Service Oriented framework for IPv4 to IPv6 Network Transformation

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Agenda

- IPv6 pros and cons
- 4to6TRANS concepts and objectives
- Use cases
- Solution Architecture
  - Network Inventory
  - BTL
  - Service Transformation
- Transformation Automation

IPv6 Pros and Cons

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Why shall we deploy IPv6?

- IPv6 technology is an 'enabler' of new business opportunities. The technology itself is not a 'market driver'.
- IPv6 is NOT a feature. It is about the fundamental IP network layer model developed for end-to-end services and network transparency.
- With the exhaustion of the IPv4 free pool (only about 8.7% left free), IPv6 deployment enables **BUSINESS CONTINUITY**.
- Last but not least IPv6 provides new features
  - virtually unlimited addressing space
  - native support for mobility, security, multicast, etc.
  - Auto configuration (plug & play)
  - No NAT ☺

Why shall we not go towards IPv6

- IPv4 Networks are already too complex
- There are still devices and applications that does not support IPv6.
- IPv4 and IPv6 do not interoperate:
  - IPv4 applications do not work with IPv6
  - IPv4 nodes can not communicate with IPv6 nodes
- Security. Currently we use NAT and the outside hosts does not see the inside hosts. Only the IP address of the NAT device.
- There are no tools able to reconfigure the services that we already use in controlled and automated fashion. So such transition might be a huge mess.

Coexistence

It is likely that IPv4 and IPv6 will coexist for a long period of time. Two questions arise:

- How to enable communication among the IPv6 islands isolated in the IPv4 world?
- How to enable communications between the existing IPv4 world and the new IPv6 world?

Basic transition mechanisms

- Dual IP Stack
  - Provision of complete support for both IPv4 and IPv6 in hosts and routers
- IPv6 over IPv4 tunneling
  - Encapsulation of IPv6 packets within IPv4 headers to carry them over an IPv4 network (e.g. Internet)
  - Two types of tunneling: configured and automatic
- NAT-PT

Transition Questions

- Current Internet Service Providers (ISPs) have millions (maybe billions) of end customers.
- These customers might be in the SOHO segment, Business Customers or even smaller Service providers.
- Each of them has a various sets of IPv4 based services.
- The following critical questions arise in front of the ISPs:
  - How to apply basic transition mechanisms in a controlled and automated way?
  - How to transfer certain customer or certain service from IPv4 domain to IPv6 domain?
  - How to be sure that the customer service will operate properly after such migration?
  - How to be sure that the customer SLA won't be breached during the migration?
  - How can that be achieved for millions of customers throughout the world?

4TO6TRANS concepts and objectives

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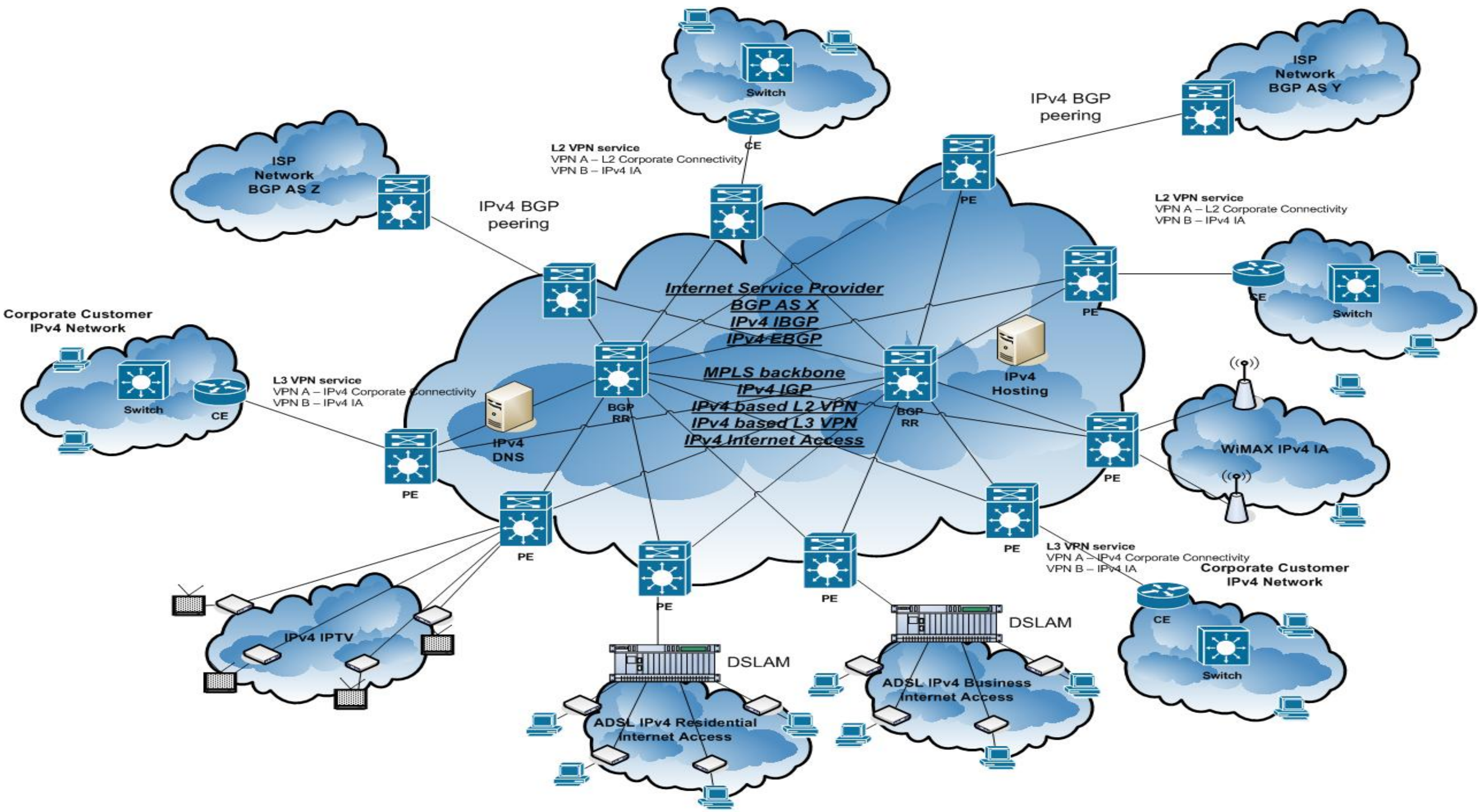
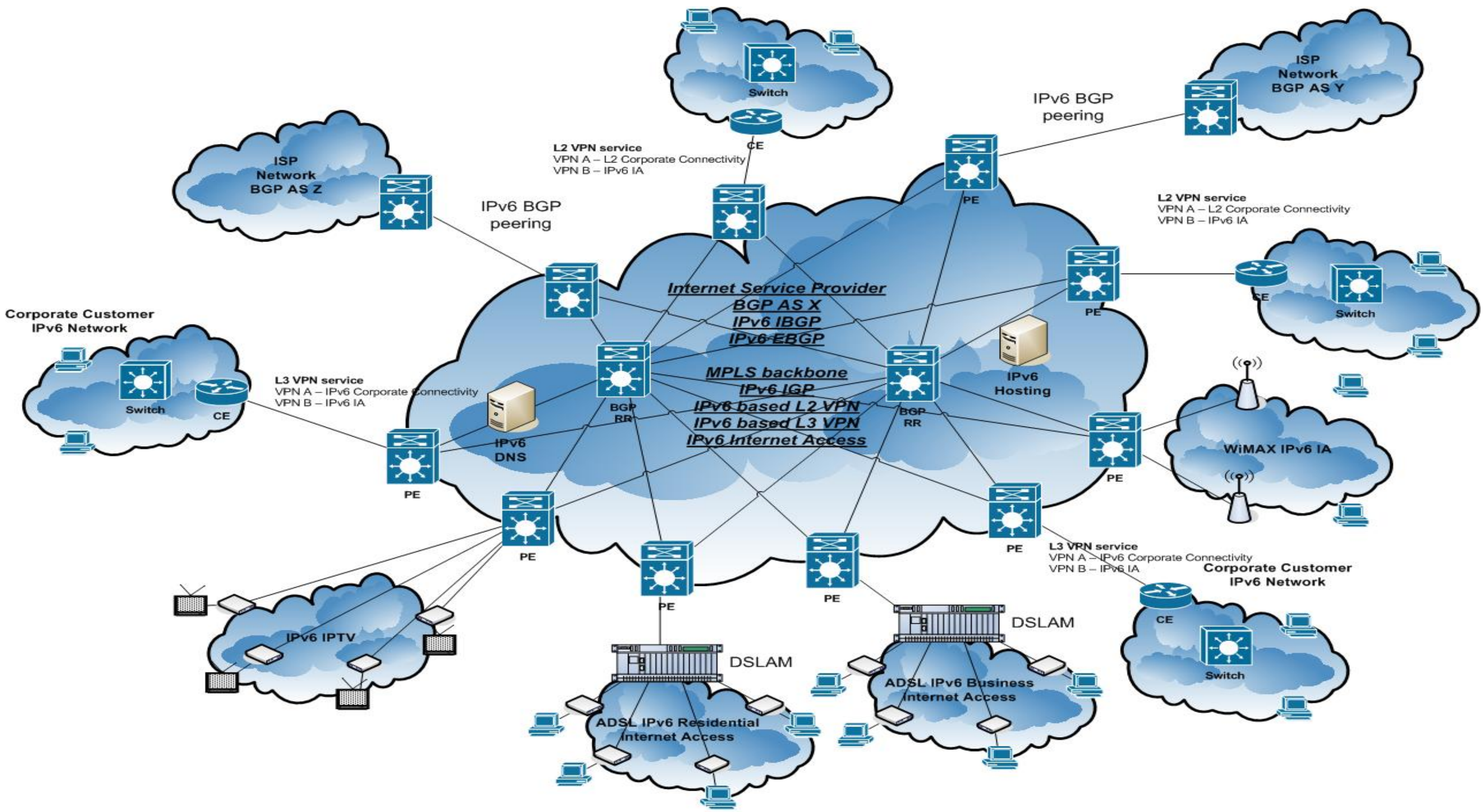
4TO6TRANS project Goals

- The project target is to transform service provider network infrastructure from IPv4 to IPv6
- The project aims to transform the IPv4 based services to IPv6 such
- The project aims to deliver a software framework able to do it in a controlled and automated way
- To go beyond the state of art of the current Operation Support Systems (OSS)

IPv4 based Service Provider Network will be transformed ….



to an IPv6 based



4to6TRANS project Objective

- Creation of 4to6TRANS framework:
  - having the power and ability to model the current and the transformed services
  - to “communicate” with the network devices via CLI and SNMP
  - to follow certain business logic during the transformation process
  - to be open for integration with other OSS tools
- The framework architecture will consist of several Application Programmable Interfaces (APIs)

Use Cases

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Use Cases – OSS common
(Still under development and internal discussion)

Common but still pain in the ass for most of Network Administrators…

- Send a bunch of commands/snmp requests, parse the responses and use it for good
- Perform configuration management including configuration backup, rollback and configuration change management
- Perform device Operating System (OS) upgrade and verification
- Perform inter-vendor device discovery

Use Cases – Service and Subscriber provisioning
(Still under development and internal discussion)

- Service/subscriber provisioning
  - MPLS L3VPN service
  - BGP peering service
  - Radius subscriber profile creation
- Dynamic Policy enforcement

Use Cases – related to IPv4 to IPv6 network transformations

- Enabling IPv6 on the device and its interfaces
- Migrate IPv4 Radius Subscriber Profile to an IPv6 such
- Transform IPv4 L3 MPLS VPN service to and IPv6 such
- Provision IPv6 BGP peering
- Transform IPv4 security policy to an IPv6 such
- Transform IPv4 based IPSEC VPN tunnel to and IPv6 such

Solution Architecture

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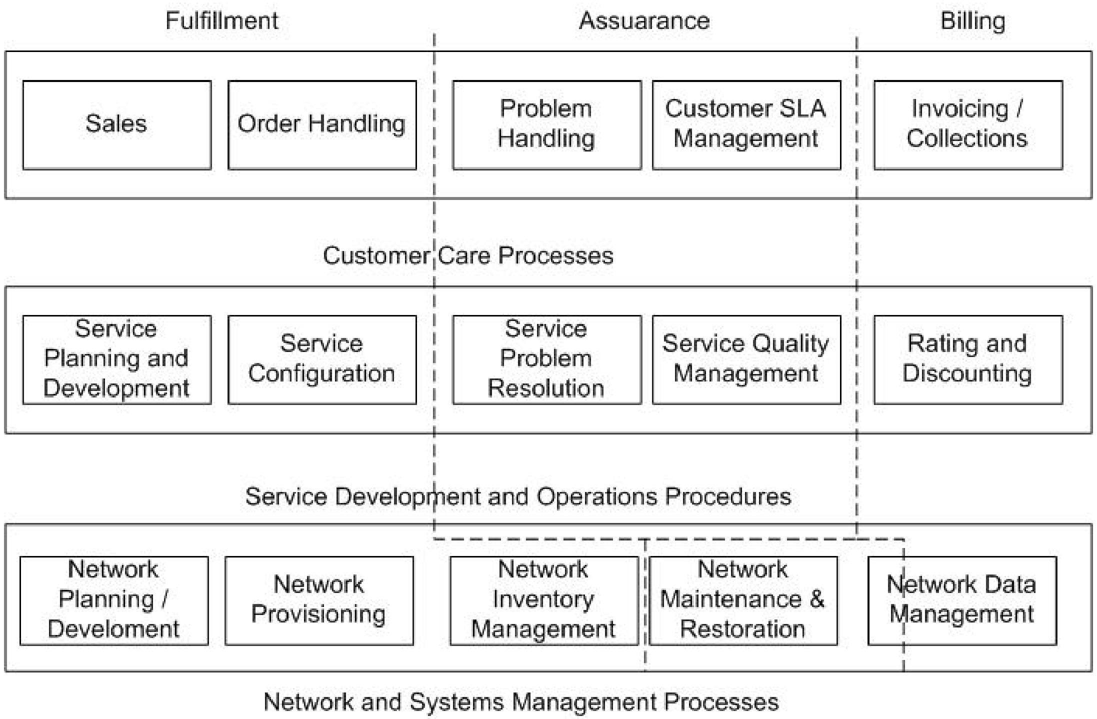
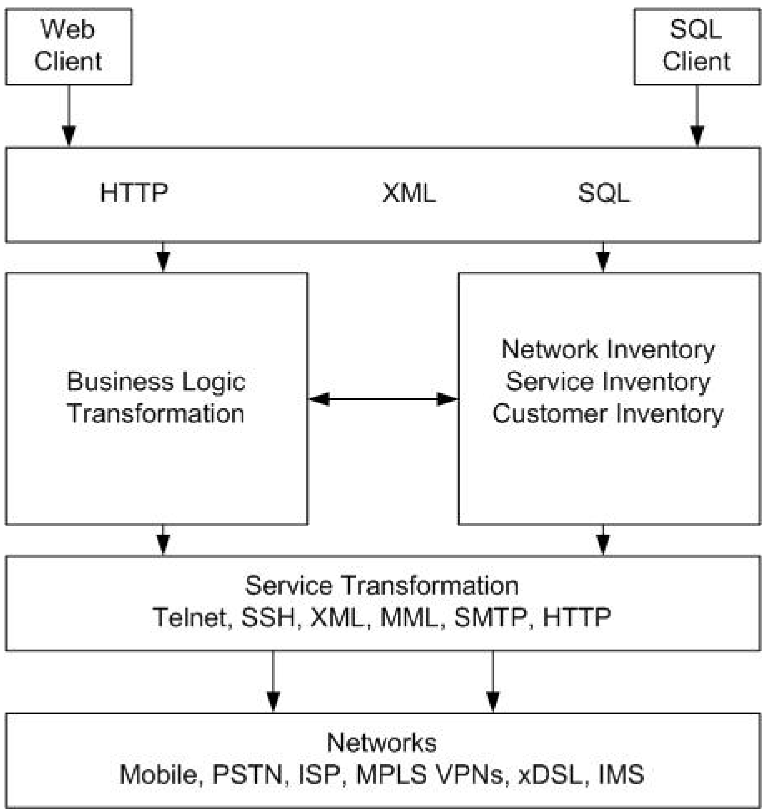
Fulfillment Assurance and Billing (FAB) model

Best practice for ISP OSS architecture recommended by TMFORM part of the OSS eTOM model.



Solution Architecture



- Transformation inputs
- BTL (Business Transform Logic) APIs
- Inventory API
- Service transformation
- Network Layer

Transformation Input Layer

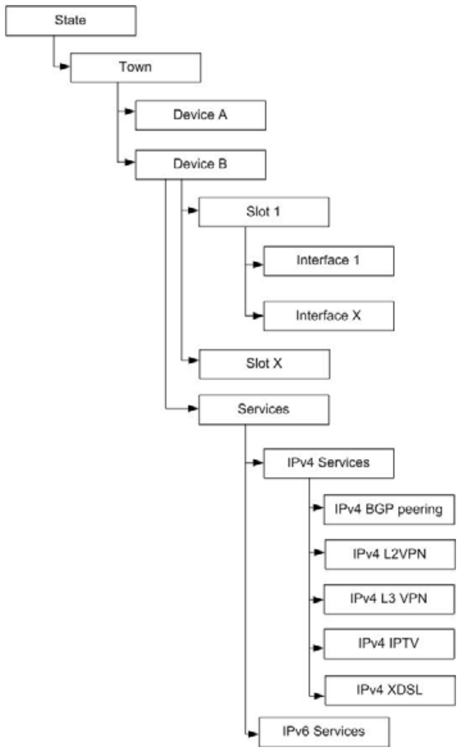
- Service transformation orders may come from different sources.
- The most common source will be the Service provider CRM system.
- The transformation request might be in HTTP, SQL or preferably in XML format.
- It shall contain the input data needed for the successful service transformation.
- The BTL shall take that input and perform the transformation.
- It shall be able to give an intermediate status of the order and also a final result once the transformation process is finished.

Network Inventory

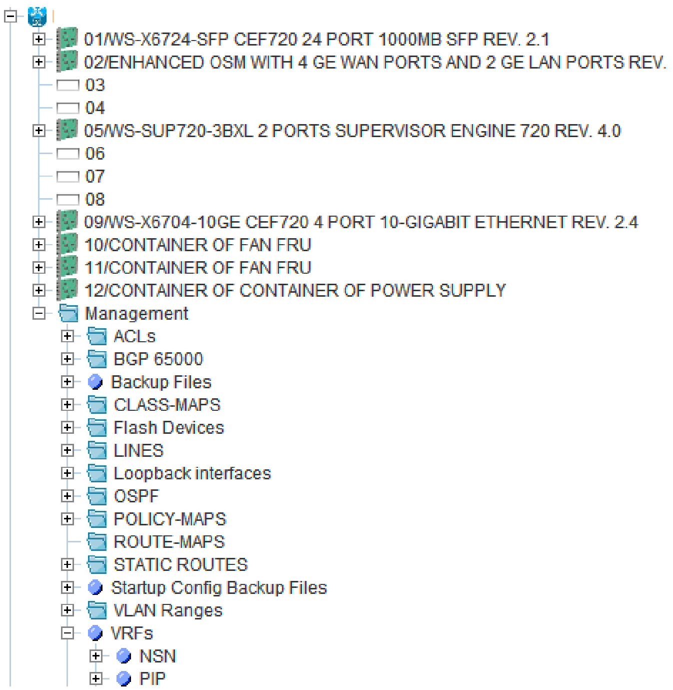
- Contains a logical data model of the network
- Has to be able to model the network devices, their physical and logical structure, the services running on them and the subscribers using those services
- Has to be flexible enough to respond to network changes, extensions and replacements
- The data inside shall be populated in a dynamic and automated way

Inventory data

- Logical Model



- Real device



Business Transformation Logic

- The main goal of the Business Transform Logic is to be able to model and execute a certain transformation workflow.
- Will consist of two major API groups
  - Transformation workflow designer
    - For OSS solution architects
  - Transformation workflow execute engine
    - For NOC operators

Transformation Automation

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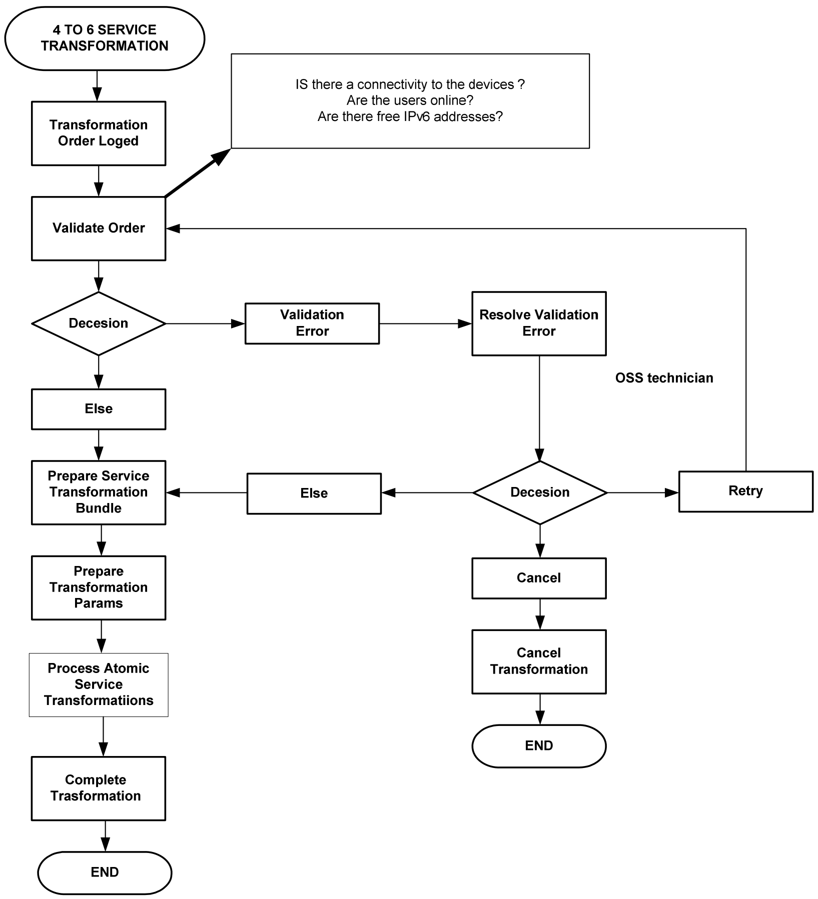
Inventory Automation

- One of the main goals of the project is to automate the IPv4 to IPv6 migration process.
- One of the most time consuming steps in that process is supplying the inventory with real data from the current IPv4 network.
- To speedup this process two additional functionalities will be developed
  - Device Discoveries
  - Automated Uploads of the discovered devices

Service Transformation

Transformation workflow

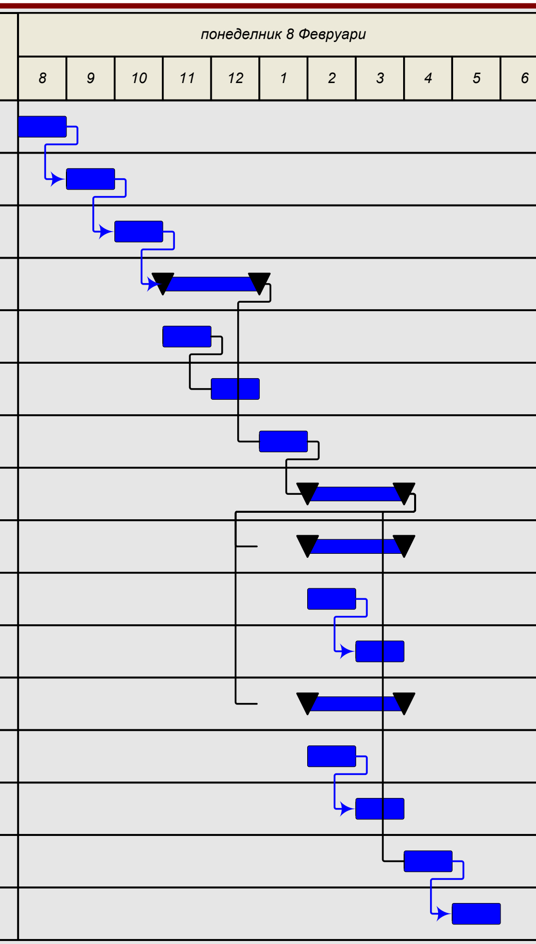


Workflow Breakdown

- Start
- Log Transformation Order
- Validate Order
- Resolve Validation Error
- Prepare Service Transformation Bundle
- Prepare Transformation Parameters
- Process Service Transformation
- Complete Transformation
- END

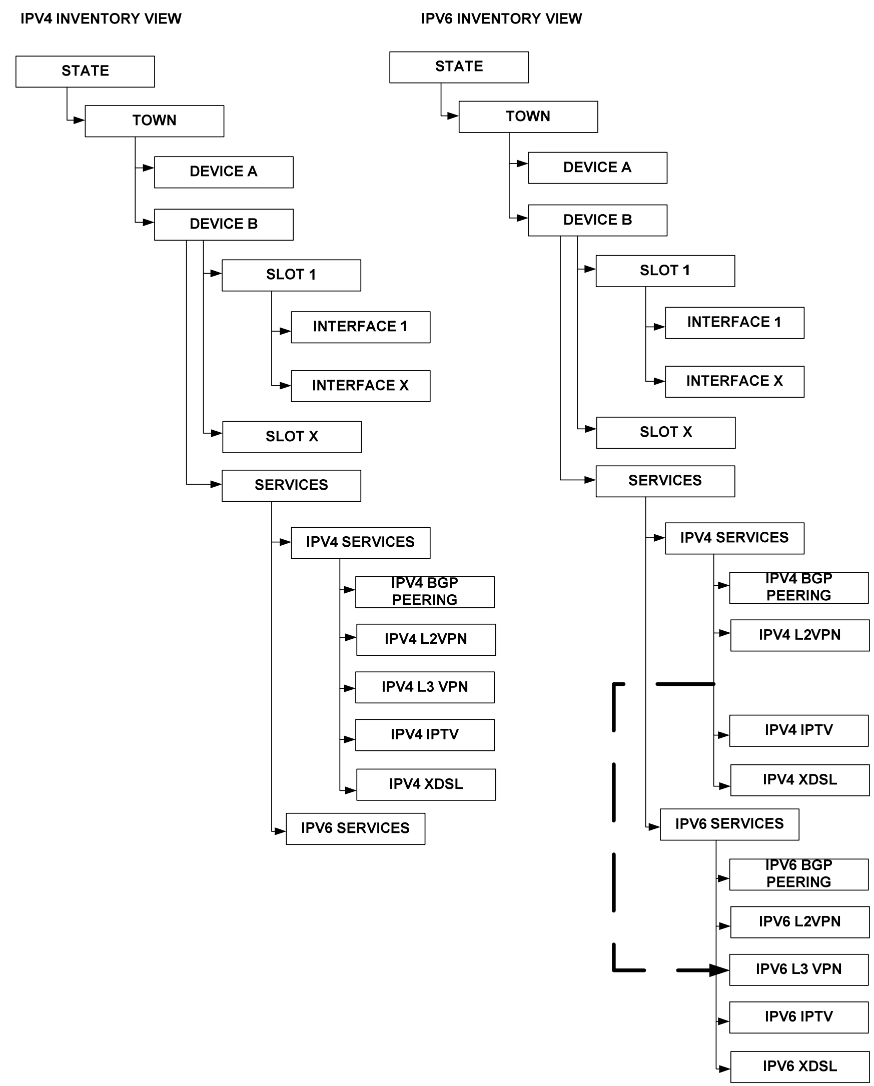
Transformation Workflow – Operator's View

ID	Task Name	Start	Finish	Duration
1	**Start**	08.2.2010 г.	08.2.2010 г.	1h
2	**TRANSFORM ORDER**	08.2.2010 г.	08.2.2010 г.	1h
3	**VALIDATE ORDER**	08.2.2010 г.	08.2.2010 г.	1h
4	**PREPARE SERVICE TRANSFORMATION BUNDLE**	**08.2.2010 г.**	**08.2.2010 г.**	**2h**
5	Prepare Service 1	08.2.2010 г.	08.2.2010 г.	1h
6	Prepare Service 2	08.2.2010 г.	08.2.2010 г.	1h
7	**PREPARE TRANSFORMATION PARAMETERS**	08.2.2010 г.	08.2.2010 г.	1h
8	**PROCESS ATOMIC SERVICE TRANSFORMATIIONS**	**08.2.2010 г.**	**08.2.2010 г.**	**2h**
9	**Process Service 1**	**08.2.2010 г.**	**08.2.2010 г.**	**2h**
10	Execute task 1	08.2.2010 г.	08.2.2010 г.	1h
11	Execute task 2	08.2.2010 г.	08.2.2010 г.	1h
12	**Process Service 2**	**08.2.2010 г.**	**08.2.2010 г.**	**2h**
13	Execute task x	08.2.2010 г.	08.2.2010 г.	1h
14	Execute task y	08.2.2010 г.	08.2.2010 г.	1h
15	**COMPLETE TRANSFORMATION**	08.2.2010 г.	08.2.2010 г.	1h
16	**END**	08.2.2010 г.	08.2.2010 г.	1h



Inventory view after a successful service transformation

- On the left we have IPv4 inventory view after a successful upload
- On the right we have an inventory view after a successful IPv4 to IPv6 service transformation



IPv4 to IPv6 TRANSFORMATION

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Backup Slides

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Introduction to IPv6

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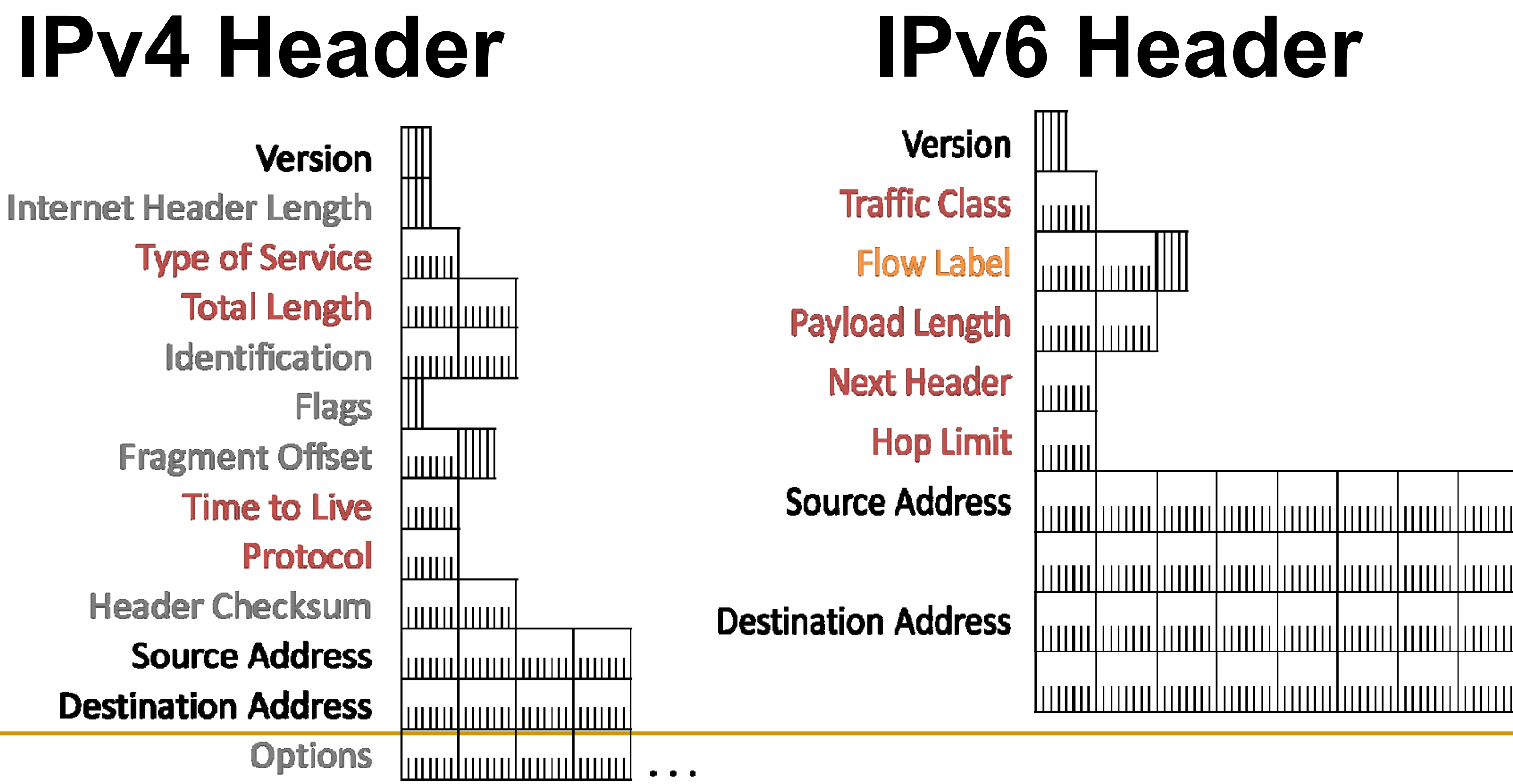
IPv6 Features

- Hierarchical network architecture
- Stateless and stateful address configuration
- Embedded security
- Multicast, not broadcast
- ICMPv6 protocol
- Built-in mobility
- Larger Address Space
- Simplified Header format

IPv4 and IPv6 Headers



IPv6 Address Syntax

- IPv6 address in binary form:

  0010000000000001000000000000000000110100010101100000
  000000000000000000000000000011110001111000001010101 1
  1100110100001001100001 11

- The 128-bit address is divided along 16-bit boundaries:

  0010000000000001 0000000000000000 0011010001010110
  0000000000000000 0000000000000000 1111000111100000
  1010101111001101 0000100110000111

- Each 16-bit block is converted to hexadecimal and delimited with colons:

  2001:0000:3456:0000:0000:F1E0:ABCD:0987

Compressing zeros

- Leading zeros within each 16-bit block can be compressed:
  2001:0000:3456:0000:0000:F1E0:ABCD:0987 becomes
  2001:0:3456:0:0:F1E0:ABCD:987
- Successive fields of 0 can be represented as "::"
  2001:0:3456:0:0:F1E0:ABCD:987 becomes
  2001:0:3456::F1E0:ABCD:987
  - FE80:0:0:0:2AA:FF:FE9A:4CA2 becomes FE80::2AA:FF:FE9A:4CA2
  - FF02:0:0:0:0:0:0:2 becomes FF02::2
  - 0:0:0:0:0:0:0:1 becomes ::1
  - 0:0:0:0:0:0:0:0 becomes ::

  A double colon is allowed only once in an IPv6 address!
  - 2001:0:3456:0:0:F1E0:ABCD:987 does not become
    2001::3456::F1E0:ABCD:987

IPv6 Address Prefixes

- Indicates the bits that have fixed values or are the bits of the subnet prefix.
- Also known as Classless Inter-Domain Routing (CIDR) notation for IPv4.
- An IPv6 prefix is written in address/prefix-length notation.
  - 2001:DB8:0:2F3B::/64 is a subnet prefix for a subnet
  - 2001:DB8::/48 is an address prefix for a summarized route
  - FF00::/8 is an address prefix for an address range
- IPv4 uses a dotted decimal representation of the network prefix known as the subnet mask. A subnet mask is not used for IPv6.

Literal IPv6 addresses in URIs

- In a URI the IPv6 address is enclosed in brackets
- Examples:
  - https://[fd00::a00:cd24]/
  - https://[fd00::a00:cd24]:443/
  - https://[fd00::0000:0000:0000:0000:0000:0a00:cd24]:443/

IPv6 supported browsers

- MS IE6 doesn’t support IPv6
- MS IE7 supports IPv6
- Safari supports IPv6
- Mozilla Firefox supports IPv6
- Google Chrome Supports IPv6

Types of IPv6 Addresses

- Unicast
  - Identifies a single interface
  - Delivery to single interface
- Anycast
  - Identifies a set of interfaces that typically belong to different nodes
  - Delivery to a single “nearest” interface in the set
- Multicast
  - Identifies a set of interfaces
  - Delivery to all interfaces in the set
- No more broadcast addresses