Network configuration problem statement
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Abstract

In LTE (Long Term Evolution) bearer network, there will be a large number of network elements and service tunnels which will bring a lot
of configuration work. The cost will be very high if all these work is performed manually.

In order to reduce the workload of configuration to minimum, the following questions should be considered:

- How to establish the DCN (Data Communication Network) connections automatically to avoid making configuration locally?

- How to establish the DCN connections automatically between different vendors’ network elements or how to pass through different service providers’ network?

- How to get network element and link information of the real network based on the information from network planning?

- How to generate configuration scripts to setup network and service links automatically in order to reduce configuration design workload.

LTE is a typical scenario which involves large number of network elements and service tunnels. Other scenarios like IPTV may also have network configuration problems discussed in this document.

This document discusses problems related to lightening network configuration workload and better transmission tunnel setup between network elements and NMS (Network Management System).

Table of Contents

1. Introduction .................................................. 2
2. Conventions used in this document ............................ 3
3. Configuration problems ....................................... 3
   3.1. Configuration workload in LTE scenario ............... 3
   3.1.1. Remote configuration .............................. 5
   3.1.2. Automatic generation of network configuration ...... 5
4. Security Considerations ....................................... 6
5. IANA Considerations .......................................... 6
6. References .................................................... 6
   6.1. Informative References ................................. 6
7. Acknowledgments .............................................. 7

1. Introduction

The mobile network will evolve to LTE obviously. In LTE phase, the number of base stations will be ten times more than 3G. Following
this, constructing LTE network will take a lot of efforts due to the large numbers of base stations and bearer network elements. SON is considered in 3GPP to lighten this work [1]. To support SON, the bearer network should be setup first to provide required service links.

Several issues of configuration in the existing network constructing should be considered:

- It takes a lot of work to design the configuration scripts for the large amount of network elements, which will often bring occasional mistakes.

- Some of the base station’s address and links can not be acquired. So the network topology often changes from what is planned, and the pre-designed configuration scripts of the network elements need to be changed in network deployment phase.

- Without DCN connection, the initial configuration scripts can only be input locally or use MODEM/CF cards, which involve large amount of manual work.

- The manual work cannot avoid mistakes which will cause failure of network.

This document provides two problem statements related to minimizing the network configuration workload.

2. Conventions used in this document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC-2119.

3. Configuration problems

3.1. Configuration workload in LTE scenario

In a typical LTE network scenario, there will be up to 16000 base stations, 20000 network elements and up to 200K service tunnels.

In the existing configuration method, the configuration related work includes:

- The engineer design of the configuration scripts of each element.

- The arrival time of engineers to the place of network elements.
The engineer check of the network elements and links based on network planning.

Change of the configuration scripts by the engineer when network topology changes unexpectedly.

The configuration scripts input to the network elements.

After network is configured and the network element is connected to NMS, the service tunnels can be configured from NMS. Configuring service tunnel from NMS is already defined which is not included in this problem statement.

The workload of network configuration in this typical scenario is estimated and shown in figure 1.

<table>
<thead>
<tr>
<th>Project</th>
<th>Config. design</th>
<th>Arrival time of engineer</th>
<th>link check</th>
<th>Temporary change of Config.</th>
<th>Config. input</th>
</tr>
</thead>
<tbody>
<tr>
<td>work load</td>
<td>30min/device</td>
<td>60min/site</td>
<td>10min/device</td>
<td>30min/device</td>
<td>10min/device</td>
</tr>
<tr>
<td>People</td>
<td>Senior engineer</td>
<td>skilled</td>
<td>Senior engineer</td>
<td>Skilled engineer</td>
<td></td>
</tr>
<tr>
<td>requirement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total workload</td>
<td>=600000</td>
<td>=1200000</td>
<td>=200000</td>
<td>=3000000</td>
<td>=2000000</td>
</tr>
</tbody>
</table>

Figure 1 Workload of network configuration in LTE scenario

The workload of arrival time of engineer to the network elements occupies 51% of total and configuration design of the device occupies 33% of total. Instead of local operation, remote operation is valuable for device or link check and configuration input to avoid manual configuration in the locale. It is also very important to reduce the large workload of device design and temporary configuration change which takes 33% of all the workload and requires senior engineers. The auto configuration based on network topology and service model is important to be realized to reduce the workload of network configuration.
3.1.1. Remote configuration

There are three questions to be solved for remote configuration:

- It takes a lot of work to design the configuration scripts for the large amount of network elements, which will often bring occasional mistakes.

- Some of the base station’s address and links can not be acquired. So the network topology often changes from what is planned, and the pre-designed configuration scripts of the network elements need to be changed in network deployment phase.

- Without DCN connection, the initial configuration scripts can only be input locally or use MODEM/CF cards, which involve large amount of manual work.

The network elements usually connect to NMS by in-band NMS channel because the separate DCN is expensive. In the existing method, the engineer should make some configuration manually before the network elements connect to NMS. For example, the configuration may include creation of interfaces, IP address assignment of the interfaces and network elements, routing protocols enable on these interfaces and assignment of parameters for the routing protocols.

After the above configuration is finished, the routing protocols will take effect. Following this, the in-band NMS connection will be setup which connects the network elements to NMS. To minimum the workload, manual configuration should be avoided.

In addition, the network may be composed of different vendors’ device, and the in-band NMS connection may pass through different service provider’s network. How to setup in-band NMS connection which passes through different vendors’ equipments and different service provider’s network is also important.

Before remote configuration, the engineer should check the real network topology which includes equipment and link information from network planning. The problem we should consider is how to get equipment and link information and sending to NMS.

3.1.2. Automatic generation of network configuration

To reduce the workload of configuration scripts design by senior engineers, it is very important to generate network configuration automatically. Though there are many devices and service links in LTE
network, the topology and the service type in access and aggregation network is simple.

Some network planning tools can generate configuration scripts, but there are also many changes during network constructing which results in invalid scripts and the engineer should design it again. If the real network topology is available, e.g. equipment and link information, the configuration scripts for the real network’ equipment can be generated, which will reduce the workload and avoid mistakes from manual configuration.

The network elements needed for network design may include:

- service type (e.g. L3 VPN/L2 VPN),
- routing protocol (e.g. OSPF/ISIS) and,
- IP addresses and etc.

The topology elements may include:

- Role of the device including name and type
- Port of the device, i.e. connection
- Connection of the device at user side and etc.

4. Security Considerations

It is possible that there are security issues with the problems stated above, e.g. the tunnel between NMS and network elements needs mutual authentication before the tunnel is finally setup.

5. IANA Considerations

None.

6. References

6.1. Informative References

7. Acknowledgments

Data on network configuration workload of LTE scenario was estimated by Weihua, CHI.
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Authors’ Addresses

Tina Tsou (editor)
Huawei Technologies
Section F, Huawei Industrial Base
Bantian Longgang, Shenzhen  518129
P.R. China

Phone: +86 755 28972912
Email: tena@huawei.com