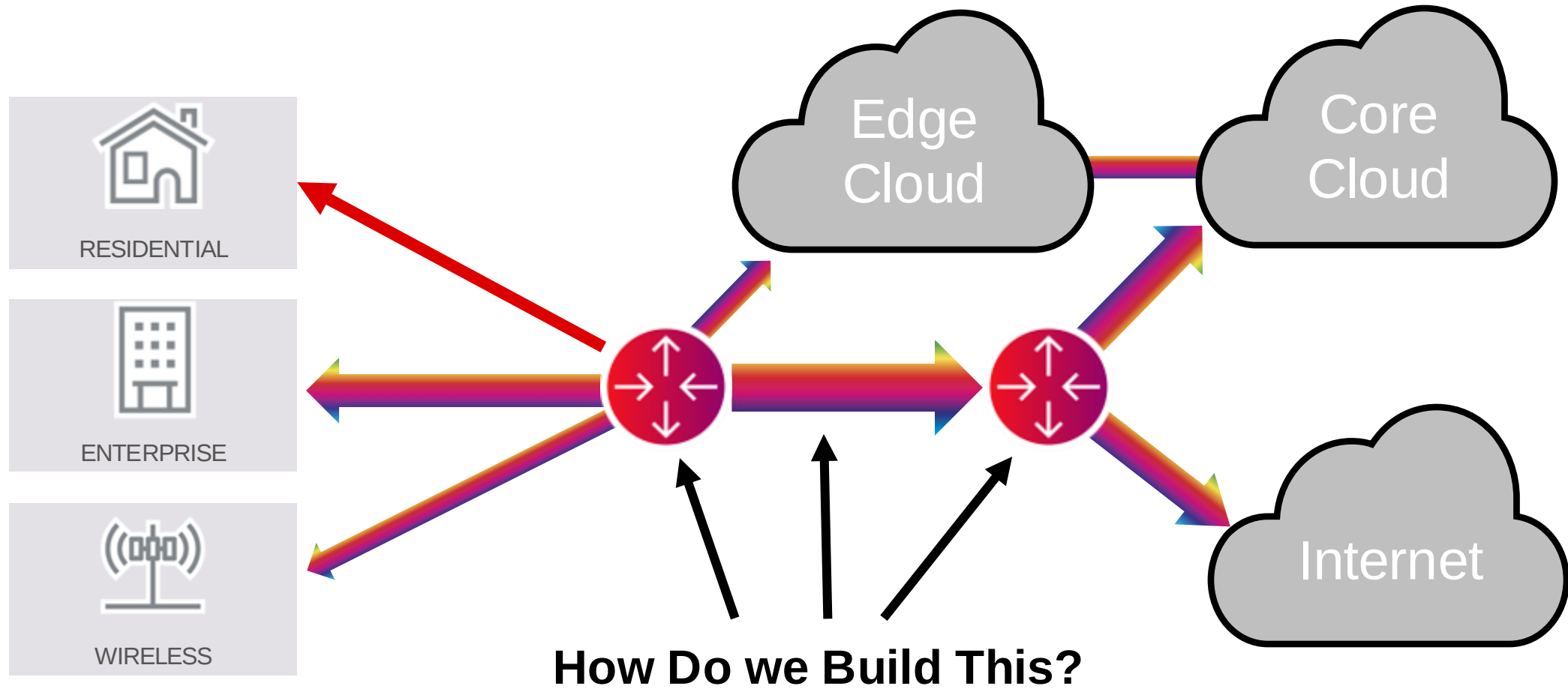


2022: OIF 400ZR
400G in your palm

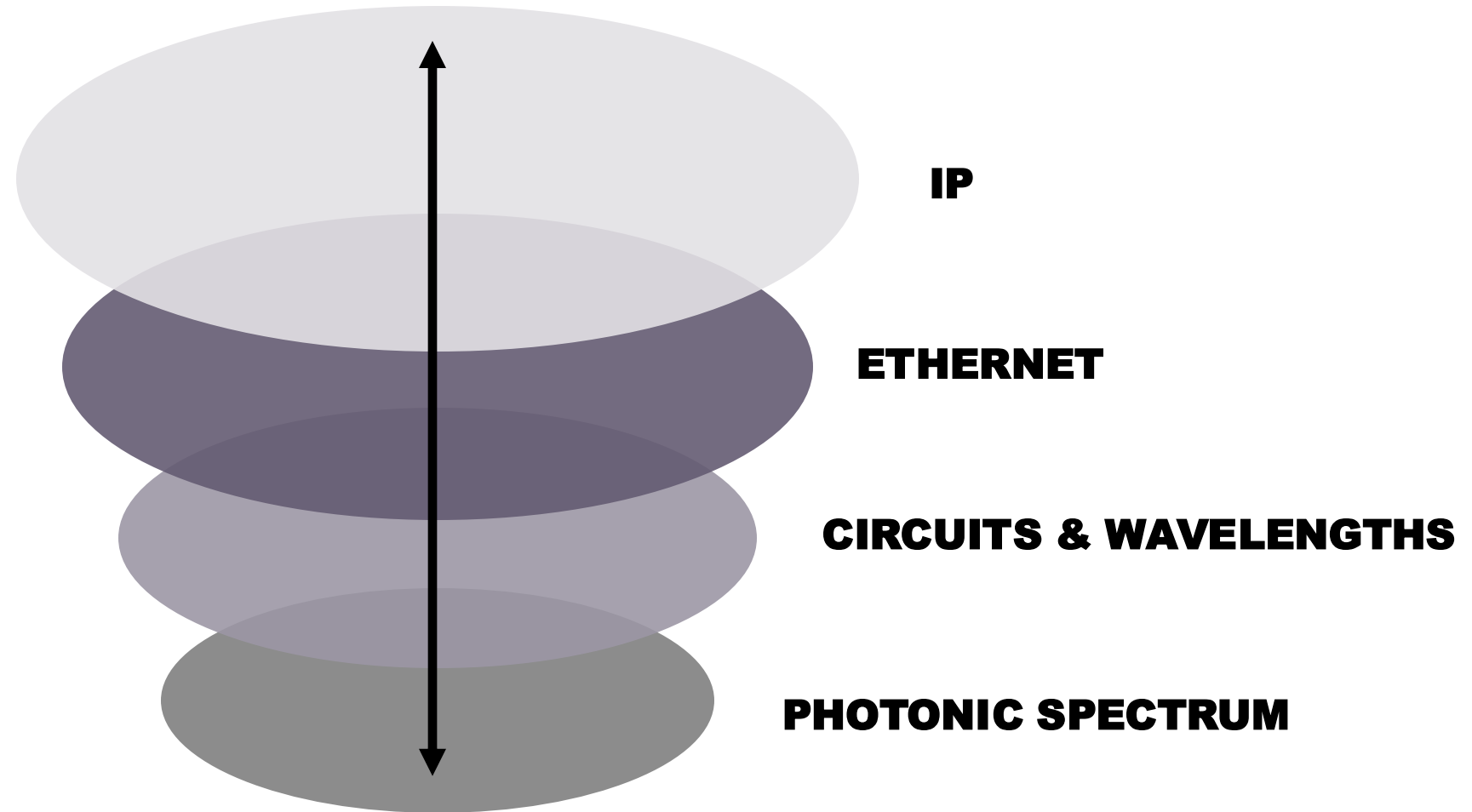
2024: OIF 800ZR
800G in your palm

1995: 40G is 16 wavelengths of 2.5G
Occupied 1 Telco Bay, 400G requires 10 Bays

The Service Provider Metro

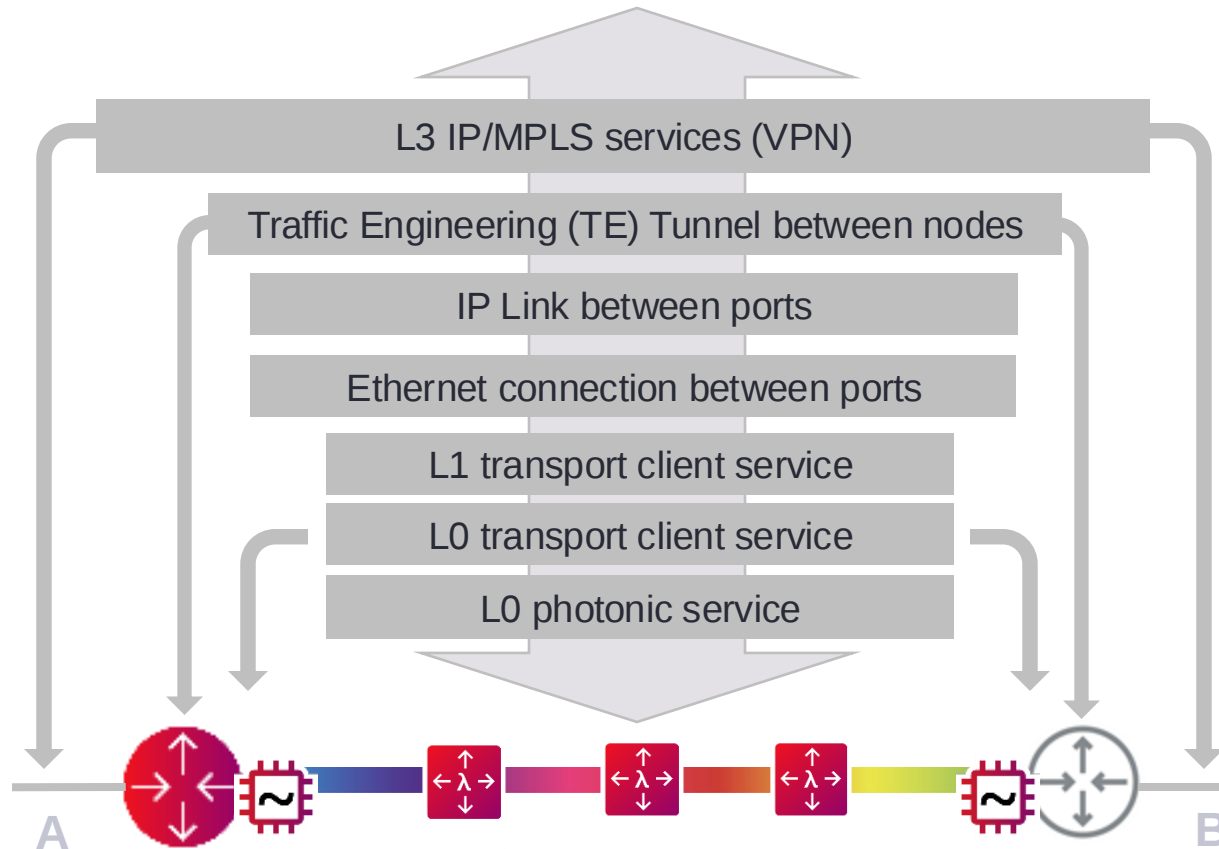


From Independent Layers to Cooperative Layers

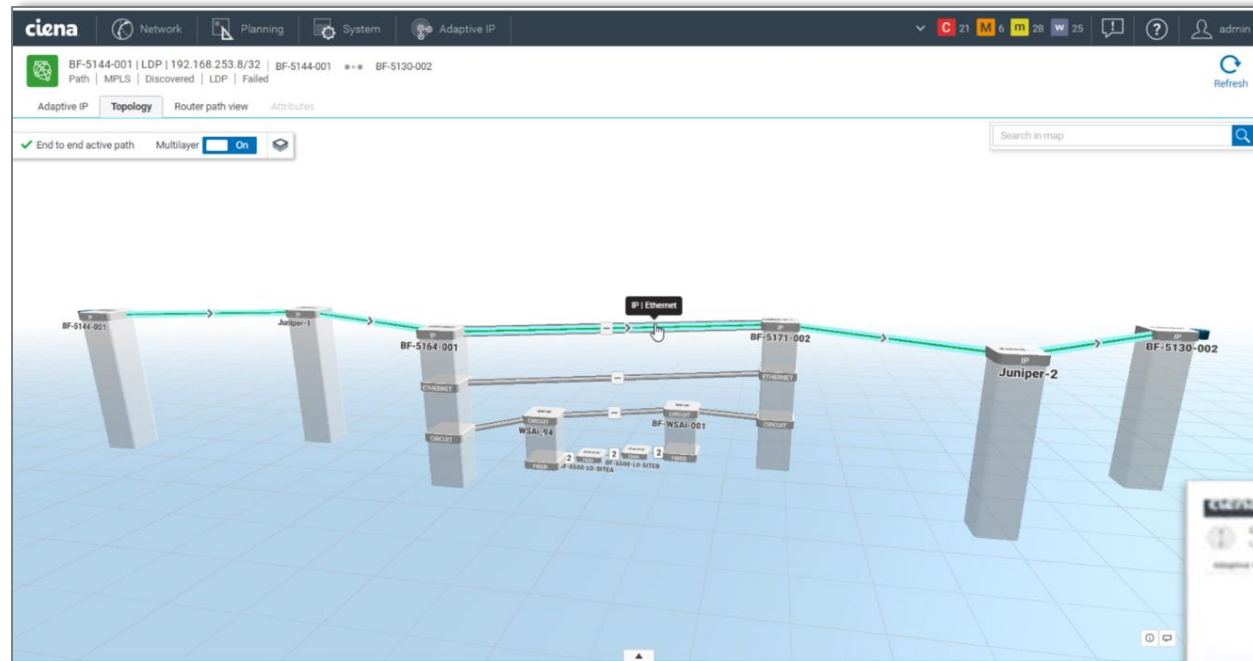


You Can't Automate What you Can't See

Visibility from Analog Photonics to Digital Services

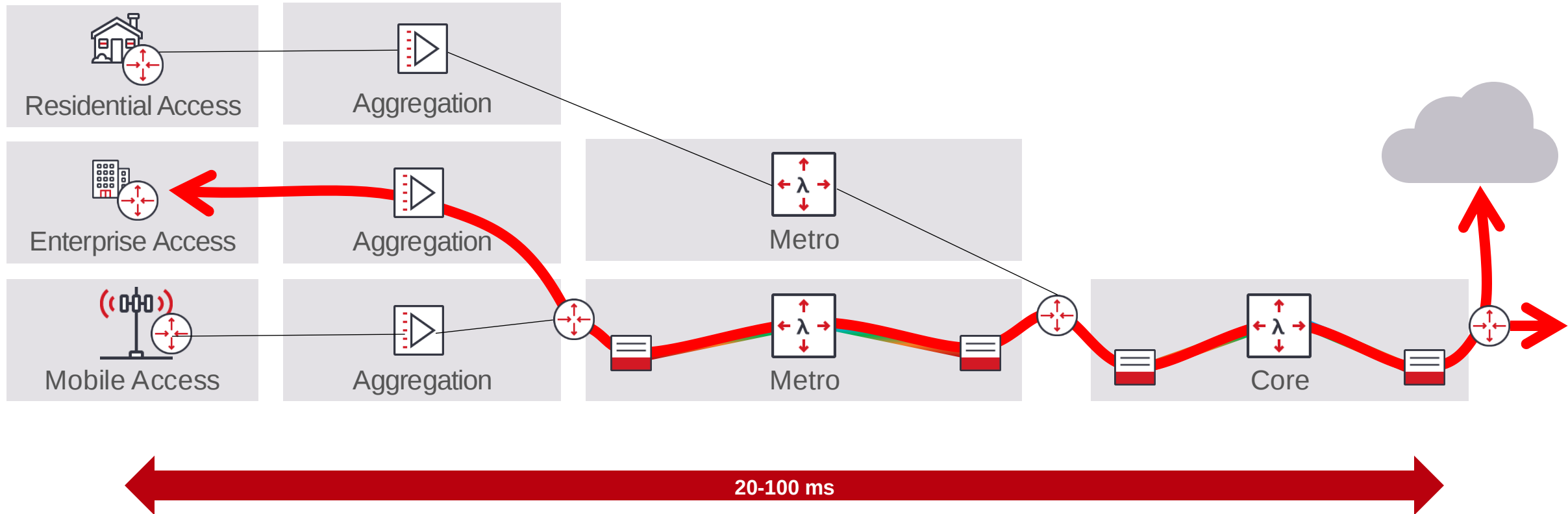


Multilayer Visibility & Correlation

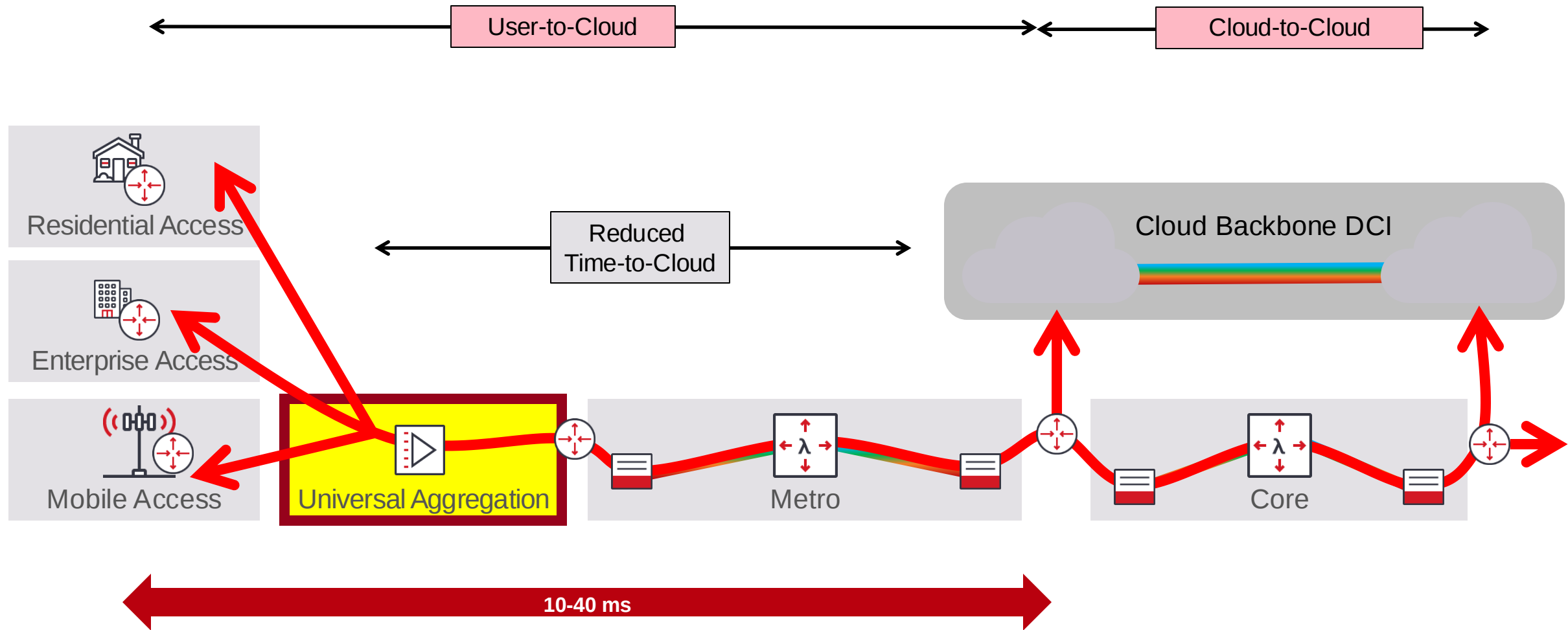


Traditional Network

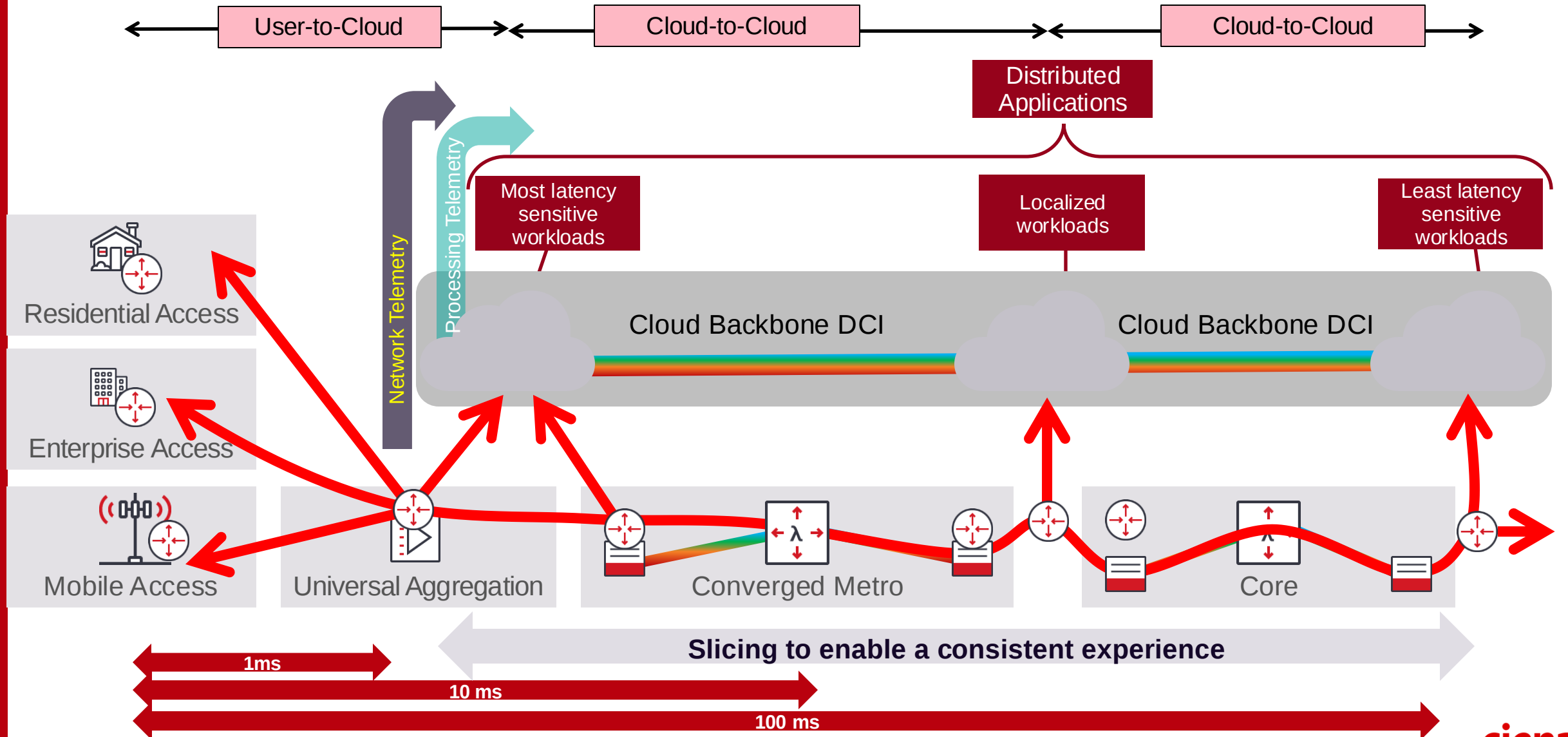
Lots of OEO, buffers, opportunities for delay



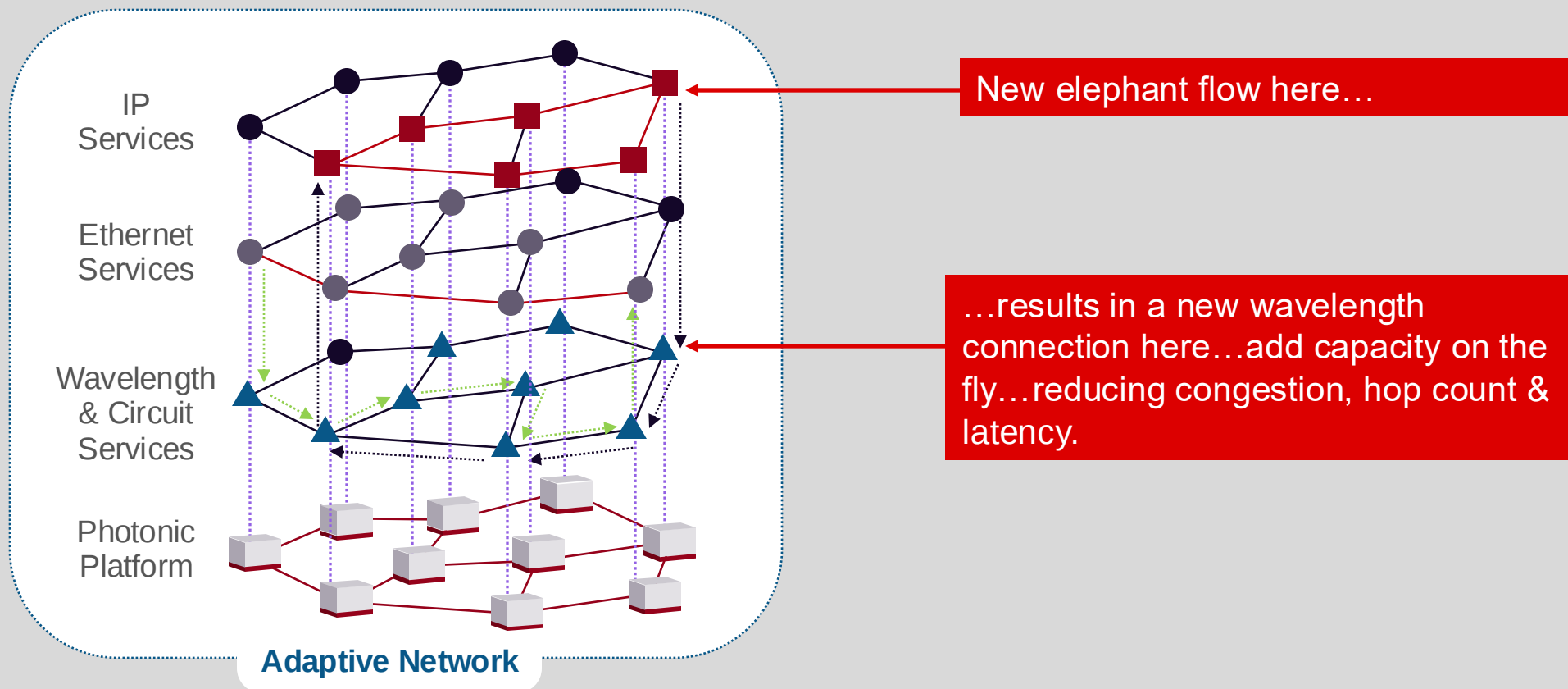
Better Cloud Experience



Evolved Network



Visibility + Intelligence + Automation = Simplicity



The Network can become a sensor of its own requirements.
It adapts without manual intervention.

Remember Bit-Heads vs. Bell-Heads



Cloud Service Velocity vs Telecom Operator Service Velocity

Key Take-Aways

	PRESENT		FUTURE
Faster	400G Everywhere		800G Everywhere 1.6T per Wavelength
Closer	10's to 100's of ms		Workloads optimally placed 10 μ s – 10 ms
Smarter	Automation of Manual Workflows		AI & ML Enable Networks to Adapt and Operate at Cloud-Speed

All underpinned by power reduction, energy conservation and optimized carbon foot-print architectures



Thank You
rgwilson@ciena.com

