5G unleashing massive IoT

Architecture and use cases

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Personas @Cisco (15 years)
Dev-test, Engineering
TAC, BU-Escalation, TL, SA

What drives me:
- Designing solutions aligned to our customer outcomes
- Digitizing industries – DC/Cloud, SP/Enterprise, IoT
- Transforming legacy → Programmable infra using Automation
- Co-innovation@ Cisco → always learning and discovering
Agenda

• 5G Evolution – Industry Architecture
• Massive IoT with 5G
• Industrial use cases
• Q & A
Time For The Next Mobile Generation

1980s
• Analog
• AMPS
• Voice

2010s
• 4G
  • LTE/LTE-A
  • Broadband data & video

1990s
• Digital
  • GSM, IS-95, IS-136
  • Voice capacity

2020s
• 5G
  Digitization

2000s
• 3G
  • WCDMA, CDMA2000
  • Voice & data
## 5G Building Blocks

### Radio
- **Open RAN** with control and distributed architecture
- Combo Radio
  - eNodeB
  - eNodeB+ 5G NR
- 5G NR
- Unlicensed radio integration at edge

### IP Transport
- Latency and bandwidth aware programmable transport
- 5G services aware Transport – network slicing, timing, security
- Front Haul, Midhaul, backhaul solutions

### Edge Computing
- Multi-access edge computing (MEC) for edge services
- User Plane forwarding at Edge
- Intelligent Service Edge - NFV, SDN, Network Fabric
- Open API

### SDN Fabric, Evolved Packet Core
- Programmable Infra
  - DC ACI
  - NFVI CVIM
- xEdge Innovations

### Orchestration
- Multi-domain Services Orchestrations
- E2E Network slicing
- Open APIs and controllers to simplify operations

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**End-to-end Service Assurance and Security**

**Network Function Virtualization** | **Dis-aggregation** | **Automation**

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5G – service catégories

- **eMBB** - Enhanced Mobile Broadband (inc. Fixed Wireless Access)
  - Increased Bandwidth and Capacity

- **mMTC** – massive Machine Type Communications
  - Slicing, Flexible deployment, NFV/Virtualization

- **URLLC** - Ultra-Reliable Low Latency
  - New use cases (V2X, AR/VR, TSN)
  - Push data plane to the edge, adaptive Intelligence in Network

Source: [Recommendation ITU-R M.2083](https://www.itu.int/rec/R-REC-M.2083/en)
4G to 5G Architecture Evolution

4G Architecture
- eNodeB
- CPRI
- RU
- DU
- Backhaul
- EPC
- Central Datacenter
- IP Core
- IP Edge
- vCore
- User plane
- MEC
- Managed Video
- Legacy 3G, LTE, LTE-A
- 5G <6GHz (Micro, Pico)
- 5G mmW (Pico, PTMP)
- WiFi next-G AP
- CIoT/LPWA
- Decompose, virtualise & centralise

5G Architecture
- Fronthaul
- vRAN
- Edge Datacenters
- vCore
- User plane
- vCore
- Control plane
- Managed Video
- Service Architecture
- SDN Network Fabric based on Segment Routing
- Data Center Fabric based on NFV
- E2E Network Slicing
- Orchestration Automation SON
- SON
- SDN
- MANO Analytics/Telemetry
- Decompose, virtualise & distribute
Open Network Architecture for 5G

Service Creation
OSS | BSS

Public • Private Cloud and/or On-Prem

Business • IoT • Video • Mobile • Collaboration

Network Abstraction

Orchestration • Automation • Assurance

Streaming Telemetry

Infrastructure

Physical & Virtual

Security
Policy
Analytics
5G Architectural Tenets

VIRTUALIZATION, NFV AND SDN
- Simplicity
- Service Velocity
- Open and Flexible

ACCESS AGNOSTIC
- True Heterogeneous Networks
- Wi-Fi
- Licensed and Unlicensed
- Small Cell
- Early 5G and FWA

AUTOMATION AND ORCHESTRATION
- Self Optimizing Infrastructure
- Optimize Operations and Service Creation

API EXPOSURE
- Build From Strength In Mobile Core
- Extract Data From The Network
- Create Vertical Value
- Enable New Business Models

SECURE DEVICE – NETWORK – CONTENT
Overview of network slicing

• A set of resources logically grouped together
• Can span across multiple domains or administrative bodies
• Resources can be dedicated or shared over a common infrastructure
• Live by a set of particular vertical business requirements
• Life-cycle of slices is automated/orchestrated
End-to-end network slicing illustration

Access  Transport  Core

Slice #1  Slice #2  Slice #3

AMF  SMF  UPF  PCF  IPS/IDS  NSSF  UDM  NRF

WWW

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Massive IoT and 5G
IoT Technology Platform. What it Takes.
Cloud and Fog

Applications

App Enablement
- Event Management
- Workflow / Rules Engine
- Video Sensing
- Data Normalization and Modeling
- Protocol Mediation
- Enterprise App Integration

Infrastructure
- Software Defined Networking
- Compute Storage

Things

Analytics

Security and Identity Management

Open and Programmability (APIs)

Ease of use and Management
Data Center

Cloud

Pass to external message system.

Integrate with IT

Format for a specific target

Format for a specific target

Data Center

Fog Node

Store as Time / Series Data

Analyze and act upon data

Transform data to canonical format

Edge Node

Communicate with Device

Filter / Evaluate Data

Device

Device

Format for a specific target

Store as Time / Series Data

Analyze and act upon data

Transform data to canonical format

Filter / Evaluate Data

Pass to external message system.
To Get Value From Data

Extract & move data from things to apps

Derive business value

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And These Things and Apps are Distributed
An IoT Distributed Data Platform is Required
Many Use Cases with Many Different Requirements

**Automation & Monitoring**
- 50 – 500kbps
- High
- Fixed
- 10 Years

**Security & Surveillance**
- 0.5 – 8Mbps
- Low
- Fixed
- Connected

**Fleet Management**
- 100s of Kbps
- Low
- 10 – 150Km/h
- ~3 months

**Smart Cities**
- 50 – 500Kbps
- Low
- Fixed
- 10 Years

**Automotive / Telematics**
- 10s of Mbps
- Low
- 10 – 150Km/h
- Vehicle

**Wearables**
- 10s of Mbps
- Low
- ~5Km/h
- ~1 week

Source: 4G Americas
Key challenge:
Optimize the waste management operations

Solution:
• LoRaWAN technology enabled waste containers that monitor the filling level of the container

Key benefits:
• Real-time location and monitoring of waste containers
• Containers are emptied only if detected as full
• Waste vehicle operations are adapted and directed in real-time towards 100% full waste containers

Device partners:
LPWA example: Anti-theft solution

Key challenge:
Track & monitor cable drums to avoid copper thefts

Solution:
- LoRaWAN technology enabled GPS trackers embedded in cable drums

Key benefits:
- Long distance coverage up to 15 km without local gateways
- GPS low power consumption
- Utility dedicated tools to manage, operate and visualize data
- Geofencing
- Alerts in case of theft
- Ability to track the drums

Device partners:
Moving Up The IoT Stack

- Many protocols and standards to choose
- How to enable and manage communication between IoT devices and apps?

Device data and applications

- HTTP, CoAP, MQTT, ..
- IP, Non-IP Data
- eMTC, NB-IoT, other LPWA, wireline, …
Tell me about your Apey Eyes
Service API and Data Modeling for 5G-IoT

- REST API to manage device data
- Stateless interfaces
- No need of many functions: just read/write/change/delete
- A common vocabulary is required to define IoT data and concepts
- Need a data model and semantics to represent device data
- Built-in Security

Source: OneM2M
Architecture for Cities

Citizen Applications

Urban Services Applications

Citizen Engagement App
Parking Enforcement App

Operations Center
City Dashboard

Common distributed s/w platform for Cities

Lighting Cloud
Parking Cloud
Safety and Security Cloud
Waste Cloud
Urban Mobility Cloud
Environmental Cloud

IoT Access
Connectivity Management
Device Management
Data Management
Application Enablement
App & Analytics
Cloud Infrastructure
Security
Secure Device Registration
Secure Architecture and Infrastructure
Secure Software Development Practices
Secure User and App Authorization
Manufacturing to Gain New Insights and Control
Asset Management Use Cases & Challenges 😊

Service Providers, Utilities

Enterprise

Renewable Energy

Manufacturing & Automotive

Transportation & Logistics

Connect the unconnected using environmental sensors like temperature, pressure, power, fuel level, IP cameras, etc. Location technologies such as RFID; WiFi; GPS; other sensors etc.

Challenges

Asset Identification, Tracking, Location

Asset Utilization, Manage by Exception

Physical Security, Theft prevention, Detection

Energy Baselining and Optimization

Improve Business Productivity
Securing IoT

- **IoT & M2M**: Weak inbuilt security in IoT devices, attacks using encrypted channels
- **Virtualization**: Increased complexity in mitigating side channel attacks
- **Distributed Architectures**: Increased threat vectors due to distributed core, edge computing & network slicing
- **New & Legacy Technologies**: Multiple technology convergence, threat migration between technologies

Adhering to Regulatory requirements (GDPR, DLP, etc…)

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Key takeaways
In a

Immersive AR/VR  IoT  Autonomous Cars, Drones & Robots  Pervasive Wireless  Customized Networks

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<th>mMTC</th>
<th>eMBB</th>
<th>uRLCC</th>
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<td>Energy</td>
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<td>Reliability</td>
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Security

Applications

Platforms

Infrastructure

Automation

Management

AR: Envision/Fix  VR: Interactive Gaming  Smart City Apps  Connected Car

IoT Connectivity Platforms

Applications

Infinite Video

Security

Automation

Management

Orchestration

IoT Connectivity Platforms

Applications

Infinite Video
Questions?