

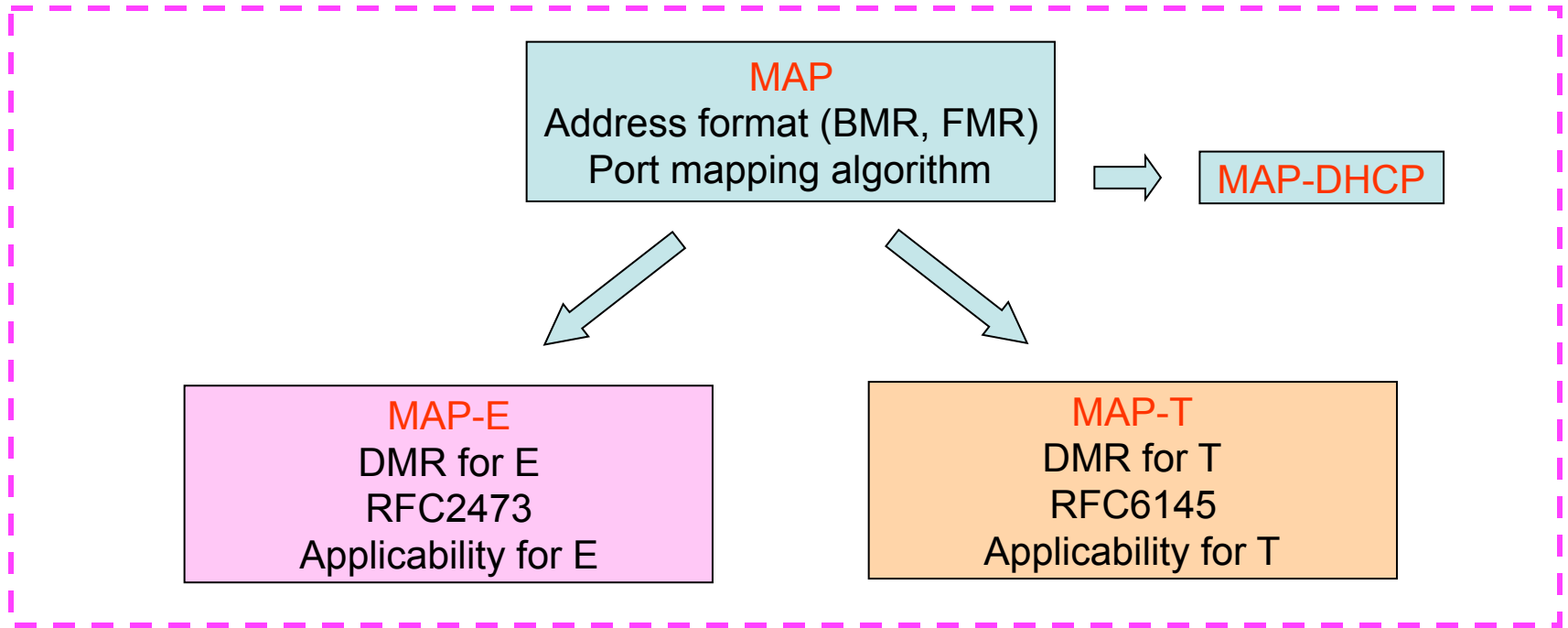
Specifications of MAP Translation (MAP-T) MAP Encapsulation (MAP-E)

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MAP framework



- MAP Series: ONE Complete Standard (MAP, MAP-E, MAP-T, MAP-DHCP)
- Data path forwarding are based on existing standards
- Different applicability

Beijing Interim meeting Consensus>Create Design team
Well-discussed in the mailing-list for about 6 months

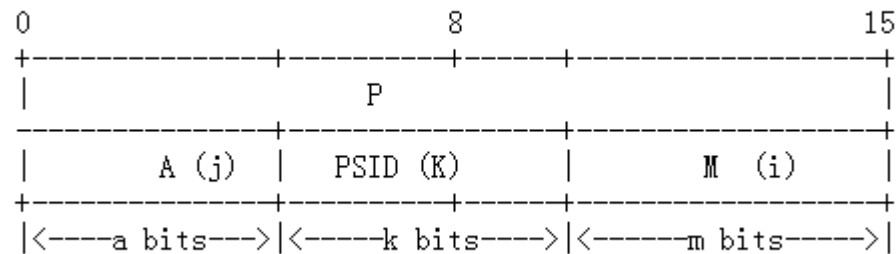
Address format and Port-mapping algorithm

```

<-- n bits -->|<o bits>|<-m bits>|< 8>|<----- L>=32 ----->|<--56-L-->
+-----+-----+-----+-----+-----+-----+
| IPv6 prefix | EA bits | Subnet-id | u | IPv4 address | PSID | 0 |
+-----+-----+-----+-----+-----+-----+
|<End-user IPv6 prefix >|

```

Same address format for BMR and FMR



Same port mapping algorithm (GMA)

MAP address example

map calculator (octet boundary, bitwise ratio)

IPv4: / PREF: / Ratio:

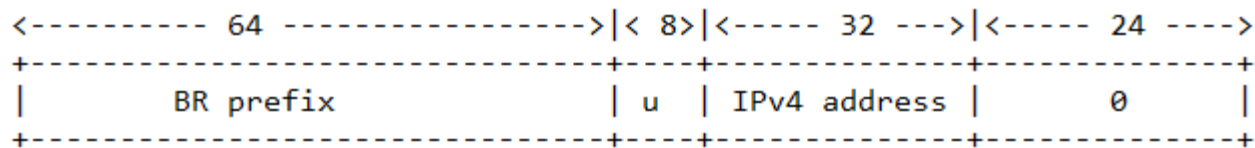
index	IPv6 prefix	IPv4 subnet	o/R	CE (IPv4-translatable address)
s0t	2001:da8:a4a6::/48	202.38.117.65/29	0/4	2001:da8:a4a6:2000:ca:2675:4100:0/53
s1t	2001:da8:a4a6::/48	202.38.117.65/29	1/4	2001:da8:a4a6:2800:ca:2675:4140:0/53
s2t	2001:da8:a4a6::/48	202.38.117.65/29	2/4	2001:da8:a4a6:3000:ca:2675:4180:0/53
s3t	2001:da8:a4a6::/48	202.38.117.65/29	3/4	2001:da8:a4a6:3800:ca:2675:41c0:0/53
s4t	2001:da8:a4a6::/48	202.38.117.66/29	0/4	2001:da8:a4a6:4000:ca:2675:4200:0/53
s5t	2001:da8:a4a6::/48	202.38.117.66/29	1/4	2001:da8:a4a6:4800:ca:2675:4240:0/53
s6t	2001:da8:a4a6::/48	202.38.117.66/29	2/4	2001:da8:a4a6:5000:ca:2675:4280:0/53
s7t	2001:da8:a4a6::/48	202.38.117.66/29	3/4	2001:da8:a4a6:5800:ca:2675:42c0:0/53
s8t	2001:da8:a4a6::/48	202.38.117.67/29	0/4	2001:da8:a4a6:6000:ca:2675:4300:0/53
s9t	2001:da8:a4a6::/48	202.38.117.67/29	1/4	2001:da8:a4a6:6800:ca:2675:4340:0/53
s10t	2001:da8:a4a6::/48	202.38.117.67/29	2/4	2001:da8:a4a6:7000:ca:2675:4380:0/53
s11t	2001:da8:a4a6::/48	202.38.117.67/29	3/4	2001:da8:a4a6:7800:ca:2675:43c0:0/53
s12t	2001:da8:a4a6::/48	202.38.117.68/29	0/4	2001:da8:a4a6:8000:ca:2675:4400:0/53
s13t	2001:da8:a4a6::/48	202.38.117.68/29	1/4	2001:da8:a4a6:8800:ca:2675:4440:0/53
s14t	2001:da8:a4a6::/48	202.38.117.68/29	2/4	2001:da8:a4a6:9000:ca:2675:4480:0/53
s15t	2001:da8:a4a6::/48	202.38.117.68/29	3/4	2001:da8:a4a6:9800:ca:2675:44c0:0/53
s16t	2001:da8:a4a6::/48	202.38.117.69/29	0/4	2001:da8:a4a6:a000:ca:2675:4500:0/53
s17t	2001:da8:a4a6::/48	202.38.117.69/29	1/4	2001:da8:a4a6:a800:ca:2675:4540:0/53
s18t	2001:da8:a4a6::/48	202.38.117.69/29	2/4	2001:da8:a4a6:b000:ca:2675:4580:0/53
s19t	2001:da8:a4a6::/48	202.38.117.69/29	3/4	2001:da8:a4a6:b800:ca:2675:45c0:0/53
s20t	2001:da8:a4a6::/48	202.38.117.70/29	0/4	2001:da8:a4a6:c000:ca:2675:4600:0/53
s21t	2001:da8:a4a6::/48	202.38.117.70/29	1/4	2001:da8:a4a6:c800:ca:2675:4640:0/53
s22t	2001:da8:a4a6::/48	202.38.117.70/29	2/4	2001:da8:a4a6:d000:ca:2675:4680:0/53
s23t	2001:da8:a4a6::/48	202.38.117.70/29	3/4	2001:da8:a4a6:d800:ca:2675:46c0:0/53

MAP-T

- Stateless Double translation
 - One mode of MAP with specific DMR
 - Keep IPv4 end-to-end transparency except corner cases
 - Use existing IPv6 tools for O&M
 - Extended work of stateless translation from Behave WG

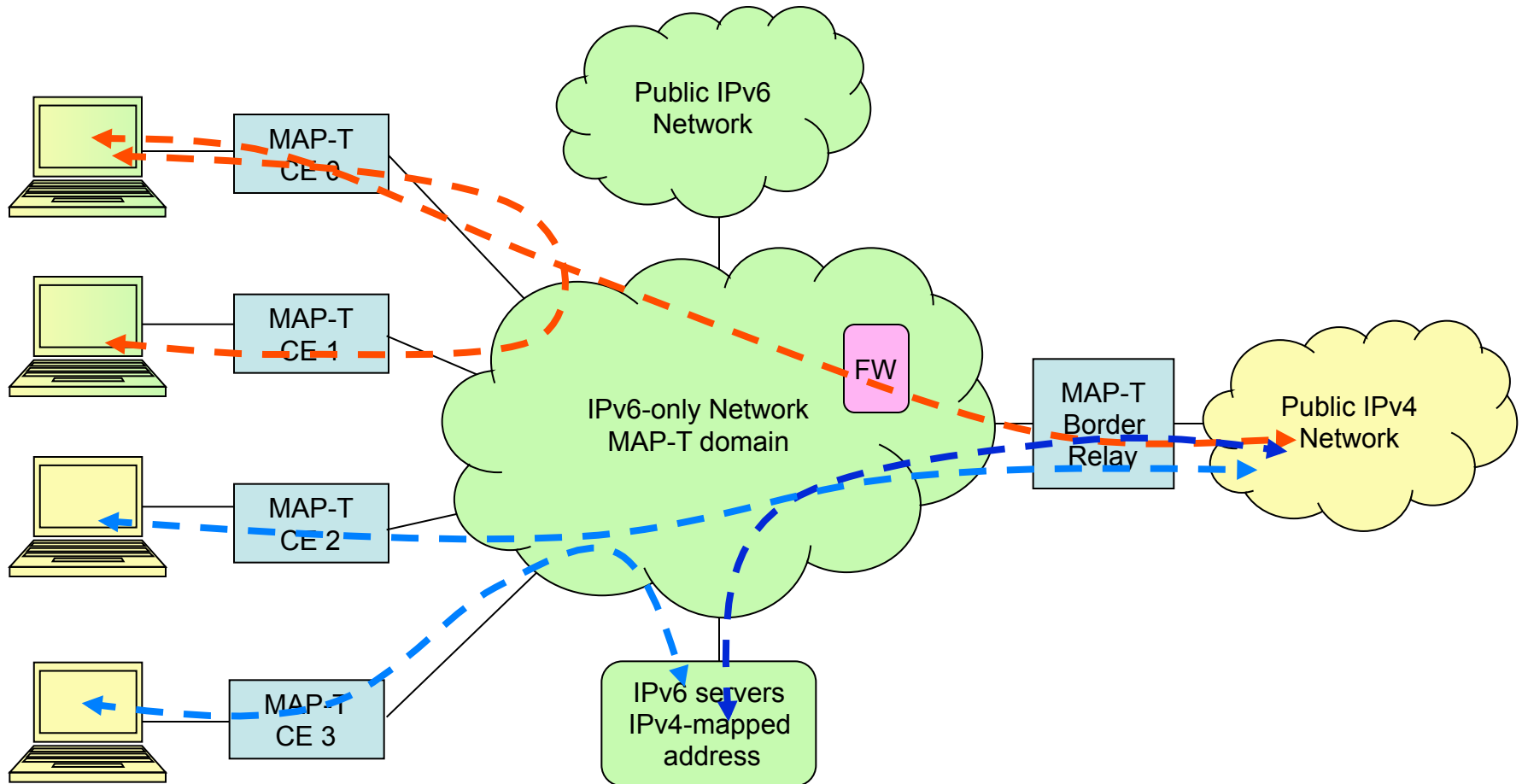
DMR /Date Forwarding Path

- DMR
 - BR IPv6 address



- Data forwarding path
 - RFC 6145
 - Compatible with single translation

Network topology



MAP-T can keep IPv4 end-to-end transparency except corner cases

Options

	packets	ratio	%
total	40702507685	1	
option	1255	3.08335E-08	0.000003
ICMP	176	4.32406E-09	
TCP	1079	2.65094E-08	

Fragmentation

	packets	ratio	%
total	40702507685	1	
frag	41990319	0.00103164	0.103163961
TCP	5843	1.43554E-07	1.43554E-05
ICMP	18414278	0.000452411	0.045241139
UDP	22786760	0.000559837	0.055983676
GRE	783259	1.92435E-05	0.001924351

DF=1 & MF=1

	sum	TCP	UDP	ICMP
Total	5822765423	3.38E+09	2.35E+09	24401444
fragmentation	36789444	395808	36392302	133
DF=1 & MF=1	65752	56582	9169	0
DF=1 & MF=1 %	0.0011	0.0017	0.0004	0.0000

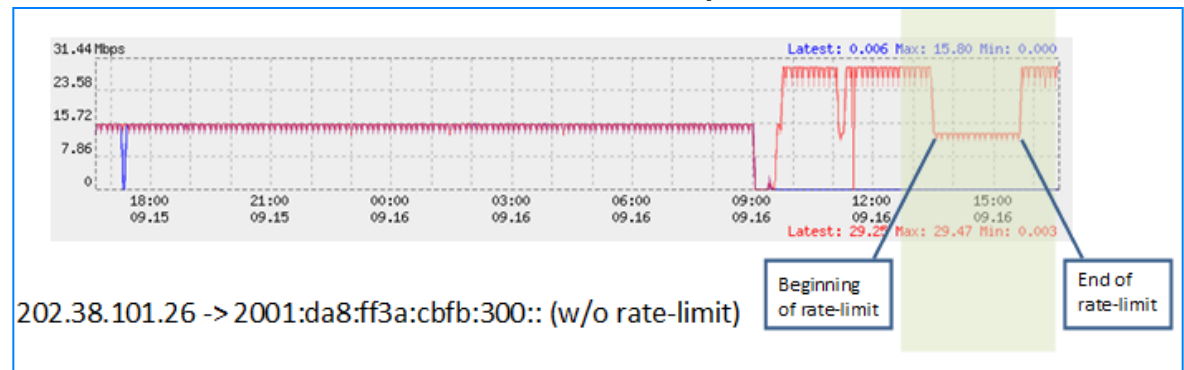
ICMP/ICMPv6

RFC6145				packets	ratio	notes
v4type	v4code	v6type	v6code	11332799		
3	14	1	无	0	0	DROP
4		n/a		644	5.683E-05	DROP
5		n/a		26438	0.0023329	DROP
6		n/a		0	0	DROP
9		n/a		0	0	DROP
10		n/a		0	0	DROP
12	1	4		0	0	DROP
12	others			0	0	DROP
13		n/a		10	8.824E-07	DROP
14		n/a		1	8.824E-08	DROP
15		n/a		0	0	DROP
16		n/a		1	8.824E-08	DROP
17		n/a		2	1.765E-07	DROP
18		n/a		0	0	DROP
				27096	0.002391	

MAP-T can use existing IPv6 tools for O&M

- Null route
- ACL
- eACL
- PBR
- QoS
- Caching

Rate limit example



Configuration

- MAP-T Border Relay configuration

```
control start
ivictl -r -p 202.38.117.0 -l 24 -P 2001:da8:b4b6:: -L 48 -R 16
-M 2 -f mapt
ivictl -r -d -P 2001:da8:b4b6:ffff:: -L 64
ivictl -s -i eth2 -I eth1
```

- MAP-T CE configuration

```
control start
ivictl -r -d -P 2001:da8:b4b6:ffff:: -L 64
ivictl -s -i eth1 -I eth0 -H -N -p 10.1.1.0 -l 24 \
-A 202.38.117.1/24 \
-P 2001:da8:b4b6:: -L 48 -R 16 -M 2 -o 0 -f mapt
```

Summary of MAP-T

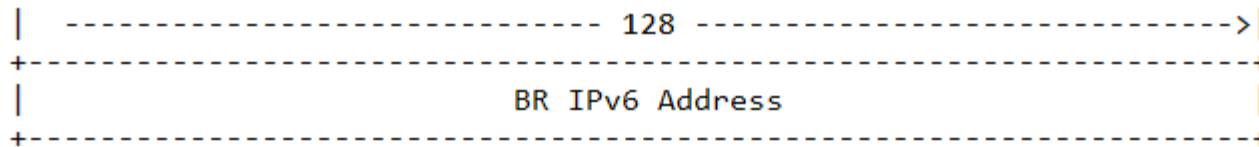
- MAP-T belongs to MAP along with MAP-E to form a single standard
- MAP-T has its own application scenarios
- MAP-T has running code and the code will be released soon
- MAP-T is tested successfully in production IPv6-only network (CERNET2)

MAP-E

- Encapsulation for stateless tunneling
 - One mode of MAP with specific DMR
 - Simply, Stateless, Automatic IPv4-in-IPv6 Tunnel
- Transparent IPv4 packet through a domain
 - Pipe/Short-Pipe Diff-Serv tunneling model
 - GTSM
 - etc.,

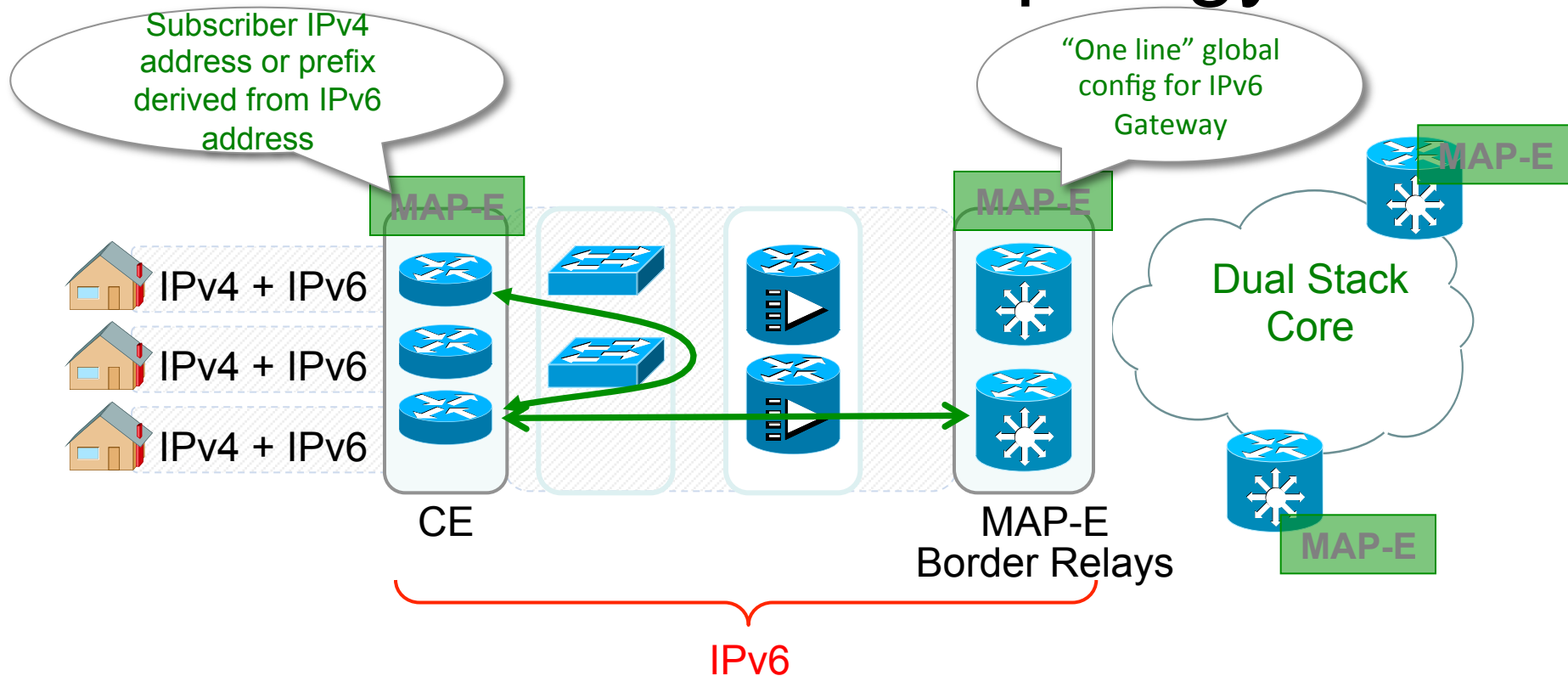
DMR/Data Forwarding Path

- DMR
 - BR IPv6 address



- Data Path
 - RFC2473
 - Keep IPv4 packet through a domain

MAP-E network topology



- Native dual-stack IP service to the Subscriber
- Simple, stateless, automatic IPv4-in-IPv6 encap and decap functions
- IPv4 traffic automatically follows IPv6 Routing
- BRs placed at IPv4 edge, addressed via anycast for load-balancing and resiliency
- Defined in draft-mdt-software-map-encapsulation

Configuration

- MAP-E Border Relay Configuration

```
# ip -6 tunnel add frd1 mode ip/ipv6
# ip -6 tunnel change frd1 rule_ipv6_prefix 2001:db8::/40
rule_ipv4_prefix 192.0.2.0/24 ce_ipv6_prefix_len 56 fmr
enable
```

- MAP-E CE Configuration

```
# ip -6 tunnel add frd1 mode ip/ipv6
# ip -6 tunnel change frd1 rule_ipv6_prefix 2001:db8::/40
rule_ipv4_prefix 192.0.2.0/24 ce_ipv6_prefix_len 56 fmr
enable border_router 2001:db8::1
```

Summary of MAP-E

- MAP-E belongs to MAP along with MAP-T to form the single standard.
- MAP-E enables existing operational techniques which rely on transparency
- Only difference is DMR/data path
- MAP-E has running code and software will be released soon.

Next steps

- Working group adoption
 - Complete MAP-T & MAP-E