Network Transformation in China Mobile
NovoNet

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President of ONAP Governing Board
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1. NovoNet: Vison of future network in CMCC
2. Open Source Practices in CMCC
World’s Leading 4G Network

**Bigger Network**
1.5 M+ 4G BSs
Account for over $\frac{1}{3}$ of global 4G BSs

**More Subscribers**
0.53 B Subscribers
Account for over 30% of global LTE users

**More Device Choices**
2600+ commercial devices
75% are 4G devices less than USD 145

**Better User Experience**
313 cities commercially launched VoLTE
Market Triggers Operator’s Network Transformation: Huge Traffic

Large granularity of video is the major part of the traffic in future—significant bandwidth demand

- High-bandwidth video services exhibits increased development trend
- Explosive growth of data usage per user/unit time

• E2E traffic flow optimization is difficult: whole network resources usage is less than 50% (20-30% in extreme cases) - however local congestion still exists
• Traffic not terminating at edge: many cross-segment network interconnections, traffic termination point is in central site
Market Triggers Operator’s Network Transformation: Large Connection

Number and type of connection will increase significantly

<table>
<thead>
<tr>
<th>Connected devices (billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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Saturation of connections between people: rapid growth of IoT connections

- IoT equipment CAGR is 23% between 2015 and 2021, will exceed the phone and become the largest Internet equipment.
- Global networking equipment is expected to reach 28 billion in 2021, 16 billion relates to IoT.

<table>
<thead>
<tr>
<th>Non-cellular IoT</th>
<th>Cellular IoT</th>
<th>CAGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2</td>
<td>0.4</td>
<td>27%</td>
</tr>
<tr>
<td>14.2</td>
<td>1.5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PC/laptop/Tablet</th>
<th>Mobile Phones</th>
<th>Fixed Phones</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.7</td>
<td>7.1</td>
<td>1.3</td>
</tr>
<tr>
<td>1.8</td>
<td>8.6</td>
<td>1.4</td>
</tr>
<tr>
<td>1%</td>
<td>3%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Challenges

- Tremendous types of business, requires high network capabilities
- Large amount of on-demand and dynamic business requirements bring challenges the network openness, automated tools and business processes
NovoNet – Our Vision of Future Network

New Network Architecture
- Virtualized Network Function
- Centralized Control
- Programmable Network

New Network Operation
- Auto Deployment
- Flexible Orchestration
- Maximal Usage

New Network Service
- More Open
- More Agile
- On-demand

Enabler Technology
NFV
SDN
Future Network: Re-construction of Infrastructure, OSS, and NFs

Features of Future network
- Re-constructed Infrastructure
- Re-constructed Network Operation and Service Delivery
- Re-constructed Function(s)
1、Re-construction of Infrastructure

New infrastructure: deploy cloud-based DC as infrastructure pool, carrying various network functions
Centralize control: network control functions is located in the core TIC
Media plane at edge: build edge TIC near access site, steer content to the network edge, fast traffic distribution
TIC is the Standard Unit for the infrastructure Of Future Network

• TIC (Telecom Integrated Cloud) is the standard unit for NovoNet. It supports telecom software app based on carrier-grade infrastructure
• TIC is based on standard network, infrastructure and orchestrator. It is easy to copy and quickly deployed.

Standard Infrastructure

• Unified hardware design with limited number of models suitable for different category of services.
• Unified Cloud OS

Standard Orchestration

• Integrated NFV & SDN Orchestration

Standard network

• Strict network plane partition, including Management net, service net, and storage net.

TIC : Telecom Integrated Cloud

MANO
SDN Controller
VNF
Cloud OS
Hardware
FW
Router
Switch
Power
2. Re-construction of OSS: Orchestrator

New network operation requires a new operation support system.

A new Orchestrator could be the core of next generation OSS.
2. Re-construction of OSS: Orchestrator

Orchestrator: enable us to organize network as easy as play Lego
3、Re-construction of Network Functions in 5G

5G network is transformed as a soft network leveraging IT technology to provide agile and flexible architecture to be faced with diverse business scenarios.

**4D Characteristics to guide Arch. Design**

- **Customized Service**
  - Network programmable and more agile
- **Modularized Function**
  - Function modularization and composition on demand
- **Virtualized Infrastructure**
  - Cloud basis
- **Centralized Management**
  - Network services and functions unified orchestration
5G Standard in Full Speed, China Mobile Plays a Leading Role

- Leading the 5G system architecture (5GS) standard project, supported by 67 companies, first time China company leading international network system design
- No. 1 among the operators of submitting 91 contributions during 5Gs study phase

Targeting year **2020** large-scale commercialization is quite critical.

**CMCC 5G plan**

**3GPP 5G timeline**

<table>
<thead>
<tr>
<th>Year</th>
<th>Phase 1</th>
<th>Phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>Frozen time for 5G Phase 1 normative work</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>23.501</td>
<td>Large-scale pre-commercial trial</td>
</tr>
<tr>
<td>2017</td>
<td>23.502</td>
<td>Pre-commercial trial for Interoperation test</td>
</tr>
<tr>
<td>2018</td>
<td></td>
<td>Architecture design and technology verification</td>
</tr>
<tr>
<td>2019</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td></td>
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Nov Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4

New Architecture of 5G — “Cloud Native” SBA Design

**Service-based Architecture (SBA):** design network functions as elementary “services”, interact through API. Three principles to define services: self-contained, reusable and independent management. SBA has been accepted as the unique architecture by 3GPP SA2#112 in May 2017.

- **Agile:** service is decoupled, network deployment, maintenance and update is faster
- **Scalability:** lightweight interface makes new feature be introduced without define point-to-point reference point
- **Flexible:** through modularization, reusability to achieve composition to meet flexible networking of network slicing
- **Openness:** new REST API interface makes operator and the third-part invoke network services much easier
Network slicing is a 5G new concept enabling a new business model to serve for 5G diverse scenarios.

- **Massive IoT**
  - no mobility, Small data: 100kbps
  - Low throughput, terminal 10 years
  - High density 100 million connections/km²

- **eMBB**
  - High throughput: 100Mbps~1Gbps
  - High mobility support

- **URLLC**
  - latency: 1ms~5ms
  - high availability, mobility and edge computing support

**Network Slicing**

- Provides E2E logical isolated network, dedicated for vertical customers
- Dedicated networks provide guaranteed performance, leveraging SBA

“Software” 5G based on NFV

- 5G NFs can be flexibly deployed in TIC+AP based on the service scenarios.
- 5G leverages cloud technology to achieve network customization, openness, service-oriented, to support huge traffic, large connection and low latency capability to connect everything.
Fixed Broadband network Evolution – C/U Separated vBNG

- **Separation of control and user plane**
  - Centralized Control Plane: NFV provides flexibility and scalability in TIC-CORE
  - Distributed User Plane: High performance hardware ensures data forwarding in TIC-EDGE

- **Advantages**
  - High utilization: Network utilization rises more than 50%
  - Simple maintenance: Centralized control, reduce 90% device configuration
  - High performance: 10 times faster dialup speed
1. NovoNet: Vision of future network in CMCC
2. Open Source Practices in CMCC
Open Source – A New Ecosystem for Communication Technology

In the development of NFV/SDN, open source communities and the standard organizations are the driving force to promote the transformation of the CT industry.

- Open Source needs standardized framework guideline and coordination from Standards
- Standard organization needs Open Source community to help promote rapid development of codes

Understand
- Promote the fulfillment of Carrier-Grade features
- Reduce difficulties and complexity of software development
- Software Integration

Self-integration
- Self-integration with multiple open-source software and tools

Self-development
- Self-development instead of procurement. Developing customize features based on open source software
- Back into upstream

Open source leads to the transformation of Service Providers from purchaser to active player in manufacture procedure
China Mobile’s Participation in Open Source

- Initiated by CMCC and AT&T
- President of ONAP Governing Board
- Vice Chair of TSC
- 2 Core projects (VF-C, Use Case Portal)
- Lead the discussion of Fusion Architecture and Use Cases

- Vice Chair of Board
- 3 PTLs (HA, DPACC, OpenRetriever)
- 2 OPNFV Ambassadors

Coordination between SDOs and open source especially in NFV and 5G
China Mobile’s Critical Practice based on Open Source

SDN Controller: “Aero”

SPTN Controller

Customized Switch

Customized Chip for SPTN
From OPEN-O to ONAP

**OPEN-O**: our first step to open source orchestrator.

ONAP: under the coordination of Linux Foundation, China Mobile, AT&T, and other partners co-founded ONAP as a unified open source project.

- **15 members**
- **125 developers**
- **1st Release SUN in 2016/11**
- **2nd Release Mercury in 2017/04**

**ONAP**

- **30+ members**
- **Merged architecture**
- **Combined community**

We believe ONAP will have a greater influence on the industry development.
ONAP architecture

- ONAP as the E2E service orchestrator will be the brain of future network.
- China Mobile will devote more resources to ONAP, develop commercial product based on ONAP and deploy it into real network.
Expectation on Open Source

5G and Open Source shall achieve interactive development.

- **Service Orchestration**: Flexible deployment and maximal usage on Service granularity
- **Open Source NF**: More Agile development of network functionality
- **Open APIs applied for Vertical Industry**: More Open and On-demand invocation of 5G network capability

- **New Coordination**: Refer the latest progress of SDO’s, provide reference implementation and feedback to SDOs for verification or new feature design
- **New Tools**: Easy for deployment and usage when open source is leveraged in production network
China Mobile hopes to work with all the partners to advance the future network transformation!

Thank You!