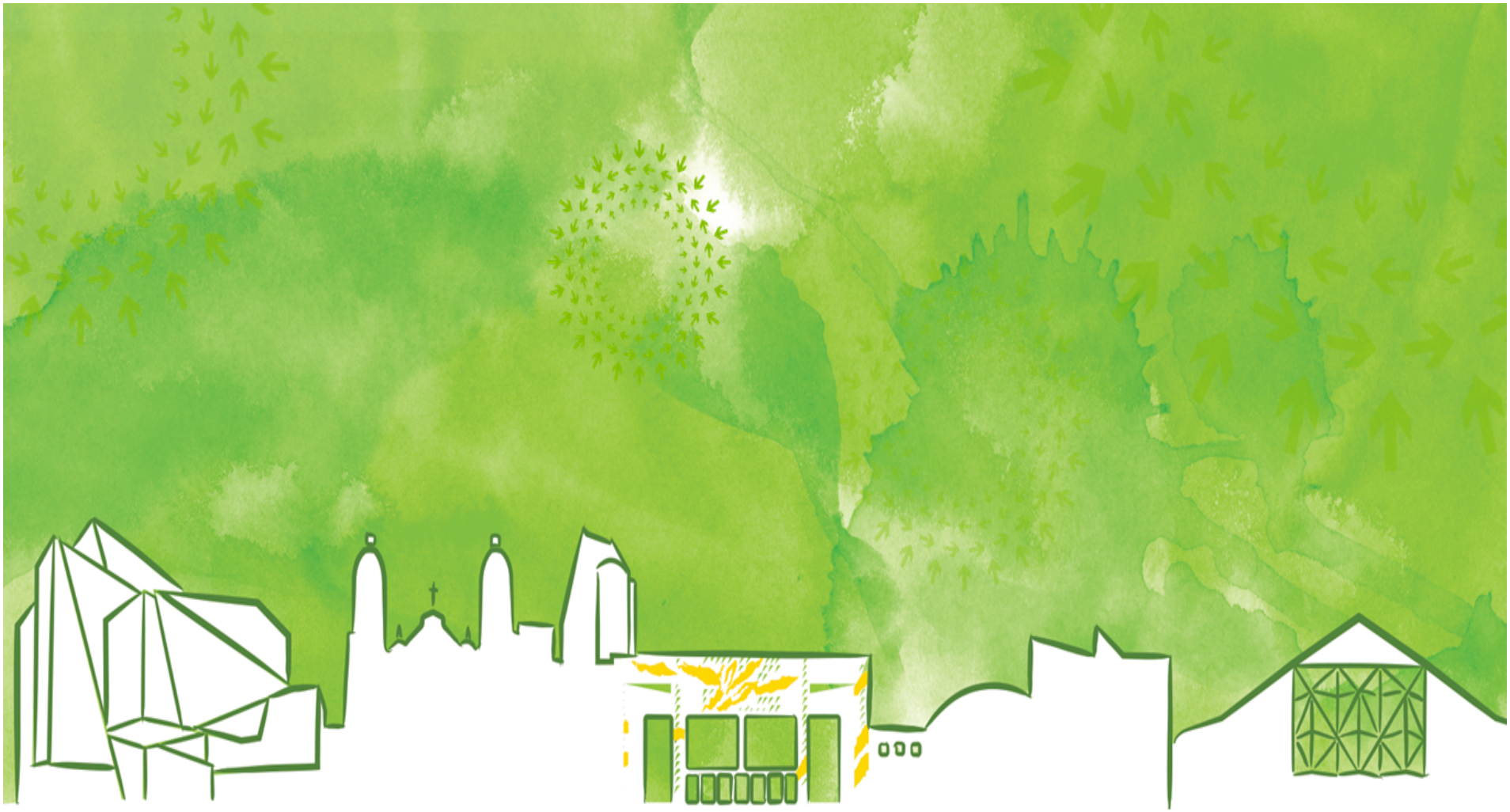


OCP U.S. SUMMIT 2016 March 9-10 | San Jose, CA

OCP U.S. SUMMIT 2016

Low Latency Mobile Edge Computing

Devashish Paul
Dir Strategic Marketing IDT

IDT Company Overview

Founded	1980
Workforce	Approximately 1,800 employees
Headquarters	San Jose, California

#1 Serial Switching – 100% 4G Infrastructure with RapidIO

#1 Memory Interface – Industry Leader DDR4

#1 Silicon Timing Devices – Broadest Portfolio

800+ Issued and Pending Patents Worldwide

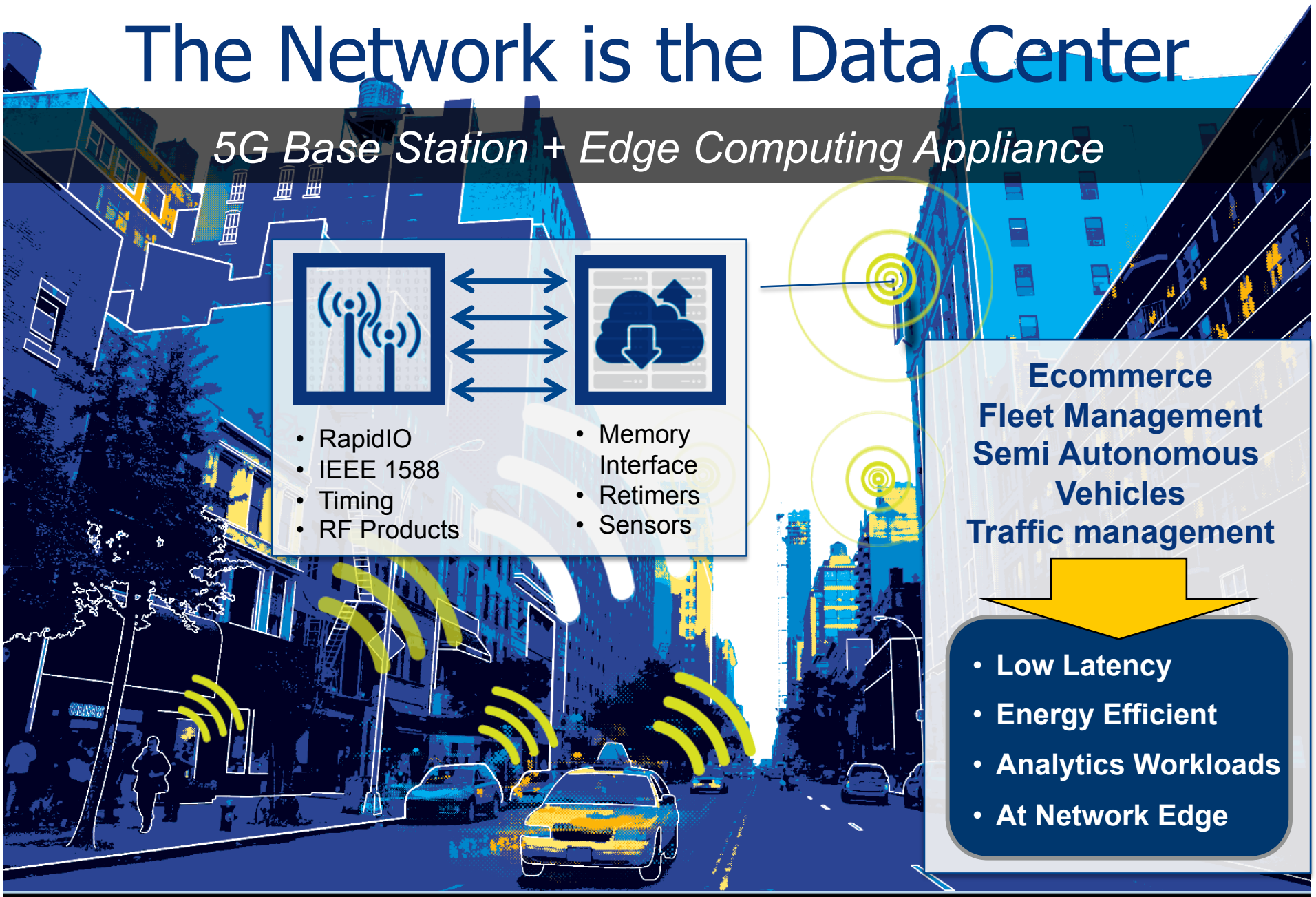
Mixed-signal application-specific solutions

Agenda

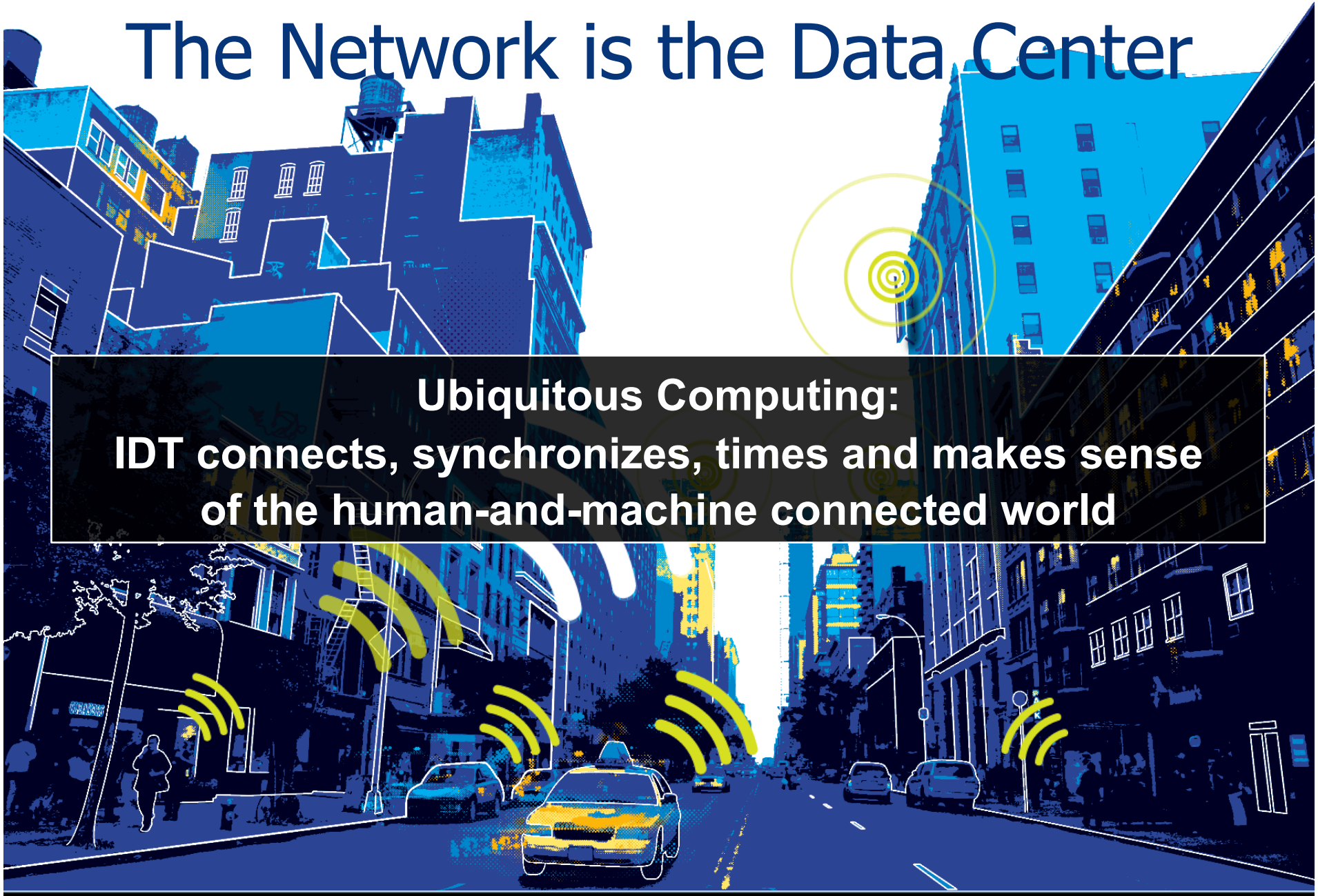
- Network Trends
- RapidIO 20-50 Gbps Technology
- Edge Computing Architectures
- OCP Edge Computing Servers and Scale Out
- Open HPAC Lab for Telco Project

The Network is the Data Center

5G Base Station + Edge Computing Appliance



The Network is the Data Center



Network and Data Center Convergence

- Apps moving from data center to co-locate with access node (base station or wired access node)
- Supporting real time communication to mobile devices (phones, cars IOT)
- Tight time synchronization between apps running on distributed servers and in data center
- Need low latency interconnect

Boosting User Experience by Innovating at the Mobile Network Edge

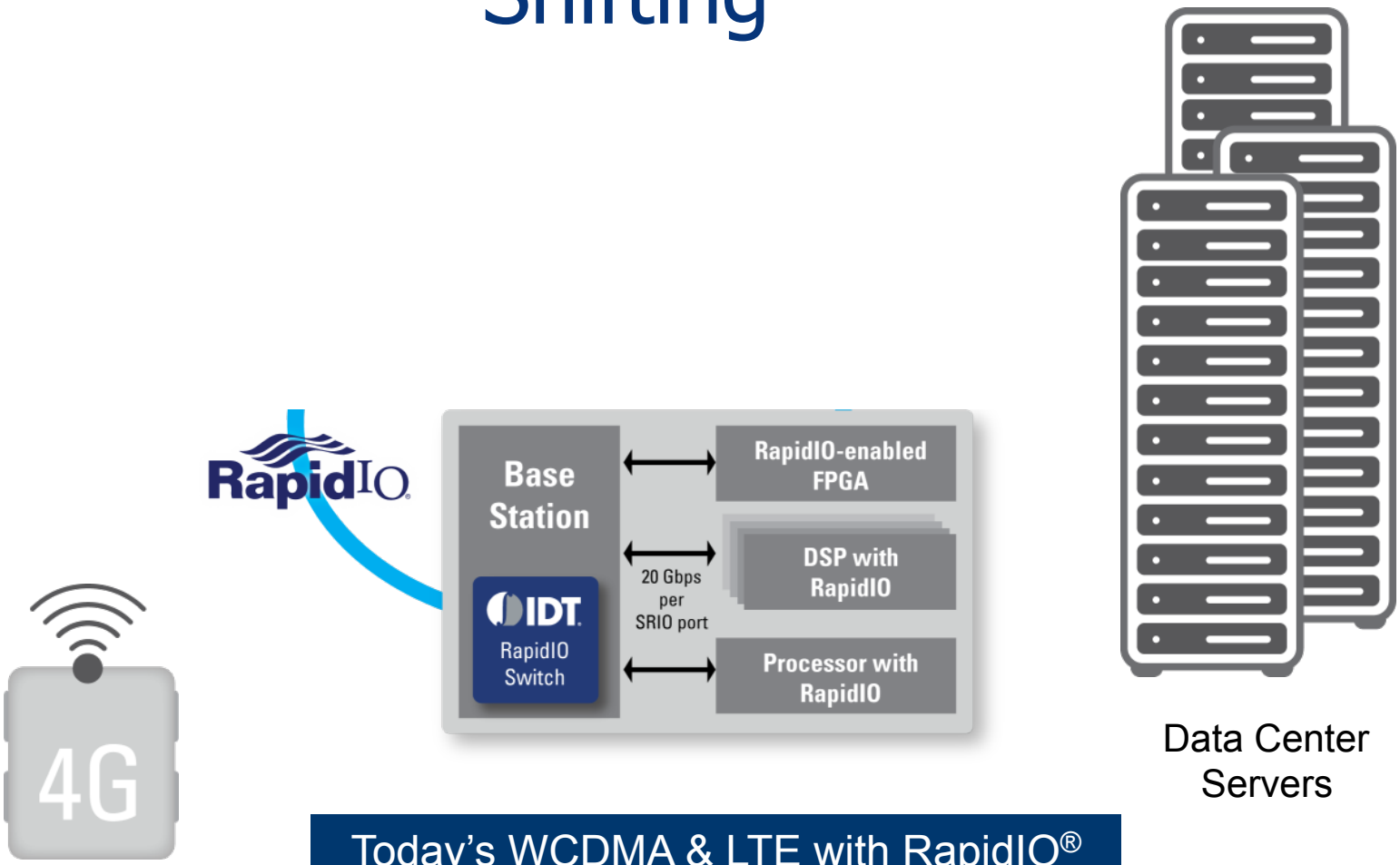
An Introduction to the new ETSI Industry Specification Group (ISG) for ***Mobile Edge Computing (MEC)***

HUAWEI IBM intel NOKIA docomo vodafone

Presented by Dr. Rolf Schuster, Vodafone

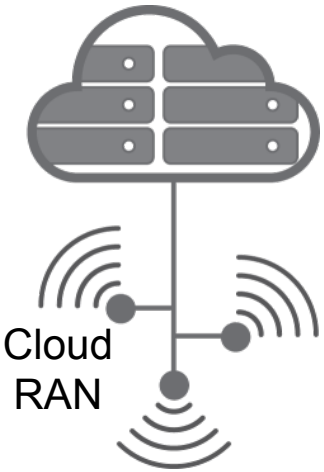
Edge Computing an essential element of 5G Rollouts

Network Deployment Architecture is Shifting

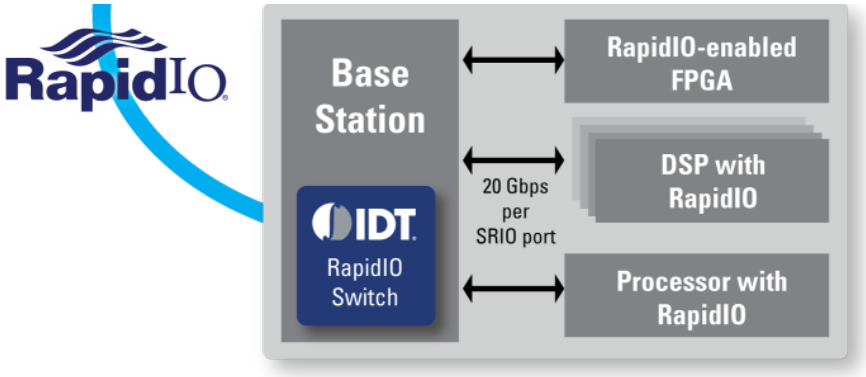


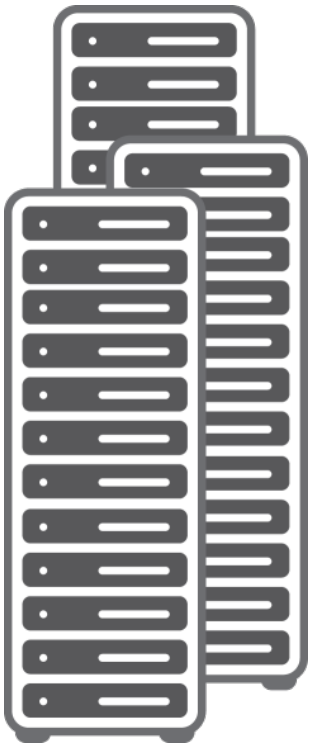
Today's WCDMA & LTE with RapidIO®

Cloud Radio Access Network (C-RAN)



4G BTS

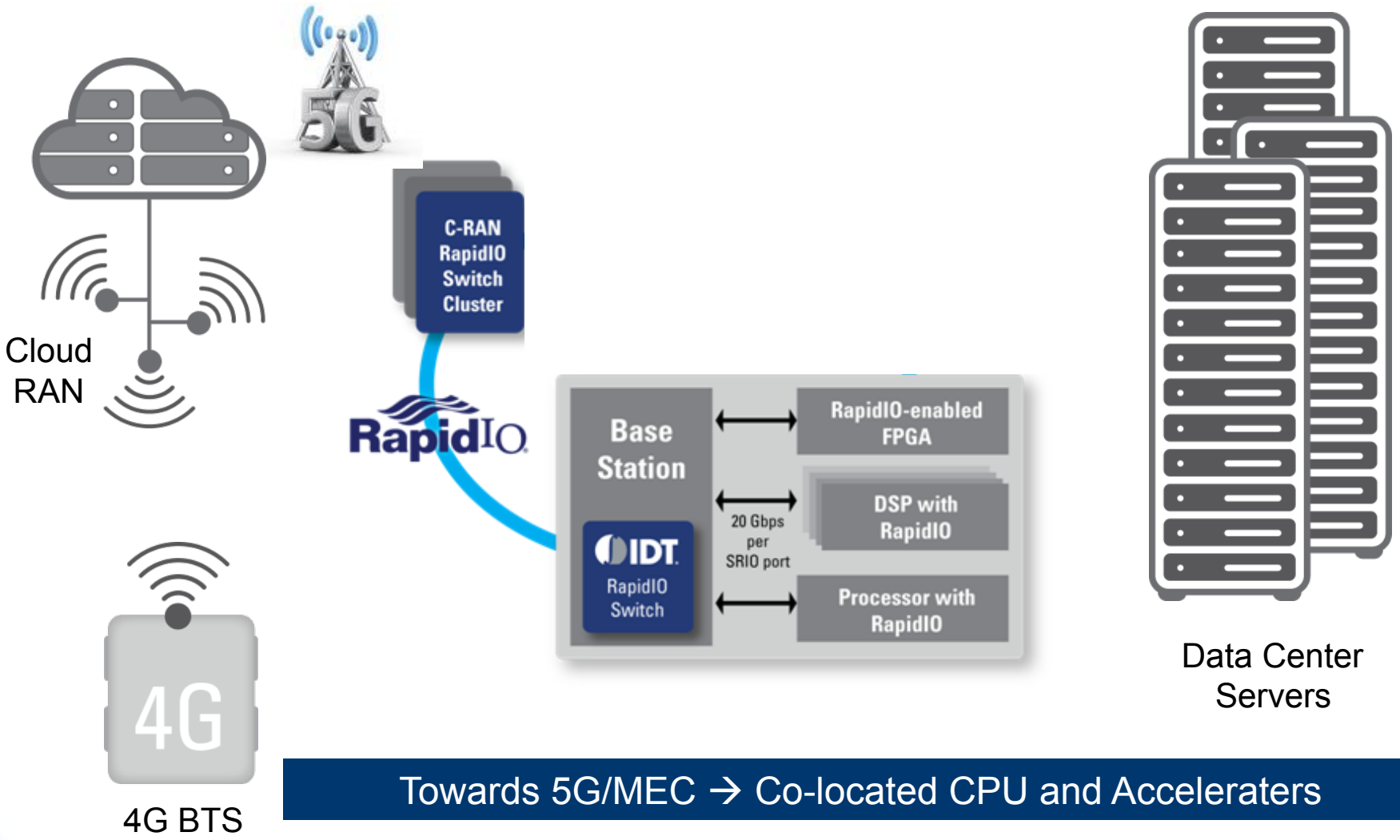




Data Center Servers

Enabling LTE-A → C-RAN Switched Cluster with Processing Nodes

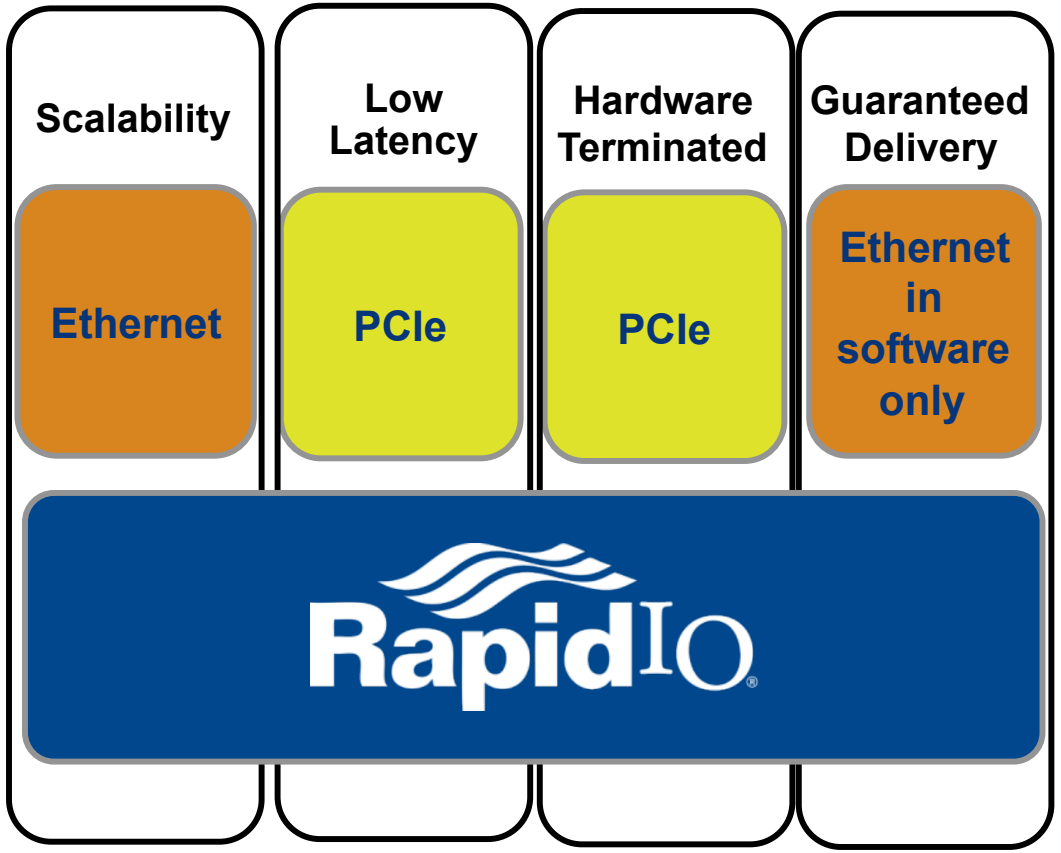
Mobile Edge Computing



Towards 5G/MEC → Co-located CPU and Accelerators

Clustering Fabric Needs

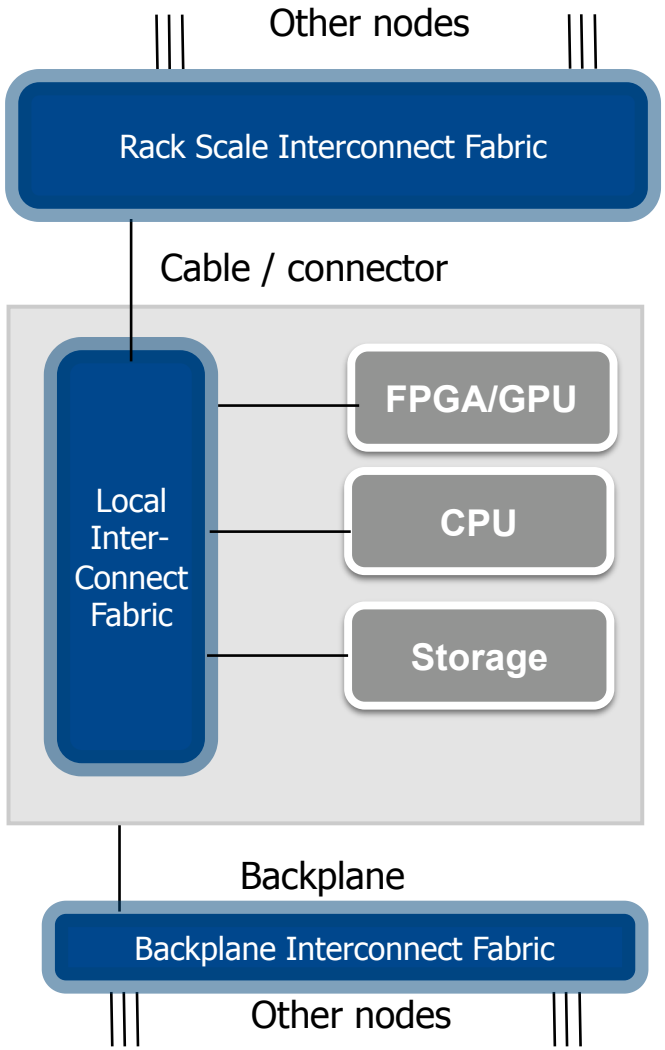
- Lowest Deterministic System Latency
- Scalability
- Peer to Peer / Any Topology
- Embedded Endpoints
- Energy Efficiency
- Cost per performance
- HW Reliability and Determinism



RapidIO Interconnect combines the best attributes of PCIe® and Ethernet in a multi-processor fabric

RapidIO in Edge Computing Appliances

- Heterogeneous compute workloads
- No protocol termination CPU cycles
- Energy efficiency
- 20 to 50 Gbps embedded interconnect
- Mission critical reliability
- Scalable Fat node connect multiple boards in Edge Appliance
- Connect multiple boards at Rack Scale in Central Office or C-RAN
- Push Data Center app use cases into the network

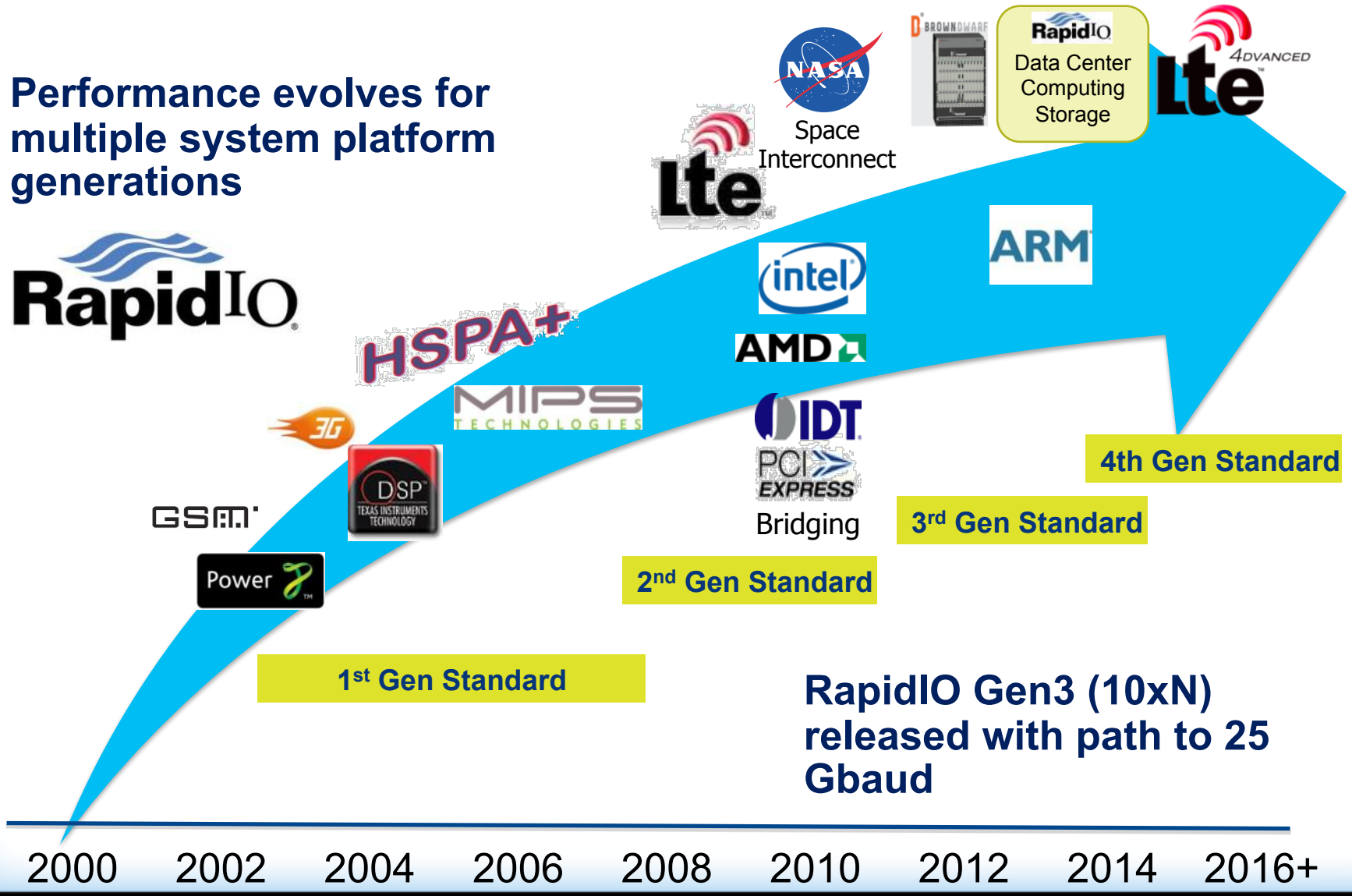


Flexible Solutions
Appliance → Rack Scale

- **10/20/40/50 Gbps per port – 6.25/10/12.5 Gps lane**
- 100+ Gbps interconnect in definition
- Embedded RapidIO NIC on processors, DSPs, FPGA and ASICs.
- Hardware termination at PHY layer: 3 layer protocol
- Lowest Latency Interconnect ~ 100 ns
- Inherently scales to large system with 1000's of nodes

- **Over 15 million RapidIO switches shipped**
- **> 2xEthernet (10GbE)** Over 110 million 10-20 Gbps ports shipped
- **100% 4G interconnect market share**
- 60% 3G, 100% China 3G market share

RapidIO Ecosystem and Market Progression



PR Newswire

IDT Launches Next-Generation RapidIO Switches for 5G Mobile Network Development and Mobile Edge Computing

With Over Twice the Performance Used in 4G Systems, the Low-Latency Devices Exceed the RapidIO 10xN Standard and are Ideal for 5G, HPC, and Mobile Edge Computing

Share +1 Pin it

IDT

IDT Launches Next-Generation RapidIO Switches for 5G Mobile Network Development and Mobile Edge Computing

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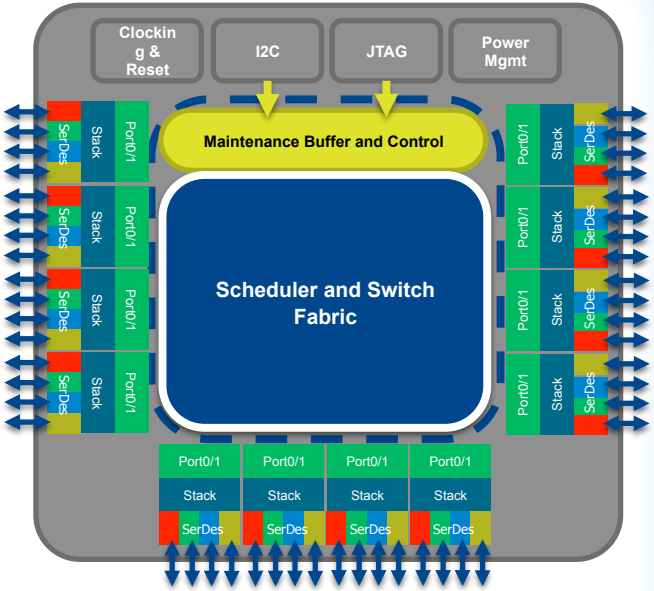

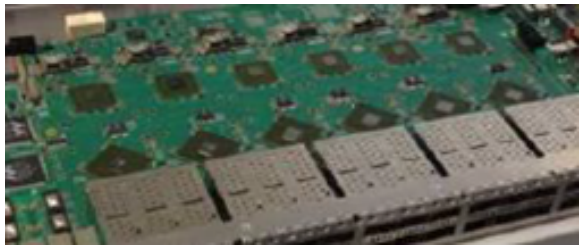

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IDT and Prodrive Technologies Partner to Develop 100ns Latency, Energy-Efficient RapidIO Switch Appliance Portfolio

Optimized Top-of-Rack Switches Deliver Scalable Bandwidth--From 750 Gbps to 4.8 Tbps--for 5G, C-RAN, Mobile Edge and High-Performance Computing, Analytics and Financial Trading

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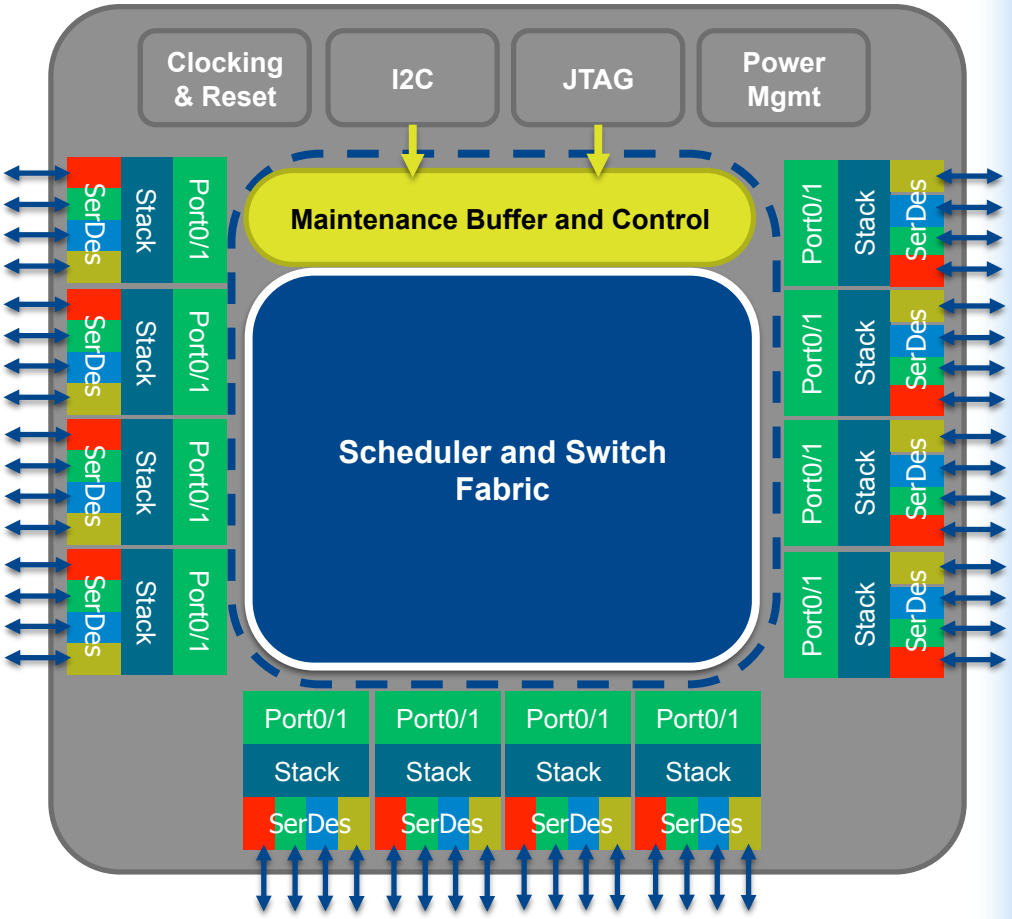
5G Telco Optimized 100ns 50 Gbps Switch Silicon

- RXS2448
  - 600 Gbps Full-Duplex Serial RapidIO® Switch
  - 50 Gbps per port
  - 33 x 33 mm package
  - 48 lanes at 12.5 Gbps
  - Up to 24 Serial RapidIO Ports
  - RapidIO Specification (Rev 3.2) Compliant
- RXS1632
  - 400 Gbps Full-Duplex Serial RapidIO Switch
  - 50 Gbps per port
  - 29 x 29 mm package
  - 32 lanes at 12.5 Gbps
  - Up to 16 Serial RapidIO Ports
  - RapidIO Specification (Rev 3.2) Compliant



50 Gbps per port | 300mW per 10 Gbps data | 100ns latency

5G Mobile Infrastructure

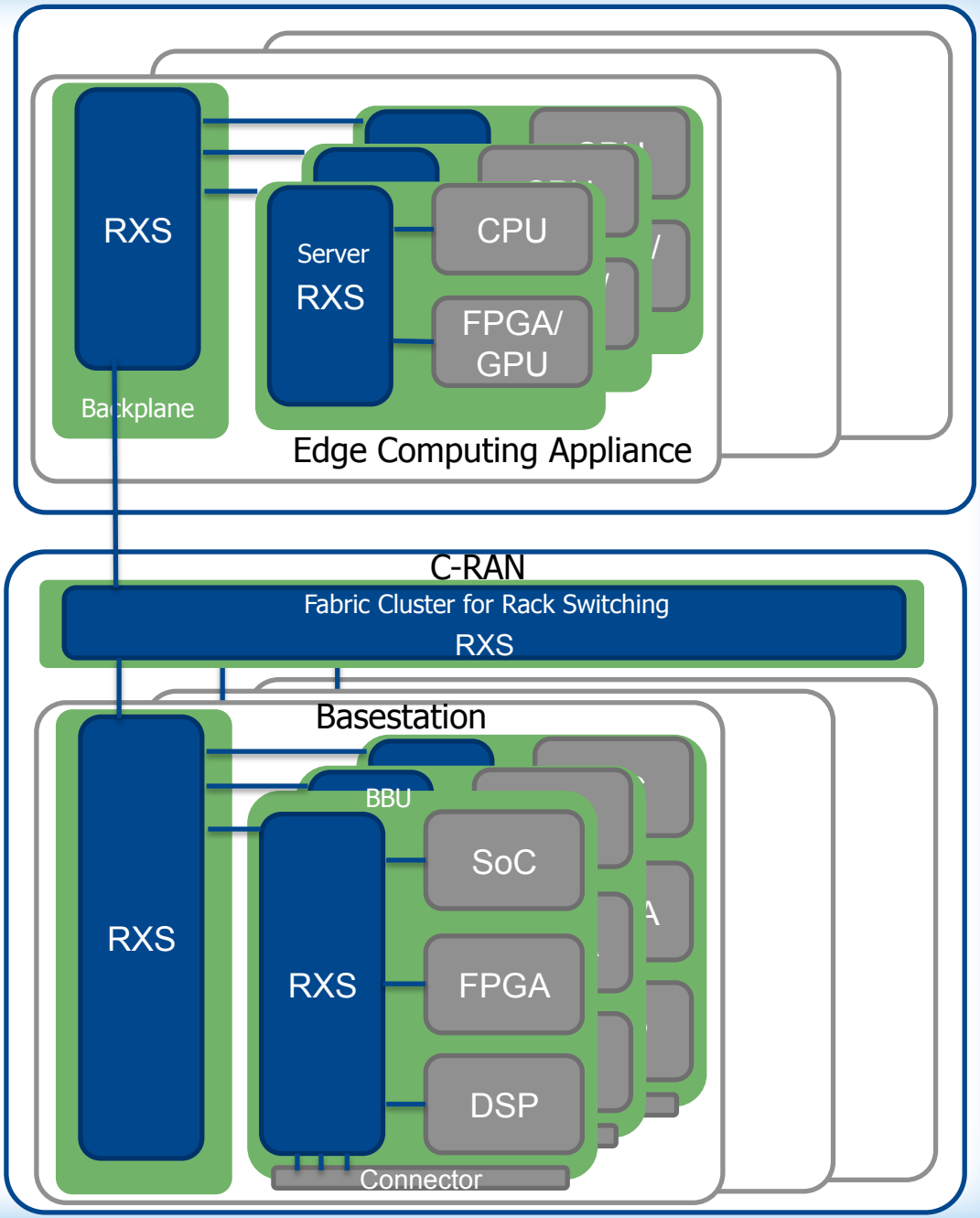
KEY APPLICATIONS

- LTE-A & 5G baseband unit
- Mobile Edge Computing
- Backplane switching
- C-RAN

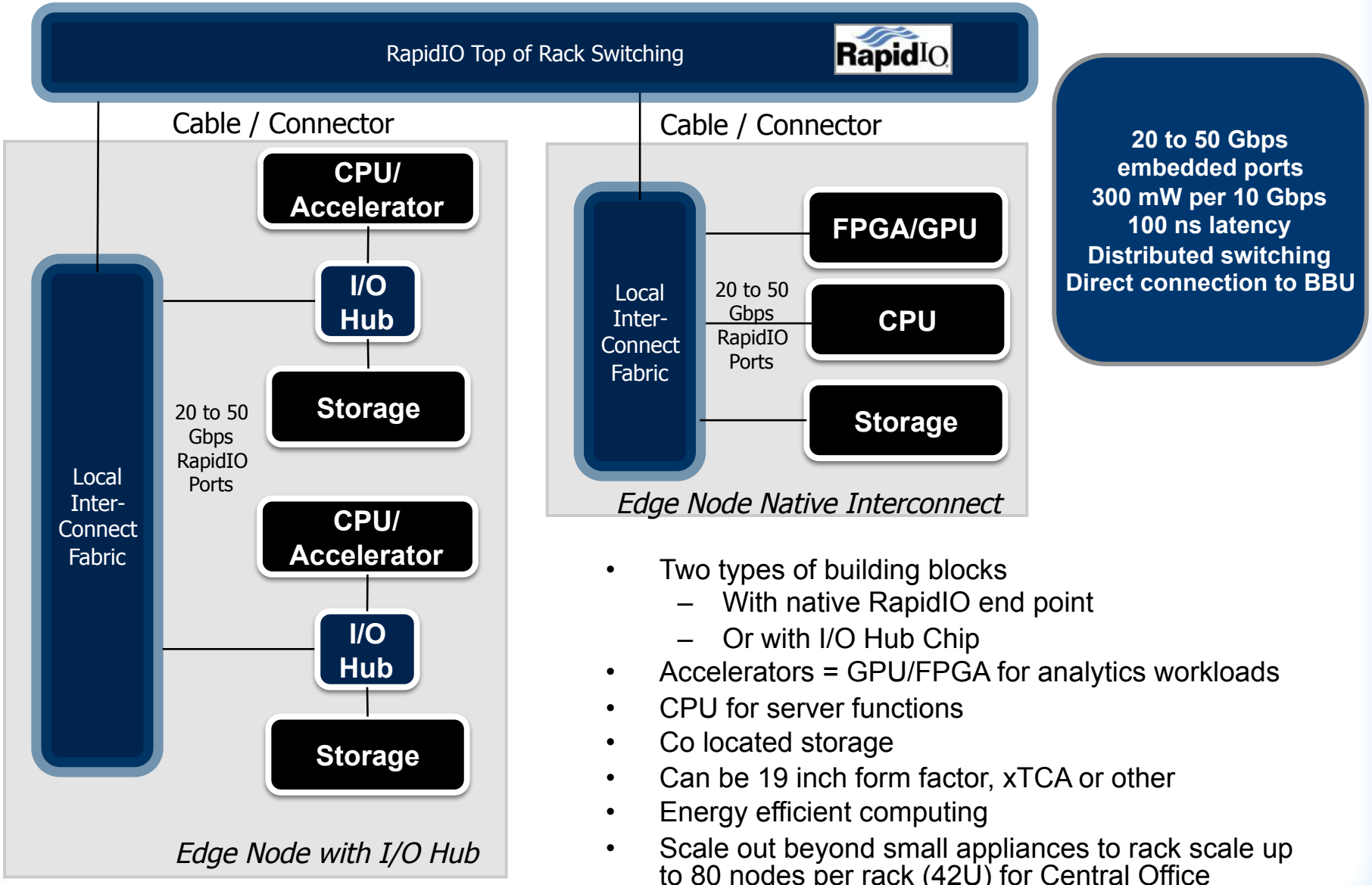
APPLICATION ISSUES SOLVED

- 50 Gbps per port with 95% link utilization
- 100 ns latency
- Power efficient 300 mW per 10 Gbps

Distributed low latency switching Optimized for needs of OCP Telco Initiatives



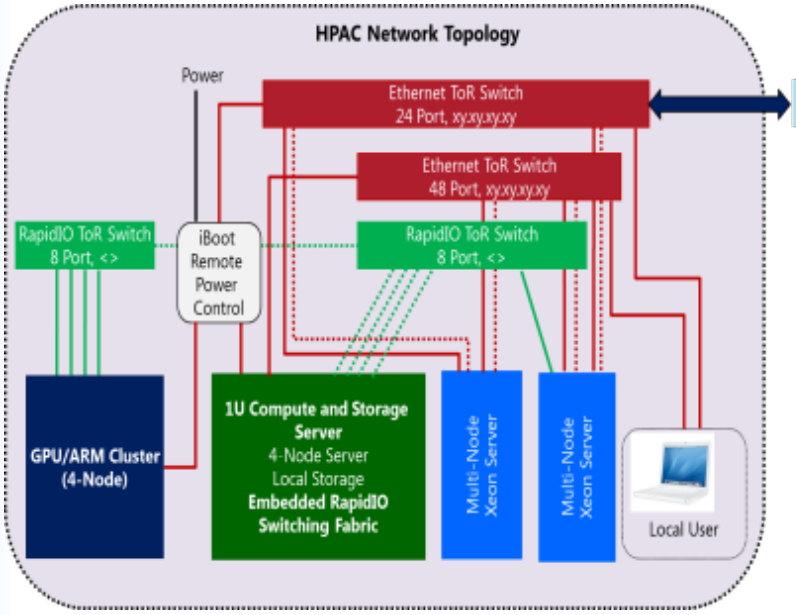
Scalable Low Latency Edge Computing Fat Node



- Two types of building blocks
  - With native RapidIO end point
  - Or with I/O Hub Chip
- Accelerators = GPU/FPGA for analytics workloads
- CPU for server functions
- Co located storage
- Can be 19 inch form factor, xTCA or other
- Energy efficient computing
- Scale out beyond small appliances to rack scale up to 80 nodes per rack (42U) for Central Office deployments

Edge Social Data Analytics

- Analyze User Impressions on World Cup Final 2014 (Germany/Argentina)
  - HPAC Lab project to analyze World Cup 2014 twitter data using Hadoop and visualize using Tableau public on HPAC Platform



Orange Silicon Valley

5G Lab Germany: Edge Analytics for Autonomous Vehicles

Autonomous Vehicle

Video Analytics/Object Recognition

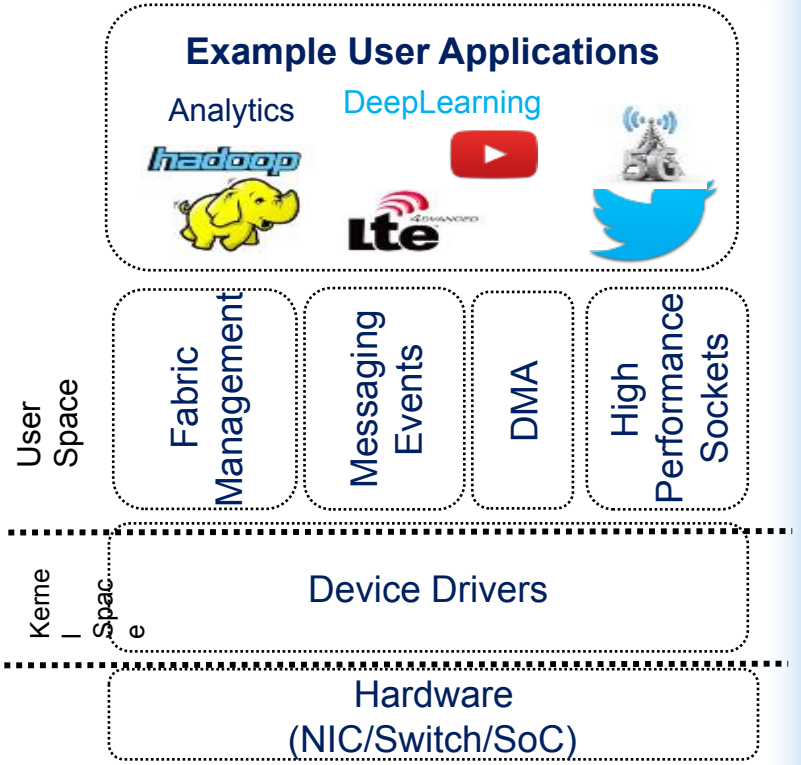
Deep Learning/Object Analytics

- Network Edge and In Vehicle Analytics
  - Edge Node Multi processor network
  - GPU/x86/ARM/Open Power based Analytics
  - Low latency RapidIO Fabric
  - In vehicle sensor fusion in real time with low latency
  - Leverage OCP Innovations (Edge Appliance and ToR)

Analytics Platform for the Edge

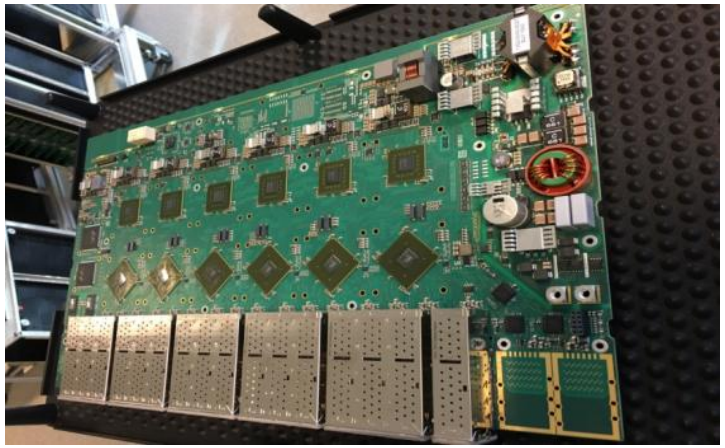
Launched at Mobile Edge Computing Congress 2015 London UK

RapidIO|GPU|x86|FPGA|Power|ARM
Low Latency | Energy Efficient | High Bandwidth



Contribute to OCP
Telco for Edge Computing
Planned 1H 2016

Proposed: OCP Telco Low Latency Switch for Edge Computing Scale Out



RapidIO PRODRIVE making your solutions more competitive IDT

0.75 Tbps
1 U 19 Inch 100 ns Switch
With 20 Gbps ports

- 38 x 20 Gbps ports
- Sub 200W switching power
- Support 42U Rack level scale out
- Available Now

Roadmap to 4.8 Tbps
2U 100 ns Switch
With 50 Gbps ports

- 96 x 50 Gbps ports
- Sub 400W switching power
- Supports redundant ports to 42U rack and intra rack scale out
- 2H 2016

5G|Mobile Edge Computing |HPC| Video Analytics | Low Latency Financial Trading

Open High Performance Analytics and Computing Lab

- Low latency scalable RapidIO interconnect to accelerate end market usage
- Key focus areas:
  - Hyperscale Cloud Data Center-Based Analytics
  - High-Performance Computing
  - Autonomous Connected Vehicles
  - Wireless 4G advanced, 5G and Mobile Edge Computing
  - Video Analytics
- Project by project contribution model
- Projects completed or in progress
  - Twitter Analytics on FIFA World Cup Finals
  - Supercomputing at the Edge with GPU
  - CERN LHC target acquisition and data center analytics
  - RapidIO ToR switching
  - 5 G Lab Germany: Mobile Edge Computing for 5G wireless networks with connected vehicles

Accelerate Adoption of OCP Solutions
Interest in establishing OCP Telco lab
Contact: Openhpac@idt.com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Compute Project