Stateless 4V6

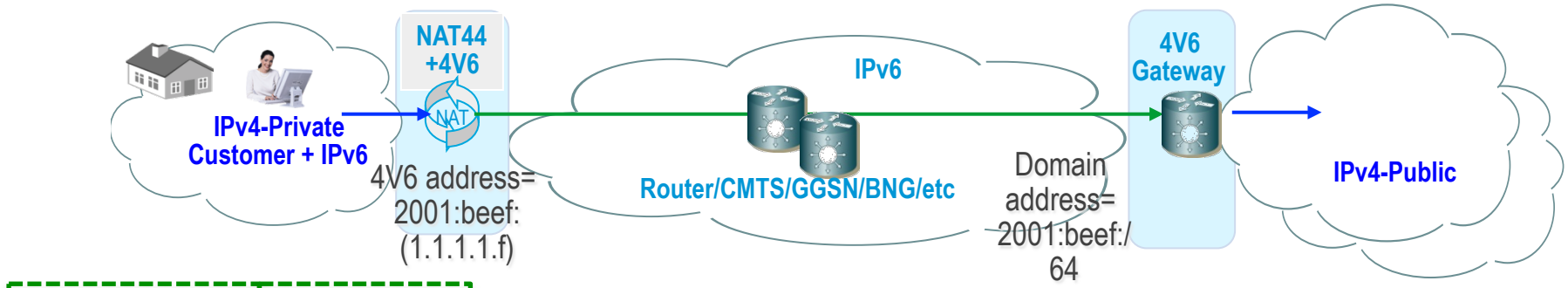
draft-dec-stateless-4v6

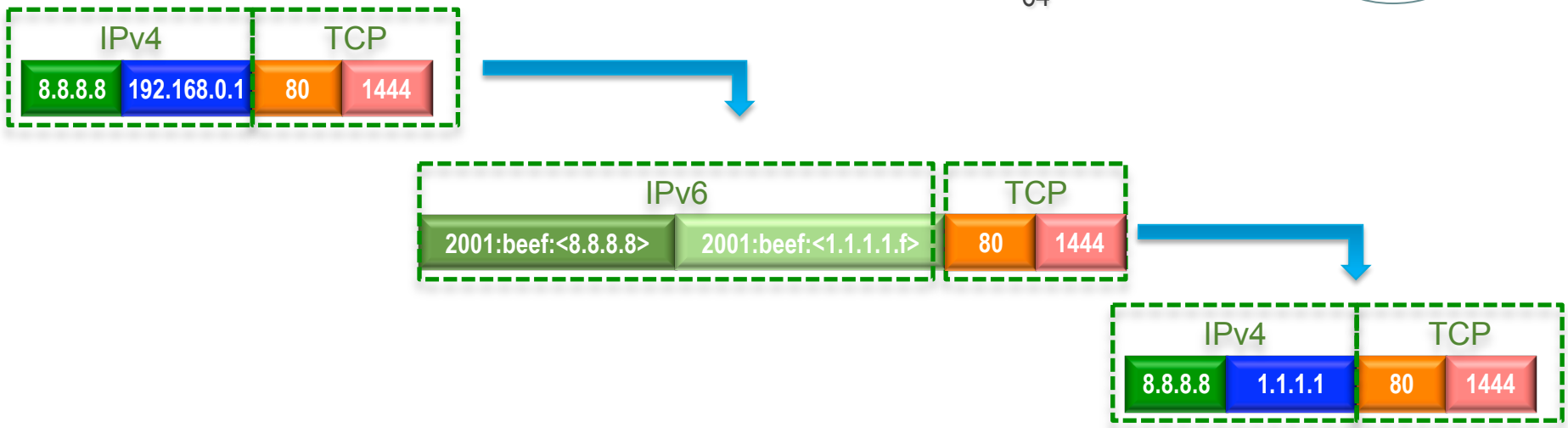
September 2011

Introduction
Context for Stateless solutions

- Operator's have an IPv6 network in production
- Limited Public IPv4 or exhausted
- Desire/intent to move to fully to IPv6 (at least operationally)
  - End goal of IPv6 Network & operations
- Required support for "legacy" IPv4
- Meet business & service continuity goals for all customers
- No desire for centralized architecture/solution
  - More specific motivations as per:
    http://tools.ietf.org/html/draft-ietf-softwire-stateless-4v6-motivation-00

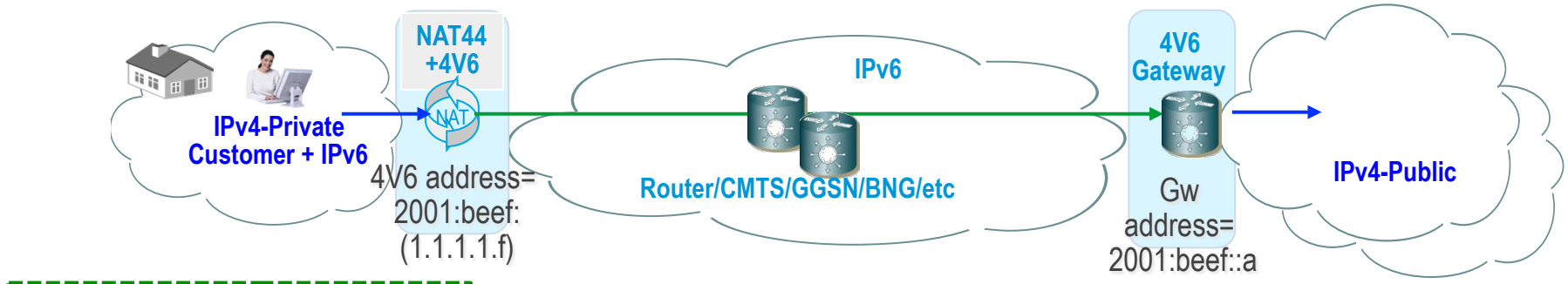
Stateless 4V6
Translation Mode

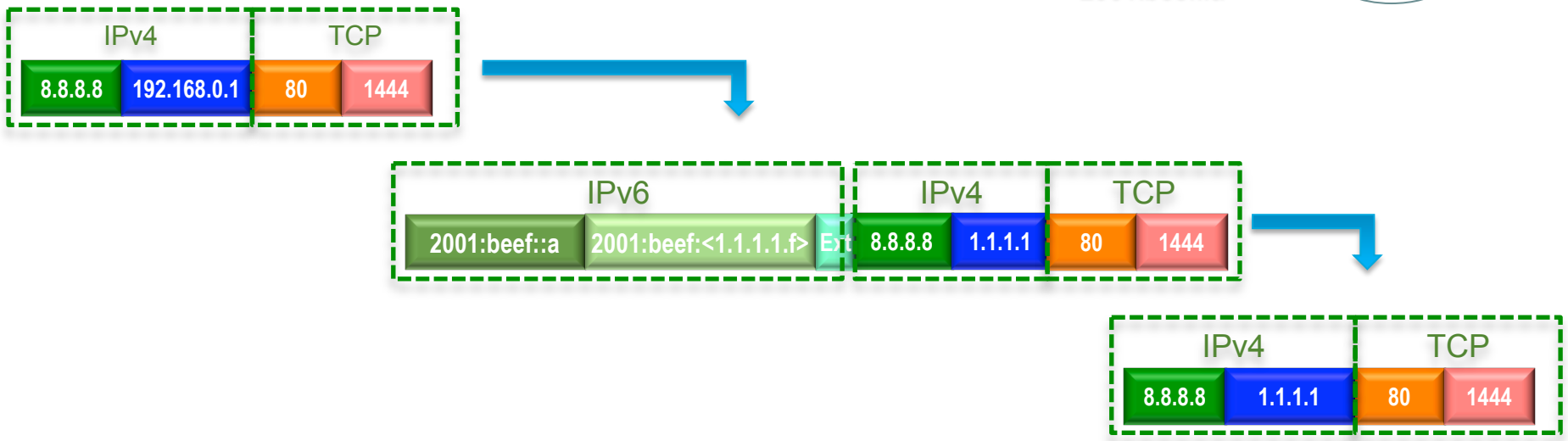




IPv6 packet: (Mapped) L3 and L4 info available
to regular IPv6 data plane devices & features

Stateless 4V6
Tunnel Mode





IPv6 Packet: Only partial L3 info available to regular IPv6 data plane devices & features

Stateless 4V6 Solutions

High level characteristics comparison 1/2

	4V6 Mapped Tunnel	4V6 Translate
Base technology	Port restricted NAPT44 + IPv4 in IPv6 mapped tunnel	Port restricted NAPT44 + Stateless NAT64
Location of NAPT44 function	CPE	CPE
Type of Relay	Stateless tunnel with IPv4 address +port mapping	Stateless NAT64 with IPv4 address+port mapping
IPv6 addressing constraints	Yes (IPv4 embedded IPv6 address).	Yes (IPv4 embedded IPv6 address)
IPv4 addressing constraints	Sharing fixed per IPv4 subnet/domain	Sharing fixed per IPv4 subnet/ domain
Stateless46 domain identified by	IPv6 Prefix, IPv4 subnet, Tunnel/ Relay IPv6 address	IPv6 Prefix, IPv4 subnet
IPv4 + TCP/UDP port mapping into IPv6 header	Yes	Yes
ICMPv4 identifier NAT/Markup needed	Yes	Yes
Supports IPv4 fragments	Partial (no fragments from outside)	Partial (No fragments from outside)
Supports IPv4 host – IPv4 communication	Yes	Yes

Stateless 4V6 Solutions

High level characteristics comparison 2/2

	4V6 Mapped Tunnel	4V6 Translate
IPv4 Checksum update required	Yes - with ICMPv4 support	Yes
TCP/UDP Checksum recalculation	No	Yes (as per NAT64)
Passes IPv4 Options	Yes	No
QoS Models	Pipe/Uniform	Uniform
Supports IPv4 fragments	Partial (no fragments from outside)	Partial (No fragments from outside)
Supports IPv4 host – IPv4 communication	Yes	Yes
Supports IPv6 host – IPv4 communication	Requires NAT64 and DNS64	Requires DNS64 (re-uses NAT64)
Allows IPv4 host – IPv6 server (SP domain)	No	Yes (Stateless with IPv4 to IPv6 addressed server)
Specific features required	Requires devices to be IPv4inIPv6 aware	Uses regular IPv6 devices dataplane and features
Changes to provisioning protocols (eg Radius)	Requires extensions to protocol attributes for IPv4inIPv6	Uses standard IPv6 interfaces & parameters
Changes to device provisioning tools	Requires support for mapping IPv4 to an IPv6 configuration	Requires support for applying IPv4 rules to IPv6 data plane

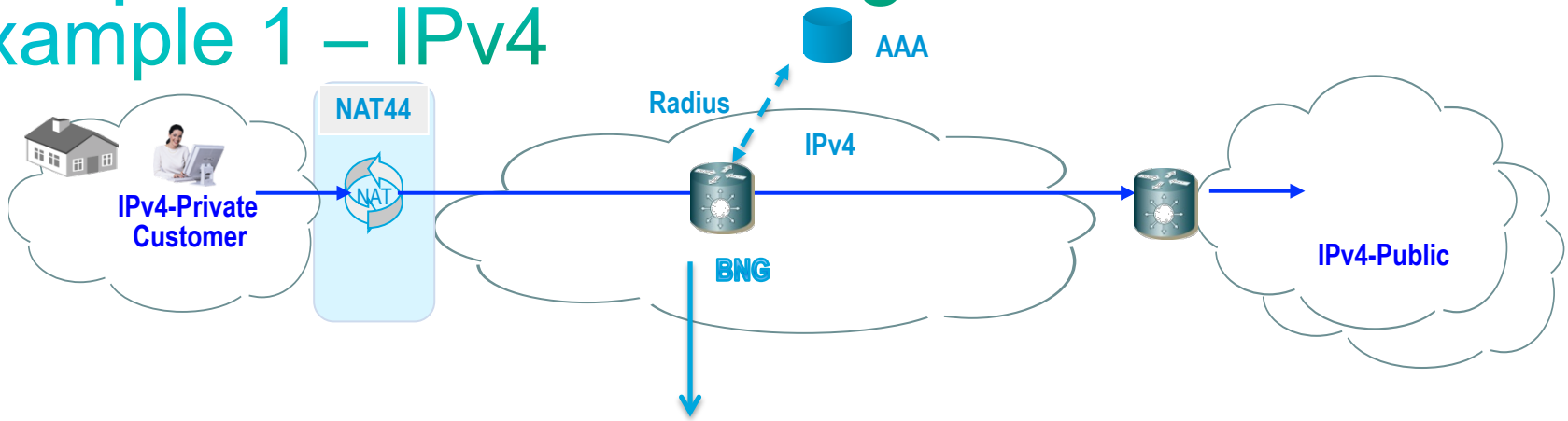
Stateless 4V6 Solutions
Summary

- Technically both solutions (translate/tunnel) solve the same core problem: Stateless IPv4 address sharing across an IPv6 network

  Both have the same characteristics/caveats of IPv4 address sharing

4V6 Translation	4V6 Mapped Tunneling
Uses NAT64 RFC – Causes **NO HARM**	L3+L4 address mapped IPinIP tunnelsulation – Causes **NO HARM**
Does NOT preserve IPv4 Options	Preserves IPv4 Options
Exposes target Layer 3 + Layer 4 information at IPv6 data plane.	Hides target Layer 3 + Layer4 information at IPv6 data plane
Allows use of regular IPv6 elements/ system components - **DAY 1**	Requires system wide changes for IPinIP processing capability.

Sample Customer configuration
Example 1 – IPv4



An ACL Dynamically applied (inbound) via RADIUS AAA onto users' PPP Connection:

ip access-list extended A100

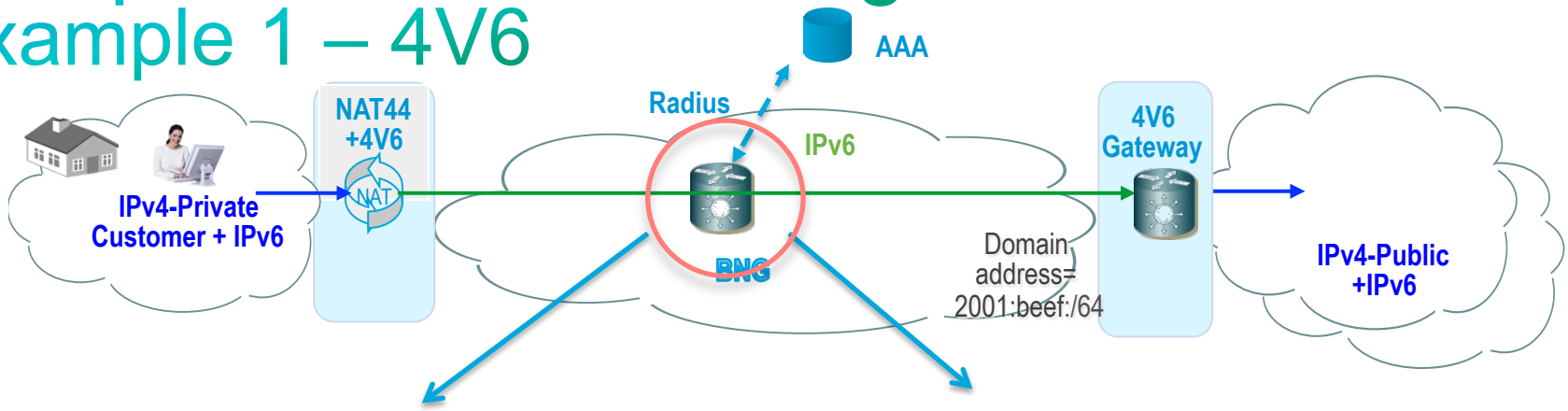
…

deny tcp any any eq smtp

deny icmp any any

permit ip any any

Sample Customer configuration
Example 1 – 4V6



4V6 Translation

ipv6 access-list extended A100

deny tcp any any eq smtp

deny icmp any any

permit ip any any

…

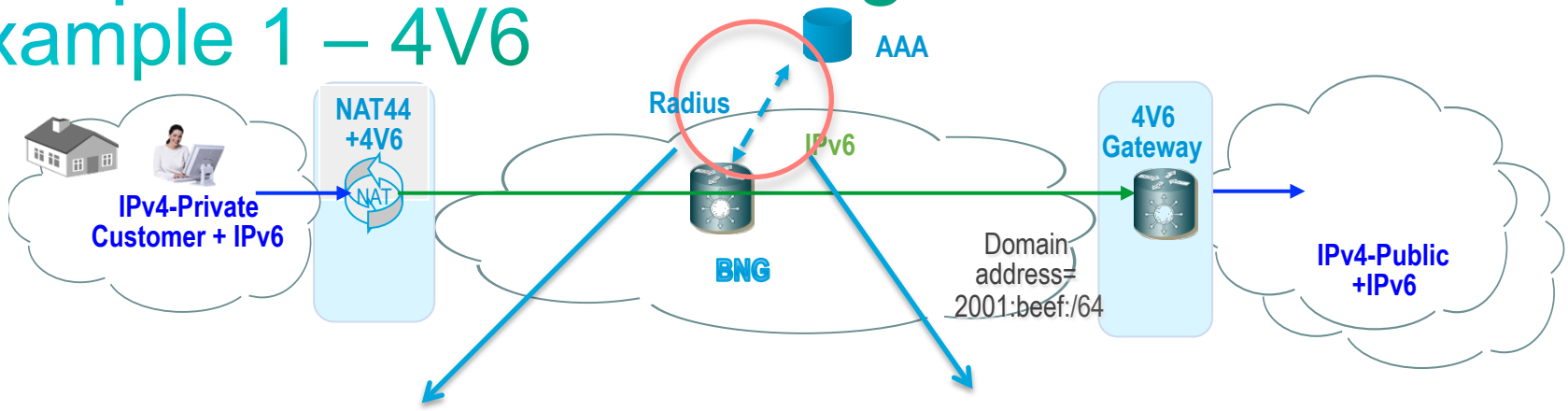
The same ACL on IPv6. Works TODAY on IPv6 capable BNG's.

4V6 Tunneling

Wait for vendors & upgrade your BNG/router network…

New BNG/Gateway functionality necessary to process IPinIP…

Sample Customer configuration
Example 1 – 4V6



4V6 Translation

RADIUS uses regular IPv6 IETF AVPs

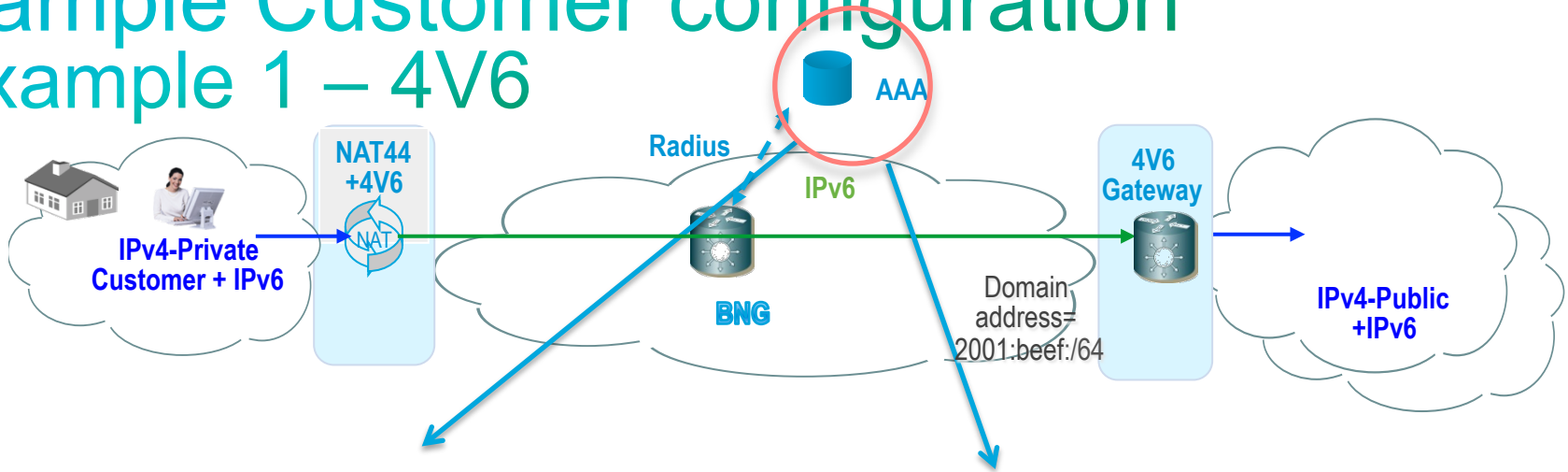
Works TODAY on IPv6 BNG's and with existing RADIUS specs

4V6 Tunneling

Wait for vendor(s) for RADIUS extensions or IETF AVPs… Then Upgrade your network.

New attribute necessary to provision/use feature…

Sample Customer configuration
Example 1 – 4V6



4V6 Translation

Server – Requires:

1. Feature to map IPv4 addresses to IPv6.

2. No new attributes

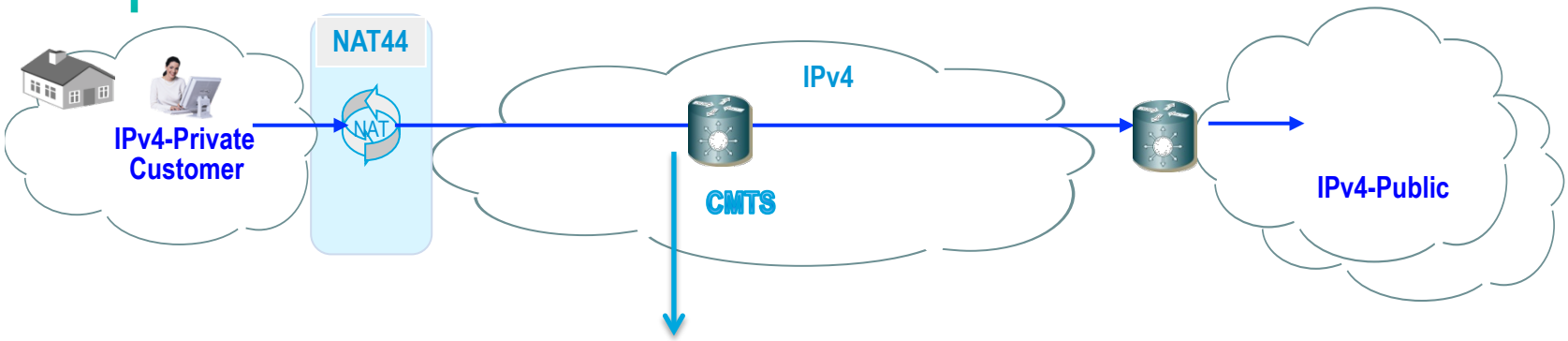
4V6 Tunneling

Server – Requires:

1. Feature to enable/map IPv4 ACL to IPv6 traffic

2. Support for new Radius attribute (s)/VSAs

Sample Customer configuration
Example 2 – IPv4



Inbound Security IP ACL applied to cable bundle interface for all subscribers

interface Bundle3

no ip address

ip access-group 157 in

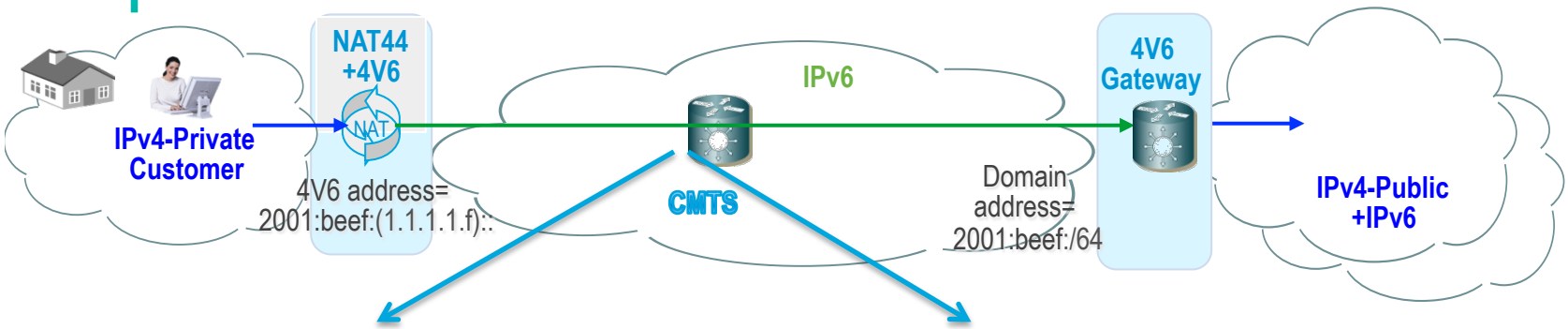
!

access-list 157 deny udp any 10.0.0.0 0.255.255.255 eq snmp

…

…

Sample Customer configuration
Example 2 – 4V6



4V6 Translation

4V6 Tunneling

ipv6 access-list 157

10 deny udp any 2001:beef:<10.0.0.0> /48 eq snmp

20 deny udp any <SP-prefix>/30 eq snmp

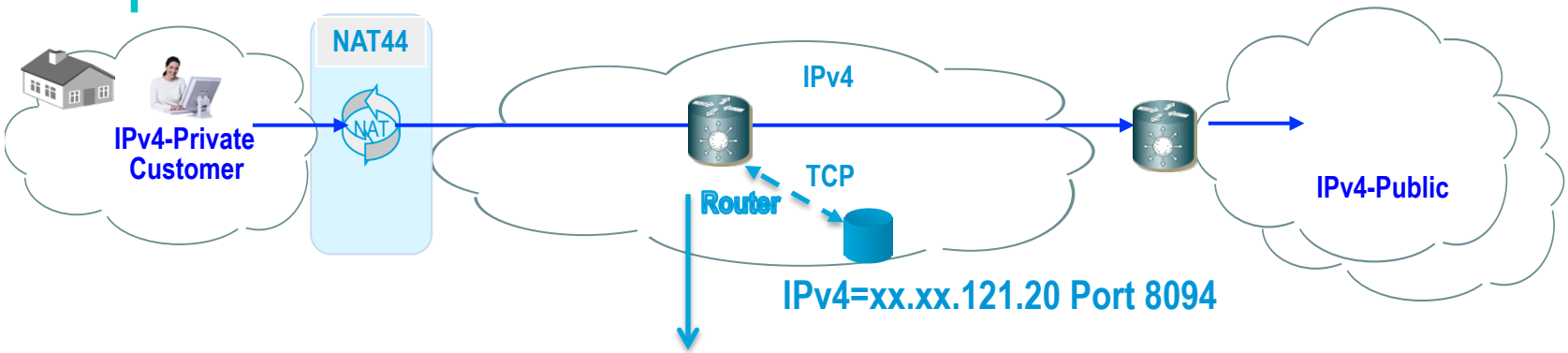
…

Wait for vendors to have functionality, then upgrade your CMTS network…

New CMTS/Gateway functionality required to apply/use ACL…

Regular IPv6 ACL with native IPv6 addresses and v4-mapped-v6 address

Sample Customer configuration
Example 3 – IPv4 Redirect Server

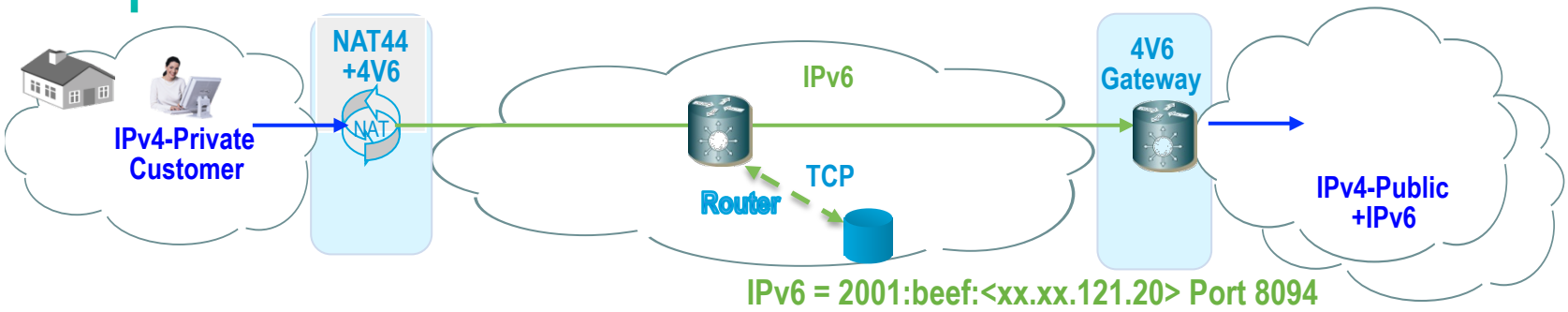


Layer 4 (or HTTP) Redirect user's traffic to SP's Self Activation/Provisioning Portal.

server-group Provisioning-server
server xx.xx.121.20 8094
!
redirect port-list WebPorts to Provisioning-server

…

Sample Customer configuration
Example 3 – 4V6



4V6 Translation

IVI mapped address

4V6 Tunneling

server-group Provisioning-server

server 2001:beef:<xx.xx.121.20> 8094

!

redirect port-list WebPorts to Provisioning-server

…

Uses Stateless NAT46 – for IPv4-IPv6

Same service configuration for native IPv6 and 4V6 traffic

Change your service and/or architecture (eg placement of redirect server or devices) or server

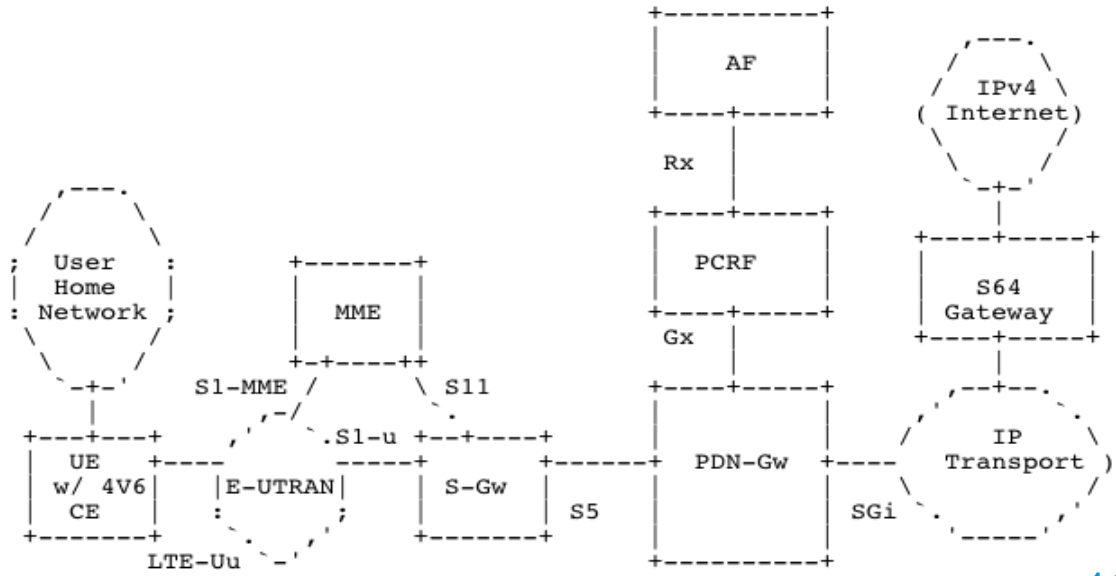
Redirect needs to happen at/after 4V6 Gateway.

IPv6 traffic redirect done elsewhere.

Server with IPinIP

What about “standard architectures”? 4V6 in a 3GPP system

- 3GPP system functionality is defined to support an extensive set of service requirements,
  - –Eg Per subscriber QoS, charging, data volume plans.
- System is in deployment. IPv6 fully supported in Release 8/9
- Key functionality is the classification of user traffic by the PDN-Gw//GGSN and signaling across various interfaces of the user’s virtual interface. This is specified in terms of IP Filters.
- 3GPP currently defines IPv4 & IPv6 traffic filters. (5 tuple ACLs)
- No defined way how to represent IPv4inIPv6 traffic.
  - –Possible options are a new APN, or a new bearer type.



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4V6 in a 3GPP System
Impact Summary

	4V6 Mapped Tunnel Mode	4V6 Translation Mode
User Data Plane at PDN-Gw	IPv4 over IPv6 over GTP-U over UDP over IP	IPv6 over GTP-U over UDP over IP
Gx (Diameter)	Needs extension for applying v4 over v6 in TFT Filter and Flow descriptors	No visible impact
Rx (diameter)	Needs extension for using v4 over v6 Flows	No visible impact
S5 (GTP)	Impacted if new Bearer type is defined	No visible impact
New APN or bearer	??? Depends	Not required
PDN-Gw	New TFT capability, IP Gate functionality + changes to Gx and any S5/S7 interfaces	No impact
SGw	No visible impact (except when new bearer is used)	No impact
PCRF	Functionality for IPv4 in IPv6 mapping needed (for IPv4-only applications)	Functionality to map IPv4-IPv6 addresses needed (only for IPv4-only applications).
AF	Flow based applications impacted	No visible impact.
UE	4V6 CPE	4V6 CPE
LTE-Uu	Likely changes required if signaling new bearer type	No visible impact
Lawful Intercept	New rules for tunnel support	No visible impact

Summary

- Technically both solutions (translate/tunnel) solve the same core problem.

  Both have the same core characteristics and caveats

  Significant differences appear in the context.

  Translation solution lines up with native IPv6 systems – also as defined by 3GPP, Cablelabs, etc

- Positioning:

	4V6 Translate	4V6 Tunnel
Objective	Native IPv6 network & operations	IPv4 over IPv6 overlay
Practical	Reuse IPv6 features and systems	IPv4 header transparency
Additional Value of solution	Functional re-use of NAT64.	“Don’t care”