Story about Translation and Encapsulation, and their co-existence

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Goals

- IETF is designing the building-block protocols and tools

- Coexistence of Translation and Encapsulation
  - Not a unified solution

- Some times we find *Translation* is the better tradeoff
  - If all we have is a ***hammer***, every problem looks like a ***nail***
  - If all we have is an ***encap***, every problem looks like a ***tunnel***

Outline

- Basic comparison
- Loss of information matter? (From operator point of view)
- Operational and easily deployment
- Update to user management plane
- Why 4v6 other than dual stack?

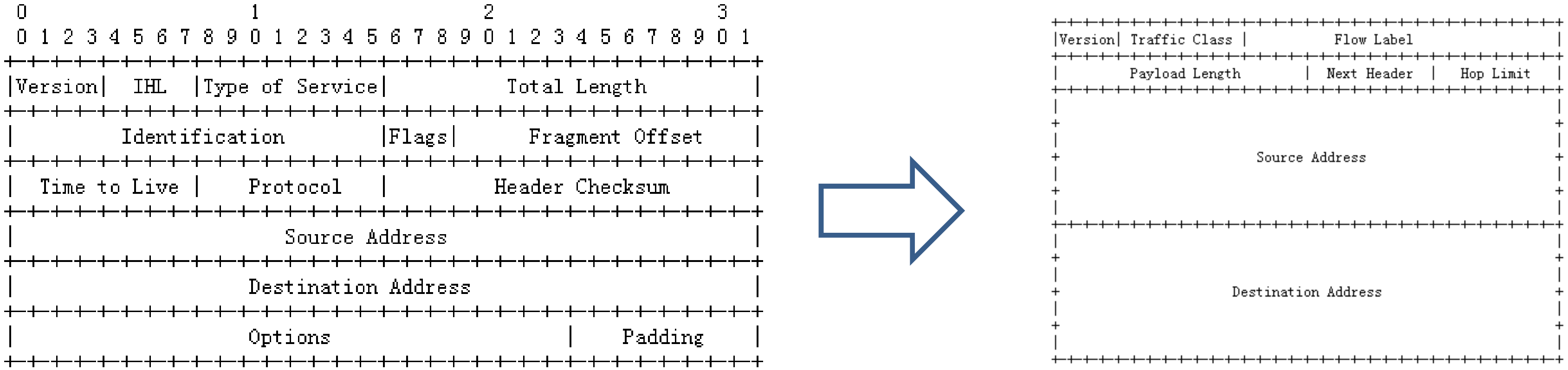
Basic comparison

- It may vary if in different scenarios, here mainly focus on 4v6 translation and encapsulation, most of them has been identified by above and day 1, here is the experience of network operation

	Tunneling	Translation
Loss of information	No	Yes
User info management plane	IPv4 and IPv6	IPv6
Easily update data and control plane to support	Both data and control plane	Only control plane
DPI service in the middle	No	Yes

- But when deep dive, it leads to different result

Lose of Information during double translation : not really



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 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Version|  IHL  |Type of Service|          Total Length         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Identification        |Flags|      Fragment Offset    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Time to Live |    Protocol   |         Header Checksum       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Source Address                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Destination Address                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Options                    |    Padding    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
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+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Version| Traffic Class |           Flow Label                  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Payload Length        |  Next Header  |   Hop Limit   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
+                                                               +
|                                                               |
+                         Source Address                        +
|                                                               |
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|                                                               |
+                                                               +
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+                      Destination Address                      +
|                                                               |
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```

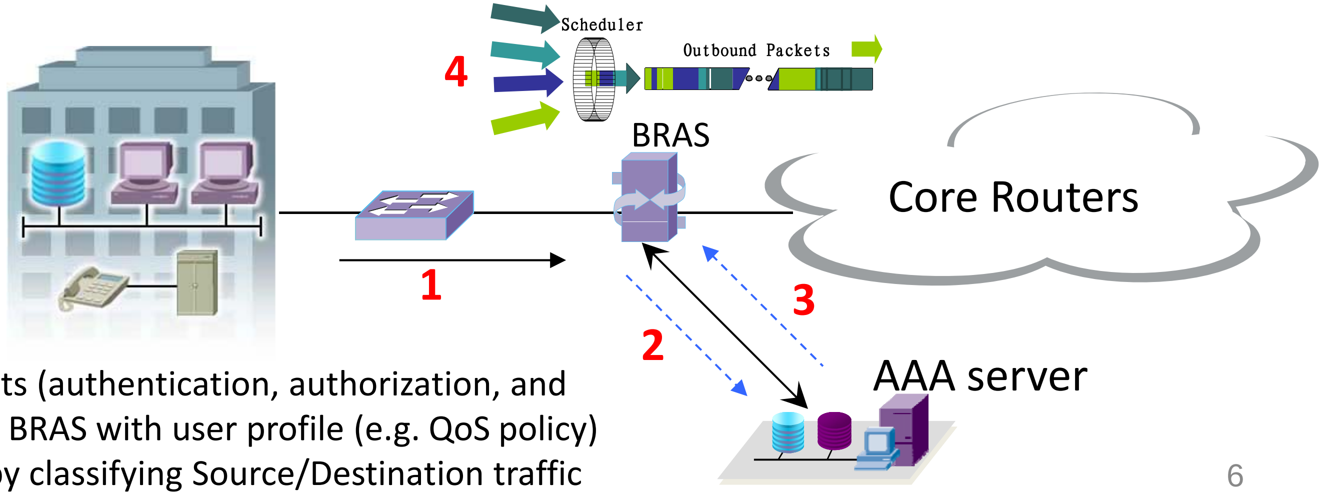
IPv4	IPv6	Operator experience
IHL	Omitted, fix header length	Useless
TOS	Traffic Class	Compatible, not end to end deploy requirement
Total Length	Payload Length	More simple
ID, Flags, Fragment Offset	Fragmentation Option	compatible
Time to Live	Hop Limit	compatible
Checksum	Omitted, but not useful	Not really use (upper layer)
Options	Option header	compatible

Same thing goes to ICMP (information, timestamp, address mask et al.), they are not used in today operator’s network

Requirements from Deployed Scenarios - Fixed Networks

- In broadband networks, DIA (Dedicated Internet Access) has been provided by operators for corporations to cater for their Internet communications needs.

1. Customers would initiate traffic heading to core network
2. BRAS would match ACL rules by identifying IP source address. A radius message would be activated to feed into the AAA server

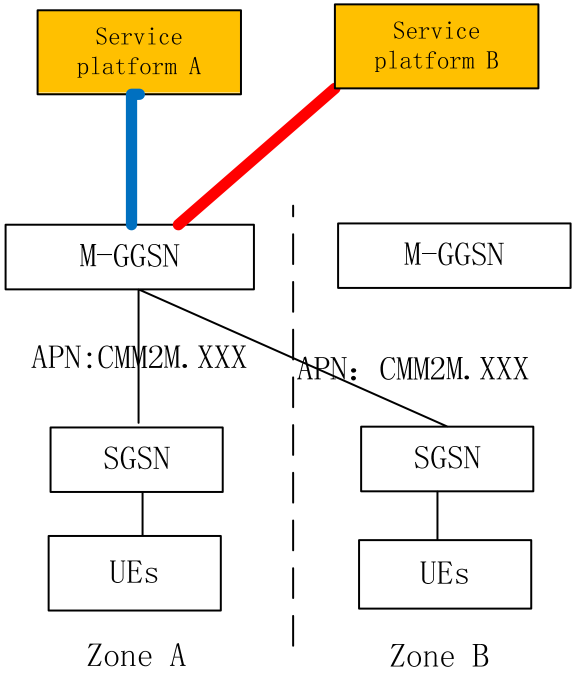


3. AAA server performs a serial events (authentication, authorization, and accounting). Afterwards, it feedback BRAS with user profile (e.g. QoS policy)
4. BRAS would take QoS into effect by classifying Source/Destination traffic

- Service is made possible via the following edge router features and key systems:
  - **A-IPv4**: IP Source/Destination traffic classification for QoS assurance
  - **B-IPv4**: Automatic Radius messages signaling by differentiating IP source address
  - **C-IPv4**: Provisioning backend, e.g. AAA server
- Committed goal is to offer the same service and features on IPv6 from different vendors

Requirements from Deployed Scenarios - Mobile networks

- In mobile networks, certain services, are provided by allocating a specific APN. GGSN would classify traffic heading to different service platforms by tracking destination address.
- This relies on the following features:
  - **D-IPv4**: IP Destination traffic classification
- Committed goal is to offer the same service and features on IPv6 from different vendors



What does it mean practically?

Deploying 4V6 modes

Features	4V6 Tunnel Mode	4V6 Translate Mode
A	• Should be supported by inspecting the internal IPv4 address • No vendor offers A, B, C, D for IPv4 in IPv6 • Significant additional investment and OPEX required to maintain all feature combinations (e.g. A-IPv4, A-IPv6, A-IPv4inIPv6)	• Easily supported by inspecting the IPv6 address • All vendors delivering or committed to deliver A, B, C, D for IPv6 • No significant additional investment and OPEX required over native IPv6
B		
C		
D		
E(Efficiency)	Generally believed efficient enough	Acceptable for stateless (we have shown that many times)
Tradeoff	Show stopper	Preferred approach

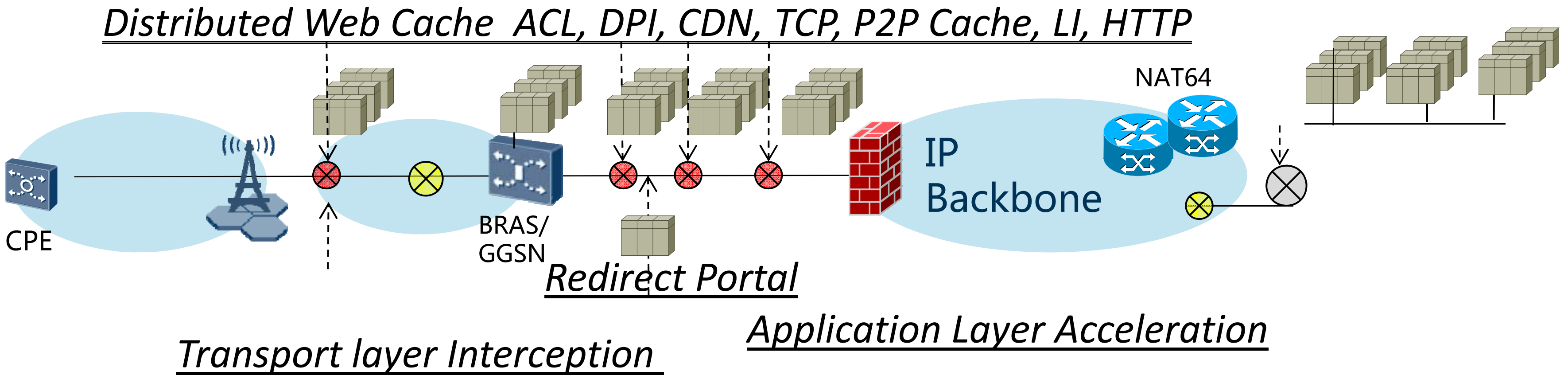
Changes to Management Plane

- Change to the management plane (update the IPv4 to IPv6-IPv6 address support)

	Encapsulation	Translation
Changes to PCC	Yes (small change, IPv6)	Yes (small change, IPv6)
Changes to HLR, MME, RNC, etc	Yes	Yes
Changes to Firewall	Yes (complicated rules and tunnel inspection)	Yes (IPv6 based)
Changes to Lawful Interception	Yes (complicated rules and tunnel inspection)	Yes (IPv6 based)
Changes to OSS/BSS	No (complicated rules)	No, IPv6 based
Added air-link overhead	40 additional bytes	20 additional bytes
Distributed Intelligent component (Cache, CDN, LI, HTTP, TCP et al.)	Need complicated upgrade for existing deployment	Without modification online device, only backend small update

Unaffected In-network Infrastructures

- There are many in-network infrastructures investments (for intelligence), and more are coming



Distributed Web Cache ACL, DPI, CDN, TCP, P2P Cache, LI, HTTP

Redirect Portal

Application Layer Acceleration

Transport layer Interception

Translation

1. Full Layer-3&4 information is kept intact
2. Investment unaffected

Encap

1. Layer-4 information is hidden
2. Investment affected

Why operator willing to run IPv4 over unproved IPv6, instead of dual stack

- Distributed intelligence access network exists already there (ACL, WEB/P2P Cache, LI, DPI), network architecture running couldn’t be updated.
- Dual stack does not resolve the lack of IPv4 address
- IPv6 only network connection (like IPv6 only APN) will be provided by operators, operators consider to do it with low tariff.

Recommendations

- IPv4 header transparency wouldn’t be an issue for today’s operator.
- 4v6 translation could exist by reasons like to keep current intelligent operator’s access network, double translation could be less-upgrade, easily deployed, keep current functionality.
- 4v6 translation and tunneling should stay together in one working group.
- Unified solution should also consider NAT64
- 4v6 translation draft is really good candidate as the basis which is align with 4v6 tunneling solution (4rd)