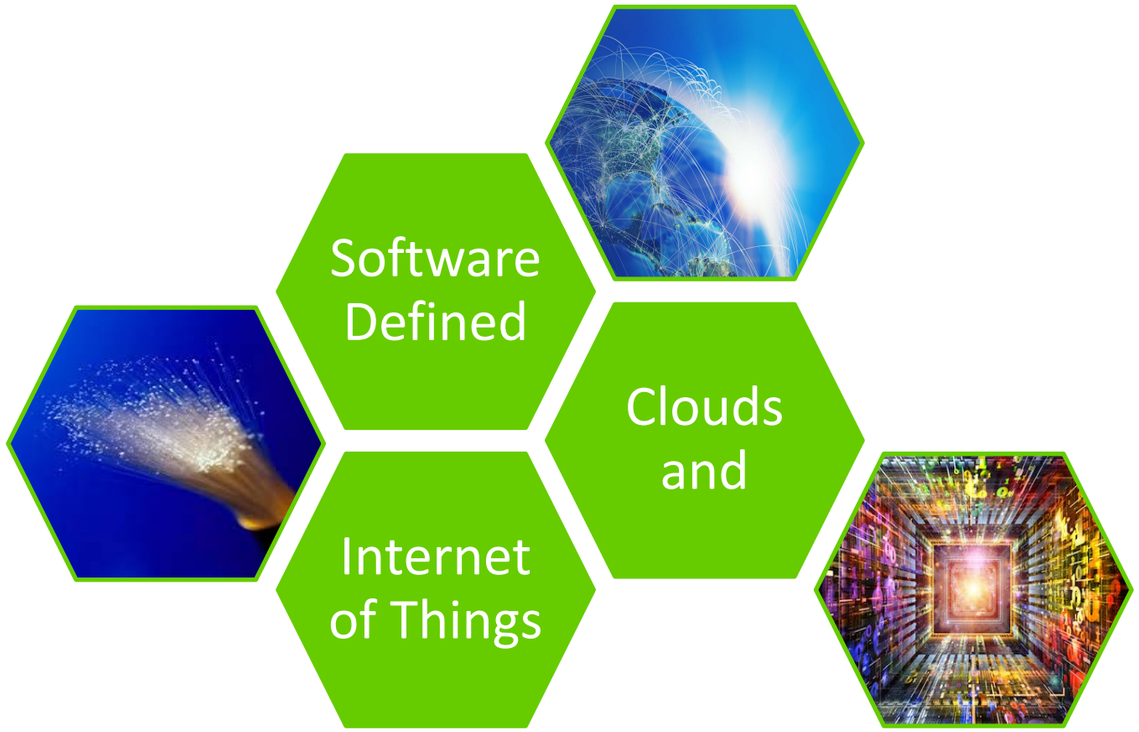


# Networks in the Software Age

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Technology Strategy, TELUS

June 06, 2016

# Storyboard

## Generational changes via Software Defined Infrastructures:

- **Long Term Topology**
  - COs vs. DCs
  - Copper vs. Fiber
  - Telephony vs. Video
  - Narrowband vs. Broadband
  - TDM leased lines vs. Ethernet and IP
- **Shift to Software and Virtualization**
  - Hardware vs. Software
  - Addresses vs. Identity
  - Appliances vs. VNFs
  - Pipes vs Apps

# Emerging Digital Network Architecture requirements

**Higher Speeds, Lower Latency, Secure Connection**

**Licenced vs Un-licenced Spectrum (Small Cells, WiFi)**

**4K video will require 25-30Mbit/s (FTTH/GPON)**

**Virtual Reality will require 1Gbit/s (5G)**

**Data Center is becoming part of the Wide Area Network (PODs, NiaB)**

**Data and Analytics are becoming the currency of the 21st century…**

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# Open Programmable Networks

Networks are Complex, Closed, Rigid and Proprietary.

SDN is designed to make them Open and Intelligent with Centralised Control for Automation.

We need to Re-Imagine the Network with Gigabit Access Speeds, Ultra Low Services Latency and Clean/Secure Pipes.


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# Placing wheels on ideas…

In the “Sharing economy” the concept of ownership is becoming obsolete…

Emerging Applications and customer expectations will dictate network resources on demand…


If the network fails, so do M2M, IOT, ICE, Smart City and the Health Applications.

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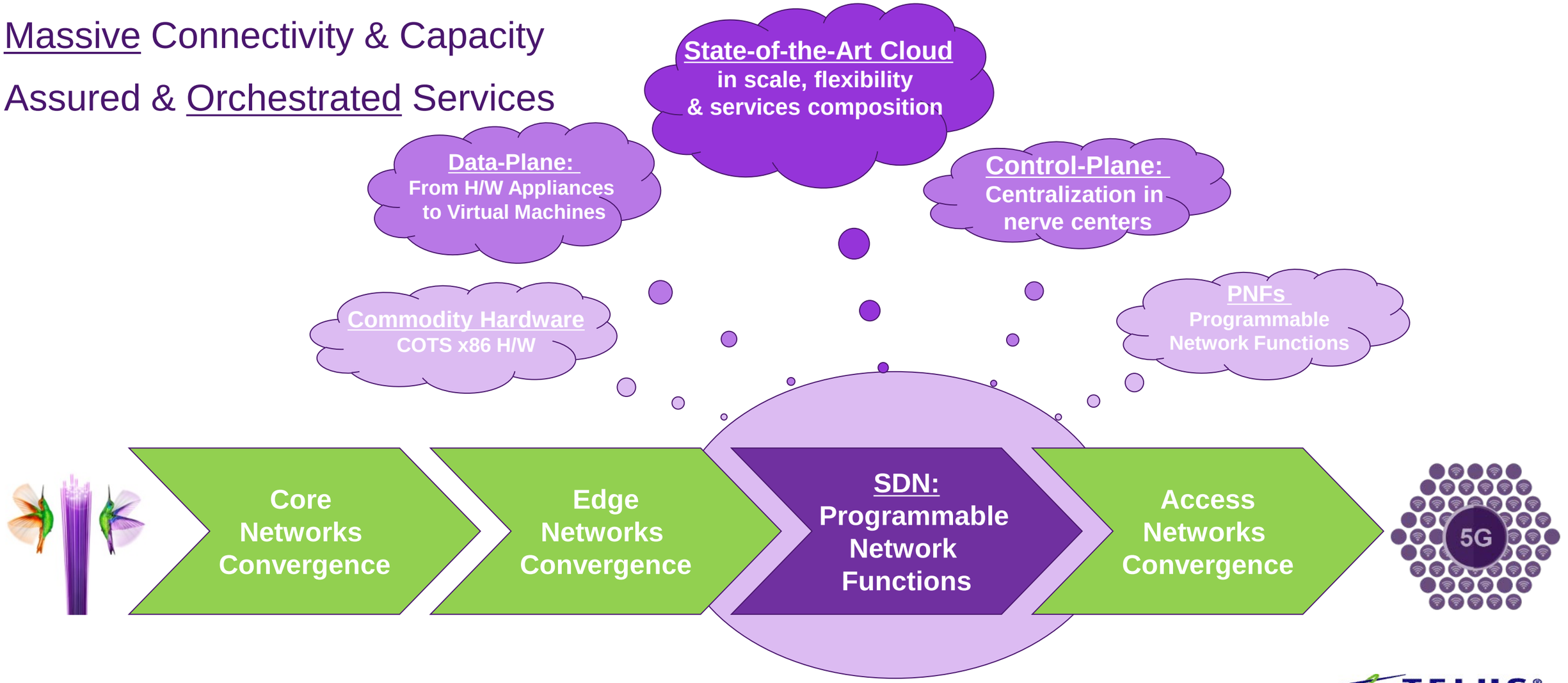
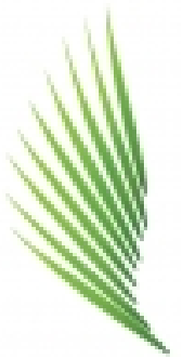
# SDN: Pre-requisite for Emerging Technologies

- SDN & Virtualization pre-requisites for 5G
- Massive Connectivity & Capacity
- Assured & Orchestrated Services

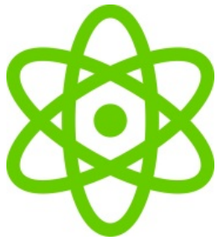


# Future Broadband

## Orchestration Layer - MANO

- Customer Plane
- Service Plane
- Network Plane



## Control Layer - SDI

- OTT Domain Controllers
- DCs and PODs Domain Controllers
- Transport SDN Controllers – Access, Backhaul, Optical, IP etc.

## Resource Layer – NFVI, NFVO and VNFM

- vNFs and on-boarding strategy
- Cloud OS
- x86

# The Next-Gen City – Gigabit City


## Key Thrusts

- Tectonic shift to Mobile
  - Up to 10x Densification required
  - Cloud based RAN
  - Virtualized EPC
  - Deeper Integration with Wireline Networks
- Programmable & Virtualized Networks
  - Policy Driven & Software Defined (Open APIs)
  - Multi-Layer Topology Integration
  - Virtualization of Functions
  - Self Organizing & Healing
  - IPv6 based numbering
  - Flows based Visibility
- Services
  - Access Independent Services
  - Metro based Content Caching (CDNs)
  - Control Planes consolidation in IDCs
  - Cloud based Services (IDCs)
  - Self Serve Portals

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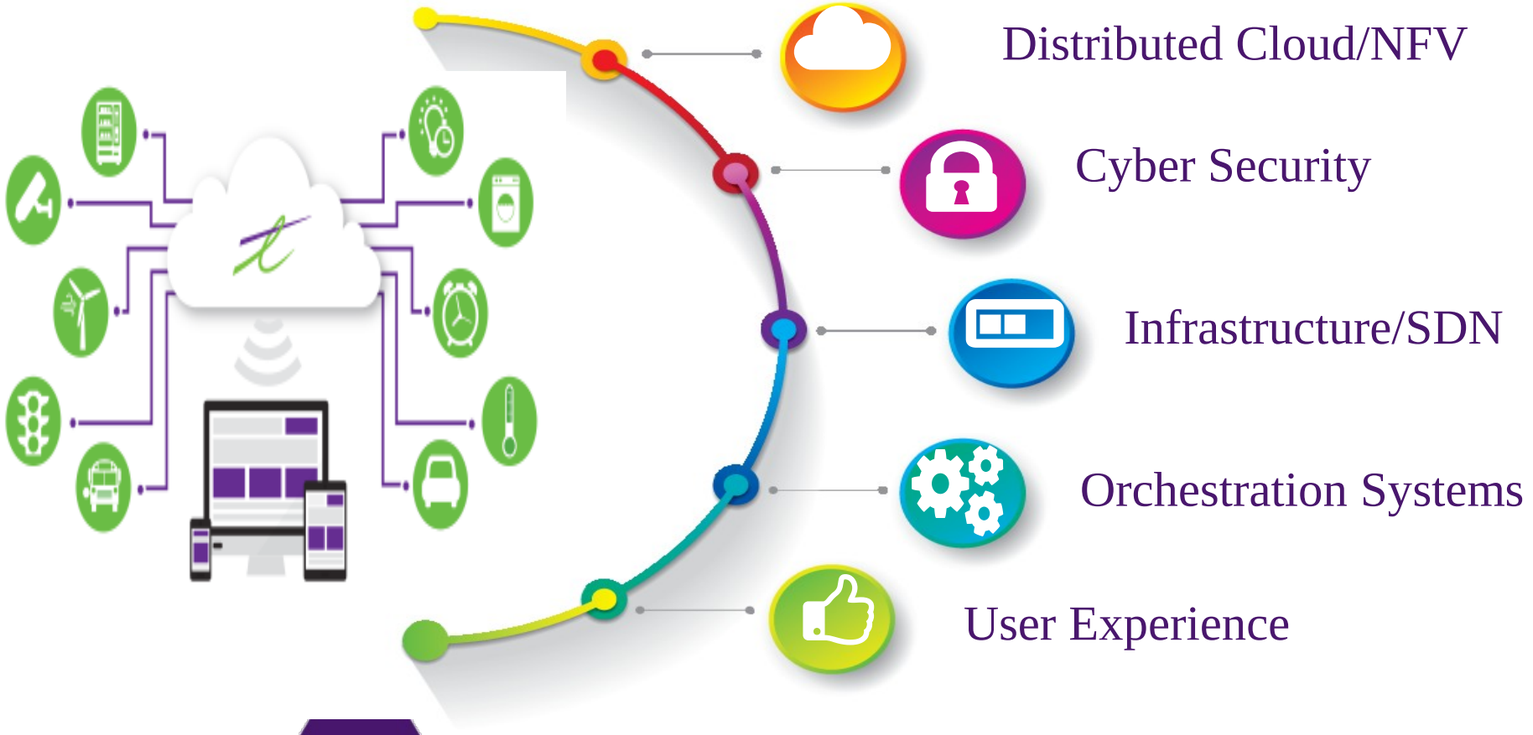
# Enabling the Gigabit City



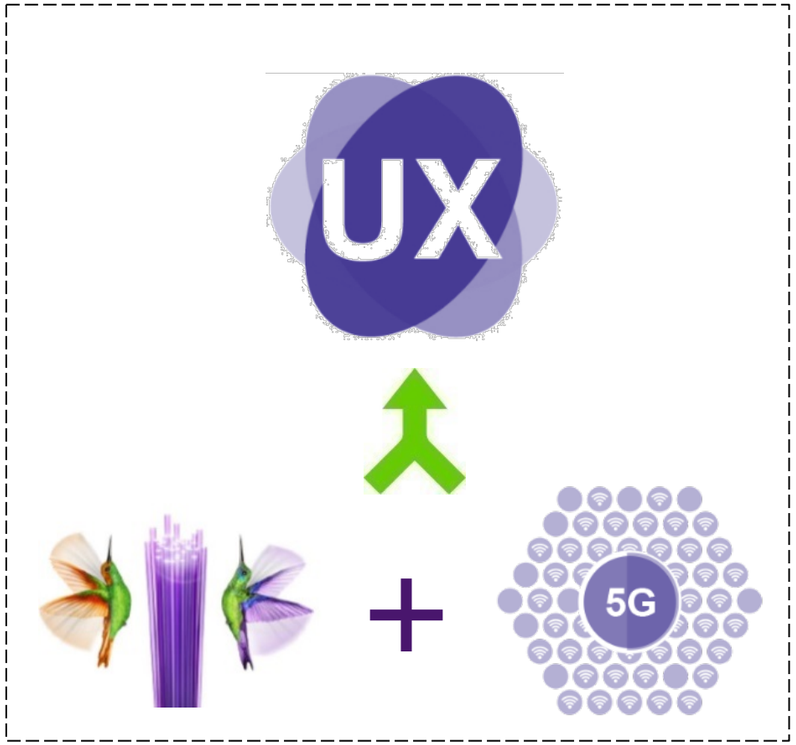
Distributed Cloud/NFV

Cyber Security

Infrastructure/SDN

Orchestration Systems

User Experience




Home

SMB

Transport

Venue

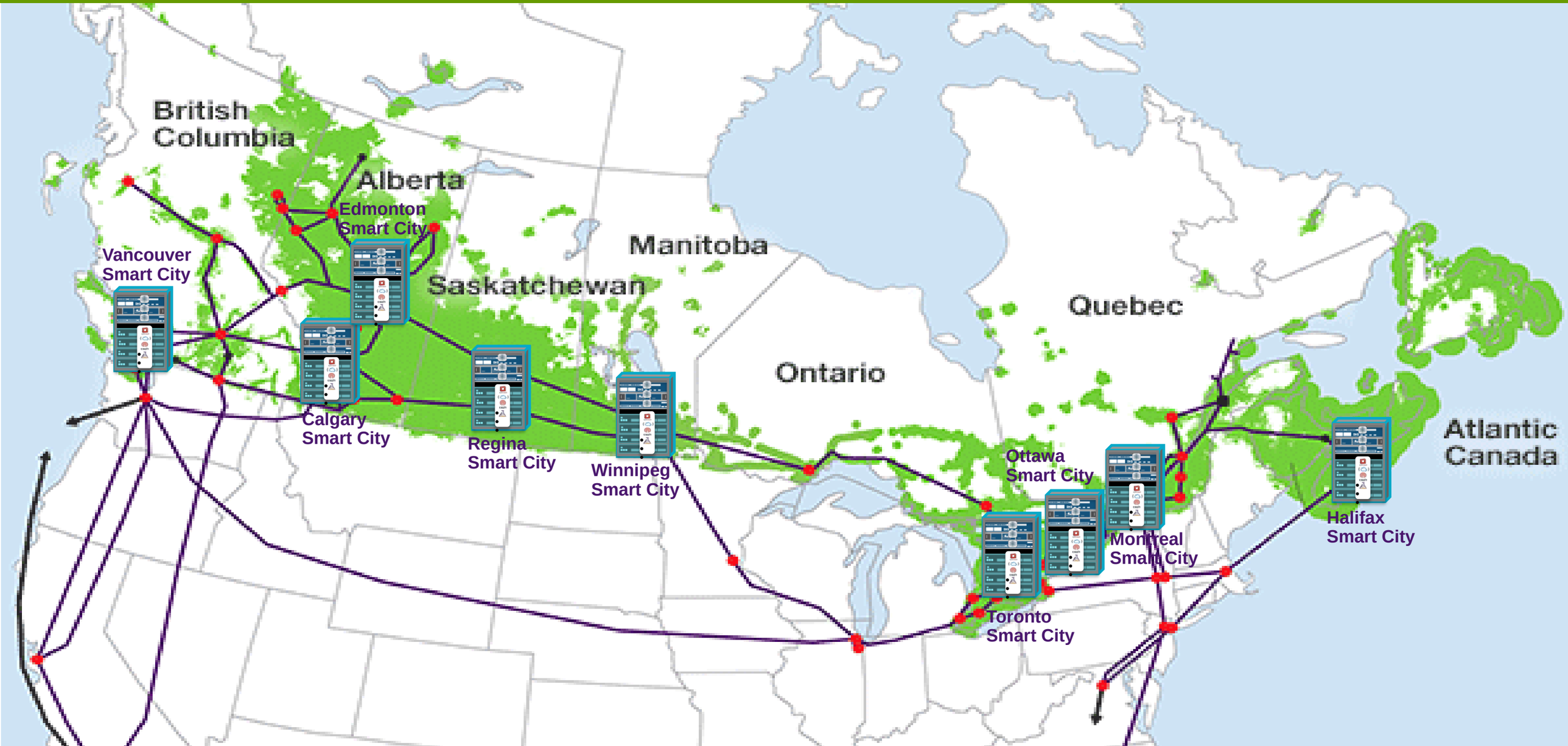
Office

Mobile

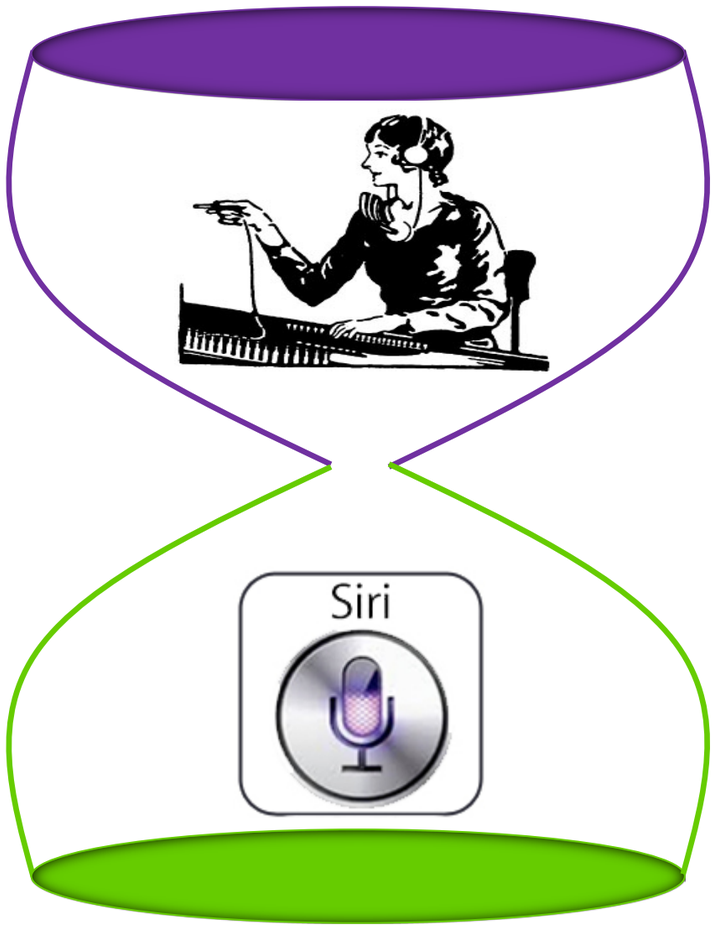
Industry

Global

# Supports the emerging needs of 5G and ICE and Health



# Our Challenge: Transforming Telco to Softco




- Addresses → Customers
- Corporate → Community
- Narrowband → Broadband
- Telephony → Video Services
- TDM leased lines → Ethernet/IP
- Shelves → Stock = Pipes → Apps…


**SOLUTIONS:**

- ❑ **Software Driven Infrastructure – Open & Programmable**
- ❑ **Process Automation – Harnessing the power of Productivity**
- ❑ **IP orientated Infrastructure - Internet vs. VPNs**
- ❑ **Re-alignment of the Communication Value Chain…**

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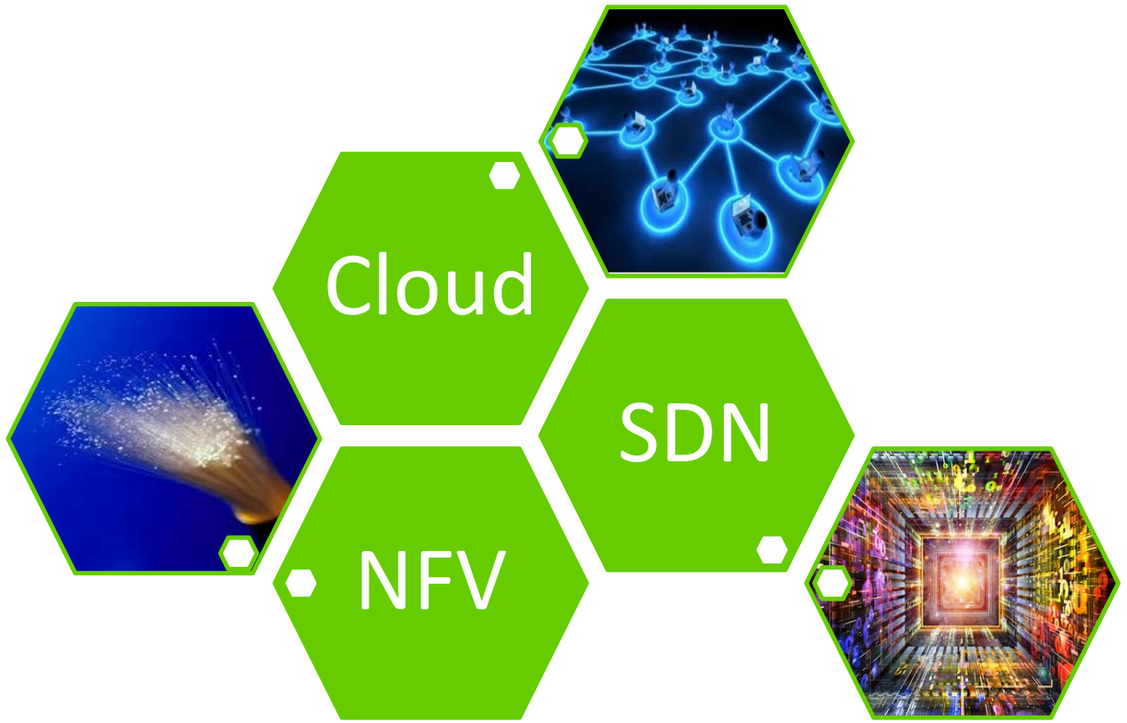
# Vessels for Change – NFV & SDN

Digital → Social → Mobile → Video → Cloud

**Role of NFV and SDN in Transformation:**

- **Intelligent** (mismatched →optimized)
- **Programmable** (rigid → agile)
- **Virtualized** (dedicated → shared)
- **Orchestrated** (manual to automated)
- **Fewer Control Planes** (IP & Optical → IP-Optical)
- **Visibility** (network based view → flow based view)
- **Reduce Costs** (elastic scale up/down etc)
- **Increase Revenues** (rapid service creation)
- **Improve Customer Experience** (improved visibility)

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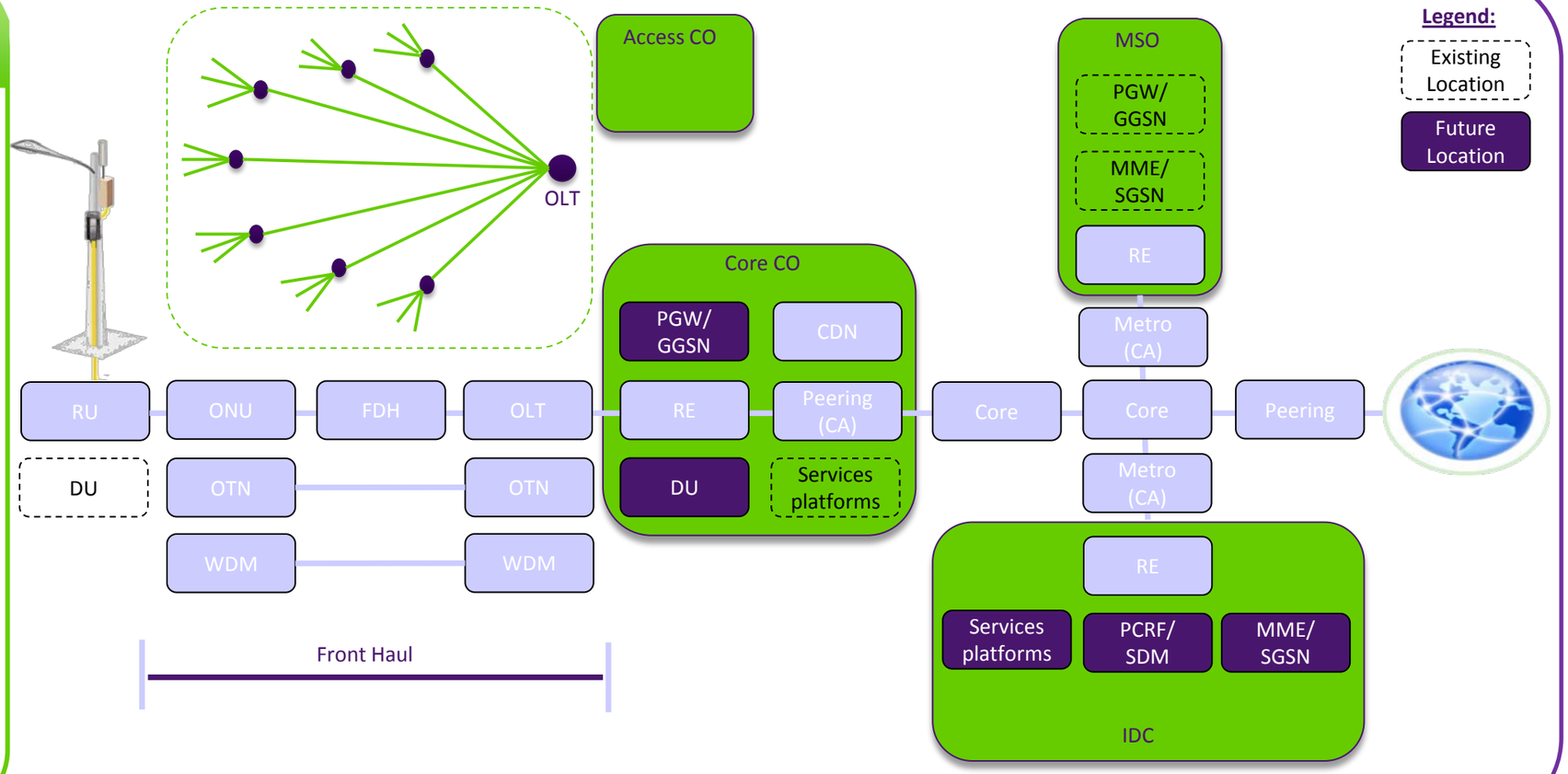
# Communication Eco-Systems in Motion

Radio → Front Haul → C-RAN → NFV → CDN → Centralization → Services → Internet

## Next-Gen City - Key Themes:

- Cloud RAN (BBU Banks in Core COs)
- Front Haul (Leveraging GPON Fiber)
- GPON (Footprint for Densification – x10)
- CO Consolidation (bypass non-essential buildings)
- Centralized Control planes in Data Centers
- Content close to the edge (CDN, Caches)
- EPC functions Virtualization

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# Universal Fiber Access

Residential Rural

Pico/WiFi

Residential Urban low value voice only

Residential med/high Value urban

Business Customer

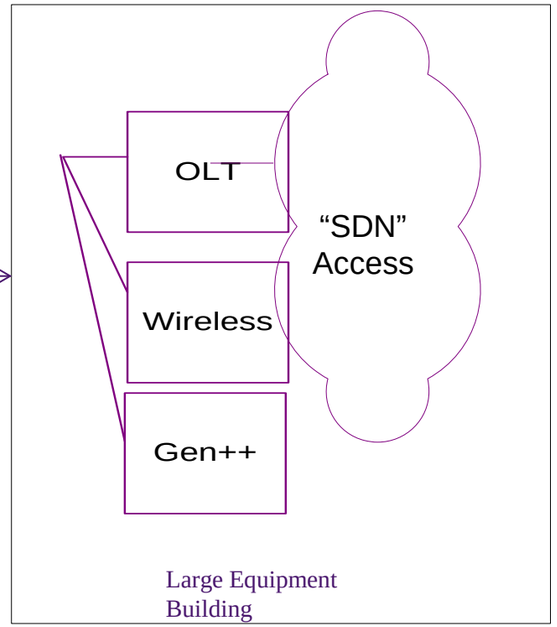
Tightly Integrated with Wireless Backhaul/Front-haul

Macro

Fiber Distribution Hub (FDH)

Existing Small Equipment Building

Location Consolidation (bypass of smaller building built solely for copper)




Large Equipment Building

Flexible Termination equipment, including multiple generations

Fiber footprint is as much about Wireless, as it is about Wireline…

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# Connectivity required Anywhere, Anytime, and on Everything

- Outdoors/Municipalities
- Retail venues
- Commercial real estate
- Large venues (ie. Stadiums, Arenas, Attractions)
- Homes
- Vehicles
- Everywhere

# What's needed for the Smart City


Access to information
Broadcast communication
Citizen feedback
Vehicle/Asset Tracking
Citizen Safety

Today

Future

Localized information
Identity
Access to Services
Smart Services
Transactions
Connected transportation

Mobile Devices
Mobile Apps
Wi-Fi
Health Services
Connected Signage

Access Gateway

Connectivity
IPTV
Cloud Storage
M2M
Security

Service Delivery

IP Enablement
Data Centres
Identity
Payment
Big Data
LBS

Service Enablement

HetNet

Connectivity Access Layer (IP)

Universal Fibre Access

Virtualized Compute & Storage

Connectivity Infrastructure

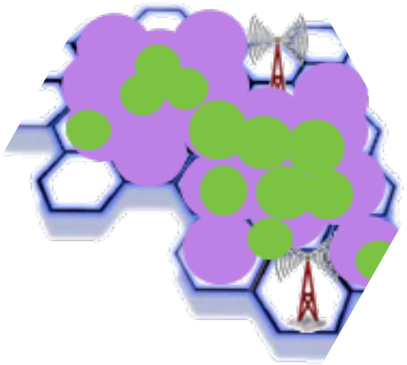
## Connected & 'Smart' City

- Connectivity access
- Mobile access to services
- Two way communication
- Transparency w Citizens
- Consumerization ready
- Operational cost savings
- Infrastructure availability
- In Depth Business Intelligence

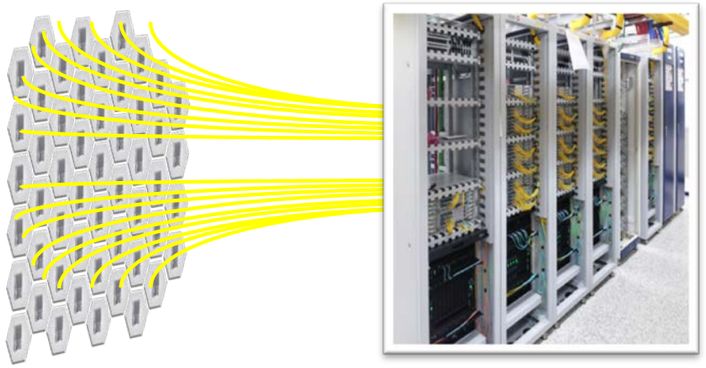
## TELUS Value provided

- Provide cost savings
  - Free public Wi-Fi, Mobile Apps as a Service, Cloud storage
- Expertise in Connectivity
  - M2M, Devices, Applications, Security
- Sustain best grade Infrastructure
  - Network, Data Centres,
- Technology Strategy and Innovation
  - Fibre, Small Cells, Identity, Health, Payments

# Key Message: The synergies between key programs!



Densification
(Small Cells, Wi-Fi etc)



Cloud RAN
(Economies of Scale)

LTE (Cloud RAN)

Swift (Small Cells & Wi-Fi)

Synergies

COR (Next-Gen City)

Falcon Investment (GPON)

Cloud, NFV & SDN

Universal Fiber Access

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# Thank-you

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