

Stateless 4over6 in access network

draft-sun-softwire-stateless-4over6-00

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Content

- Operational Requirement for Stateless Approach
- Stateless 4over6 Specification
- Deployment Considerations
- Conclusion and Next Step

Flexible Addressing

- Current situation
 - Some ISPs are facing great pressure of IPv4 address shortage. In China Telecom, most provinces will run out of v4 addresses in next 1 to 2 years.
 - The remaining IPv4 address blocks are rather scattered*.
 - ISP may keep updating the IPv4 address plan in the network in order to best utilizing its reminding IPv4 addresses.
- Requirement
 - Flexible IPv4 addressing is needed during transitioning without big impact on the whole network and CPEs.
 - Support scattered IPv4 address blocks, e.g. </24.
 - Keep centralized address planning within ISP side (ie **No changed in the CPE while updating IPv4 address plan**)

* <http://www.apnic.net/policy/add-manage-policy#delegations>

Simple CPE

- Current situation
 - CPE is a big issue in IPv6 transition.
 - CPE is cost sensitive and resource limited. It should be simple and not required for frequent update.
 - CPE management and trouble shooting are difficult due to large number of CPEs built by multiple vendors.
- Requirement
 - Keep CPE as simple as possible.
 - Keep CPE stable in order to simplify CPE management and trouble shooting.

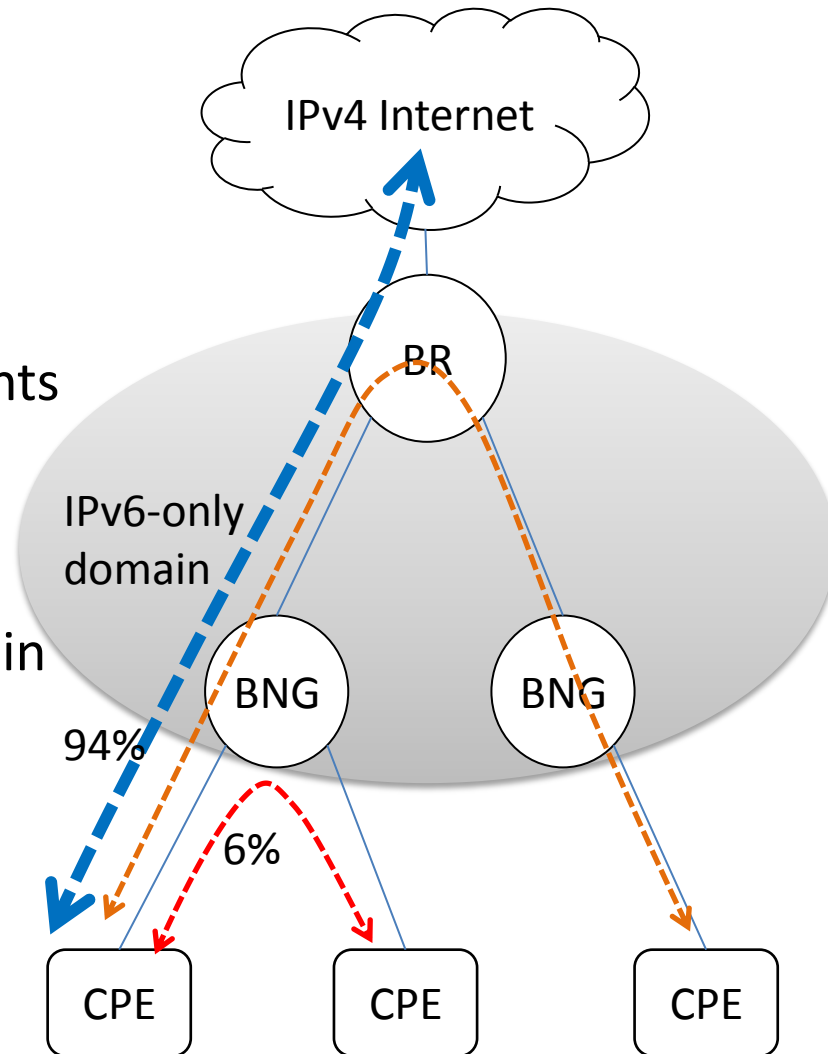
Centralized deployment

- Current situation
 - Large scale ISPs usually have few thousand BNGs with multiple vendors and versions distributed in the network.
 - Most of them can be updated to IPv6, but some models do not provide IPv4-v6 transition strategy.
 - Transition technology can be deployed in a more centralized location next (or closer) to the core router and leave the BNGs transparent to transition technology.
 - Centralized deployment will normally cover a large area.
- Requirement
 - Support multiple domains* in centralized deployment
 - Support centralized subscriber-management

* A domain shares the same IPv4/IPv6 stateless mapping rule(s).

Incremental CPE-CPE optimization

- Current situation
 - Our network architecture is quite flat.
 - No direct link between CPEs.
 - Traffic local to the same BNG represents a small percentage (**about 6%**).
- Requirement
 - CPE-CPE optimization is **NOT A MUST** in general.
 - Further optimization can be deployed **incrementally when necessary** (according to future traffic model).

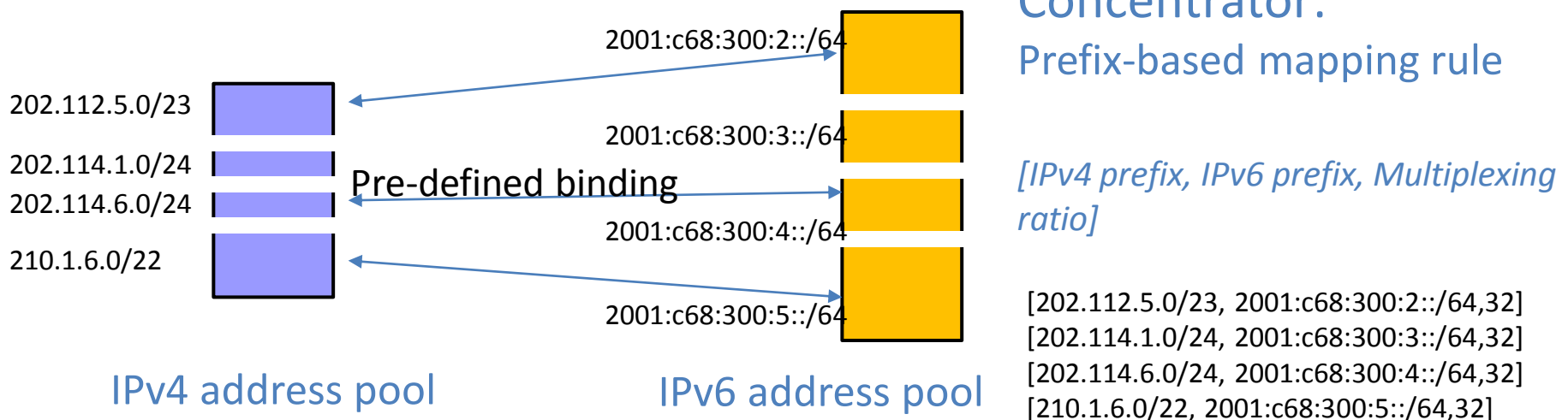


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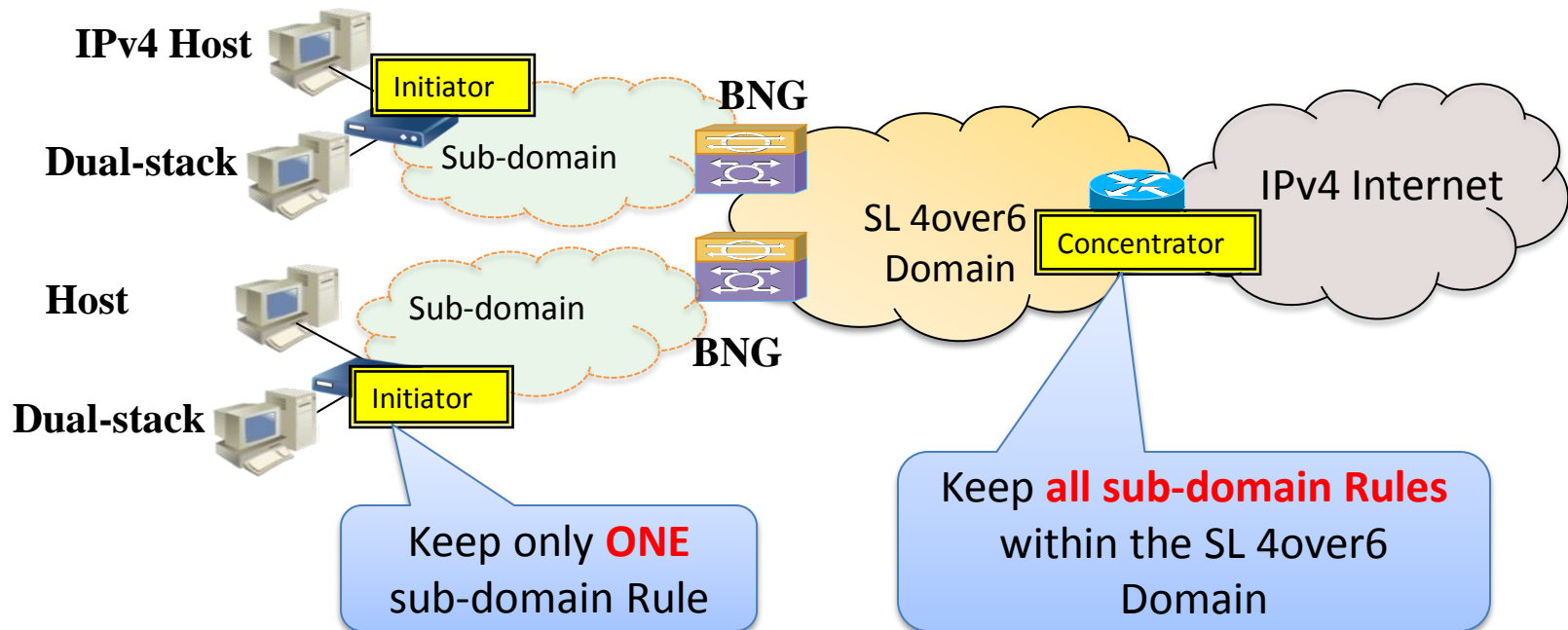
What is Stateless (SL) 4over6?

- Stateless Hub & Spokes Tunnel
- Keep only **ONE Domain RULE** in CPE, consists of IPv6 domain prefix, IPv4 domain prefix and Multiplexing ratio.
- All traffic will be **tunneled to the concentrator** by default.
- Traffic optimization (when needed) can be further **achieved by prefix mapping at BNG**.



Terminology

- **SL 4over6 Domain:** An IPv6 network a concentrator covers.
- **SL 4over6 sub-Domain:** An IPv6 sub-network where different initiators share the same v4/v6 prefix for stateless mapping.
- **subPre6/subPre4:** a common IPv6/IPv4 prefix in the sub-domain
- **sub-domain Rule:** include subPre6, subPre4 and Multiplexing ratio

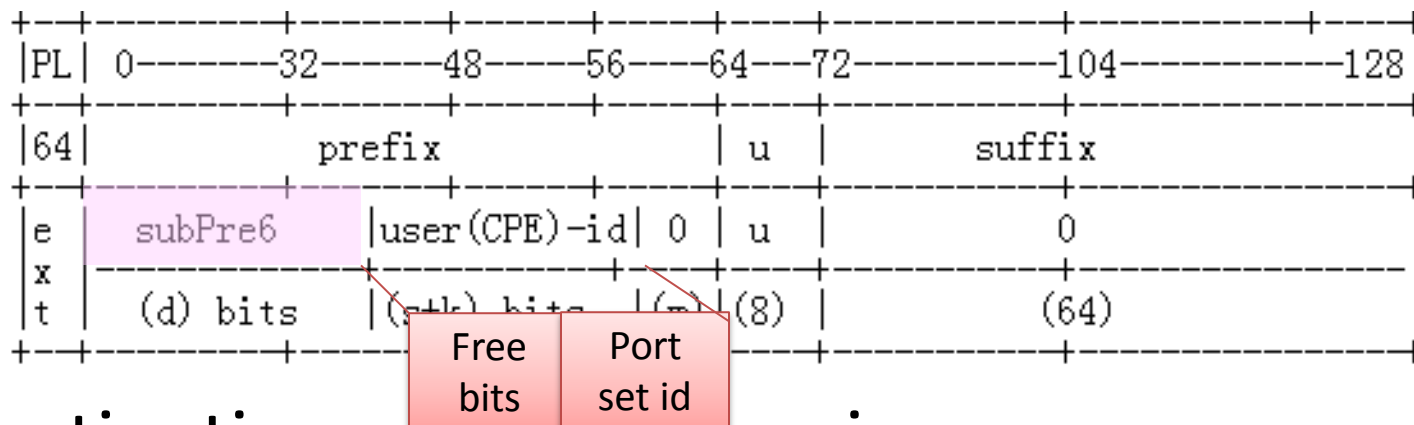


Characteristics of sub-domain

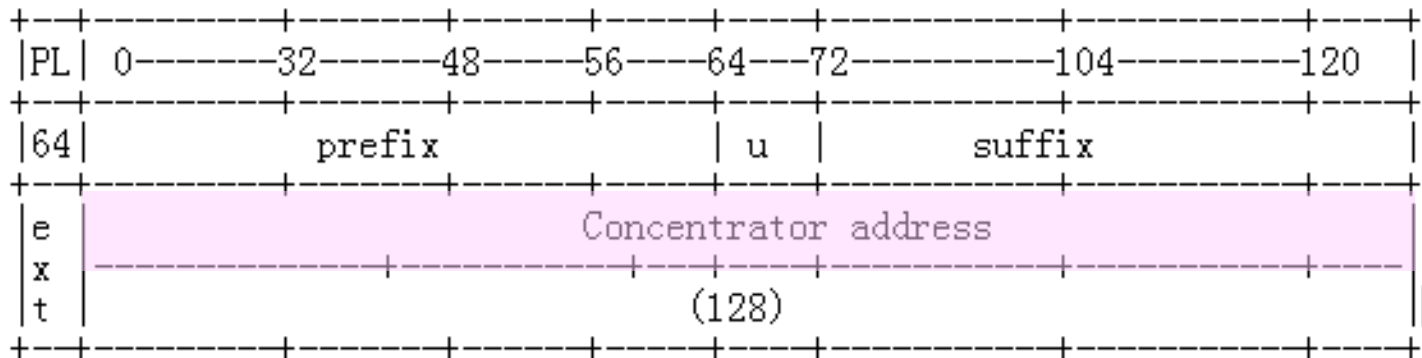
- One sub-domain only has **ONE** sub-domain Rule
- One BNG can have **ONE or More** sub-domains
- Multiple BNGs can also be covered **in the same sub-domain**.
- One initiator will only belong to **ONE** sub-domain
- One sub-domain has a **UNIFIED** Multiplexing ratio.

Address/Prefix Mapping Format

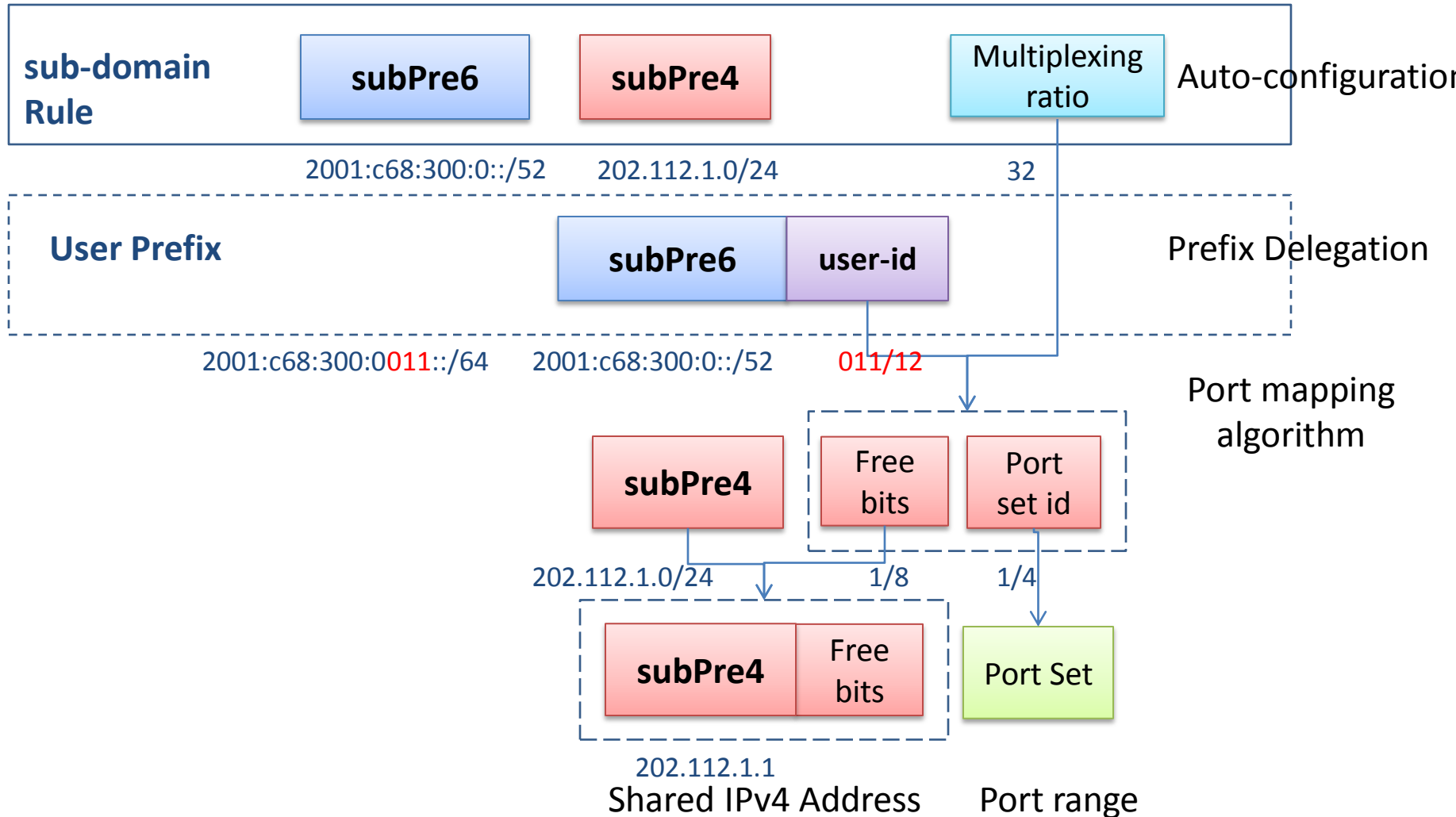
- Source address mapping [[I-D.xli-behave-divi-pd](#)]



- Destination address mapping



Address/Prefix Mapping Mechanism



Port Mapping Algorithm

- A unified Port mapping algorithms should be defined to determine the mapping rule between Port-set id to Port-set.
- Take modulo algorithm for example [[I-D.xli-behave-divi-pd](#)]
- Each subscriber will have two port sets: {P-odd}, {P-even}

Multiplexing ratio

Port-set ID, 0,1,...,N/2

$$P\text{-even} = j \times (N/2) + 2 \times k + 1024$$

$$P\text{-odd} = j \times (N/2) + 2 \times k + 1024 + 1$$

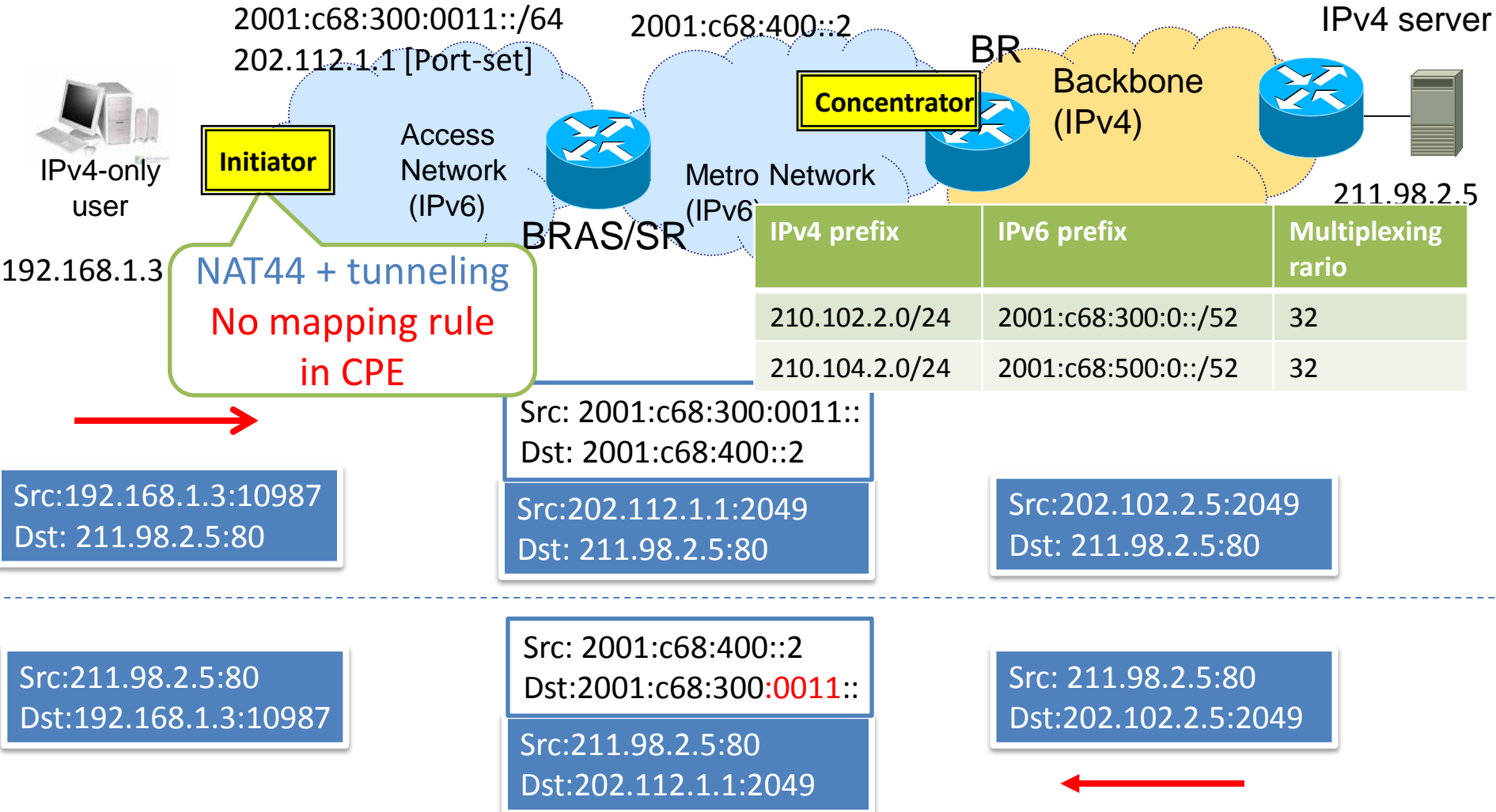
$$K = \lfloor (P - 1024) \% N / 2 \rfloor$$

Example: N=32, k=1

P-even={1026, 1032, 1058,..., 1282}

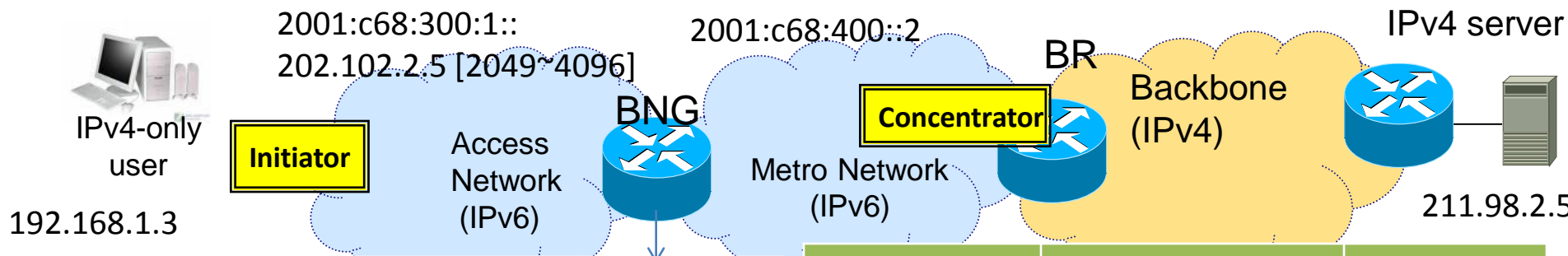
P-odd={1027, 1033, 1059, ..., 1283}

Workflow of stateless 4over6

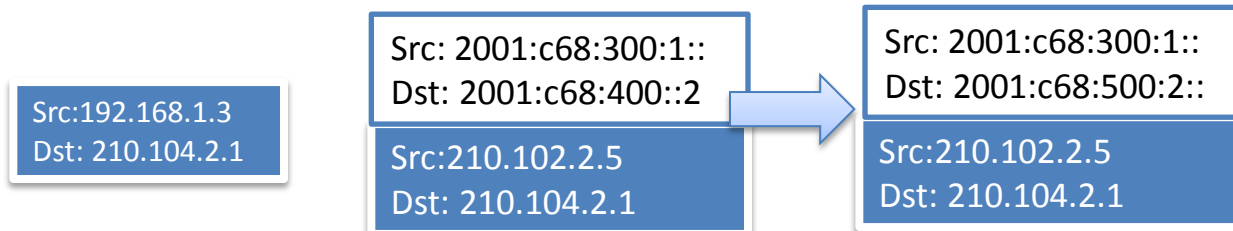


CPE-CPE optimization

- Add prefix mapping in BNG to support CPE-CPE optimization.



IPv4 prefix	IPv6 prefix	Multiplexing ratio	IPv4 prefix	IPv6 prefix	Multiplexing ratio
210.102.2.0/24	2001:c68:300:0::/52	32	210.102.2.0/24	2001:c68:300:0::/52	32
210.104.2.0/24	2001:c68:500:0::/52	32	210.104.2.0/24	2001:c68:500:0::/52	32

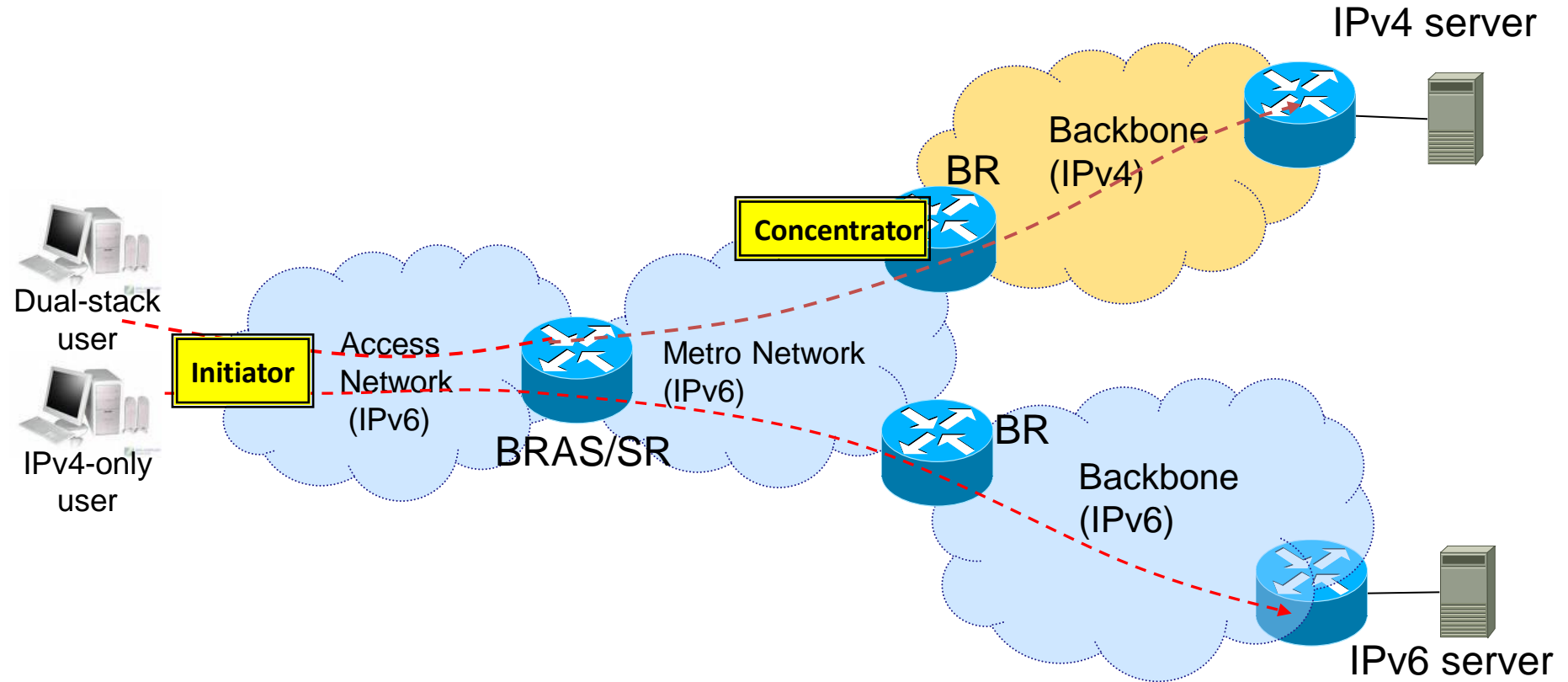


BNG need to be modified to support traffic optimization.

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Broadband Deployment scenarios



Addressing and Routing

- Pre-determine the IPv4/IPv6 prefix binding relationship.
- Maintain IPv4/IPv6 prefix binding in ISP network, **rather than distributing in CPEs.**
- Each initiator only gets its own sub-domain rule.
- No impact on IPv6 network routing.

Domain Coverage Planning

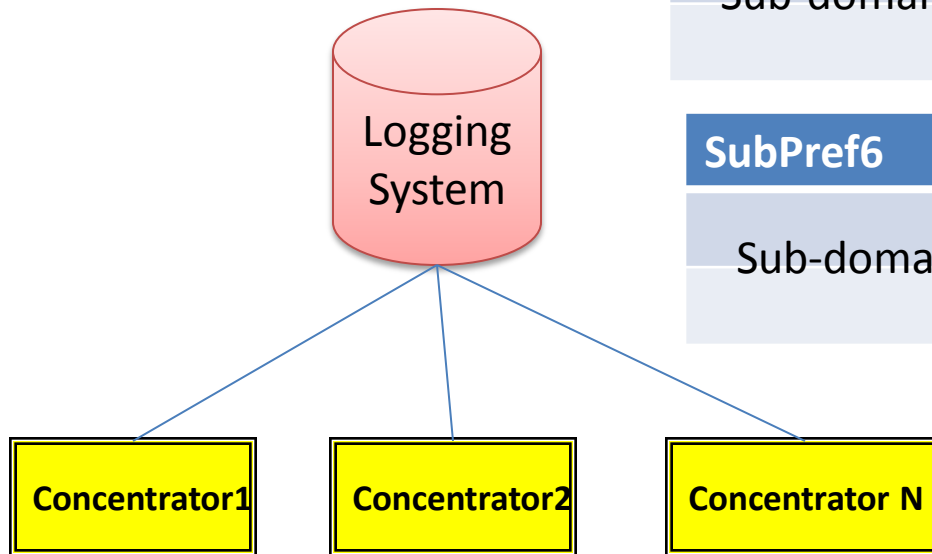
- The placement of concentrator will determine the domain coverage.
- A larger domain would normally have more sub-domain rules.
- A centralized deployment is also good for management, policy control, and reduce cost.
- It is also consistent with the overall network transitioning to IPv6.

CPE management

- CPEs may receive its **sub-domain rule** in a variety of provisioning methods, including DHCPv6, "TR-69", etc.
- CPE will get its **user-prefix** via Prefix Delegation process.
- CPE will get **concentrator address** in a similar way of DS-Lite.

Traffic Logging

- Traffic logging system need to maintain all sub-domain rules for its concentrators.



SubPref6	SubPref4	ratio
Sub-domain rules form Concentrator1		

SubPref6	SubPref4	ratio
Sub-domain rules form Concentrator2		
.....		

CPE-CPE optimization

- Analyze the traffic model in MAN.
- If the traffic within the same BNG occupies a large percentage, incrementally deploy prefix mapping functionality in these BNGs.

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Benefits from stateless 4over6

- Flexible Addressing: centralized IPv4/IPv6 address planning within ISP network
- Simple CPE: keep only **a single rule** of its sub-domain
- Support scattered IPv4 address blocks: a centralized concentrator can easily handle a few thousand rules.
- Incremental CPE-CPE optimization: ISP can adjust their traffic when **needed**.

Technology **stateless 4over6** ID card

Axis	Stateless 4over6
NAT bindings	Initiator (CPE)
Mesh vs. Hub & Spokes	Hub & Spokes (optional traffic optimization)
Translation vs. Encapsulation	Encapsulation
How does the CPEs “learns” its IPv4 address and port range ?	Sub-domain rule: auto-configuration IPv6 user-prefix: IPv6 address allocation Concentrator address: similar to DS-Lite
Address mapping rules (remote point)	Sub-domain rule + user-id Modulo based algorithm
Address mapping rules (outside point)	Concentrator address
Integration with Existing Mechanism	A stateless mode of 4over6 (DS-Lite)

Next step

- Define a unified prefix format and a default port mapping algorithm(e.g. modulo, etc.).
- Comments and contributions are welcome
 - <http://tools.ietf.org/html/draft-sun-softwire-stateless-4over6-00>

Thank you 😊

Q&A