Implementation of IPV6 in Telenor's mobile network

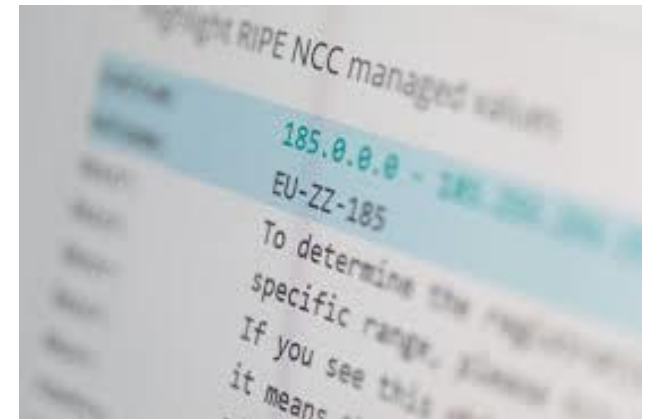**Peđa Radoičić**
20.04. 2021.

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Agenda

- IPv6 introduction drivers

- Mobile handset IPv6 support

- IPv6 network environment

- Migration options
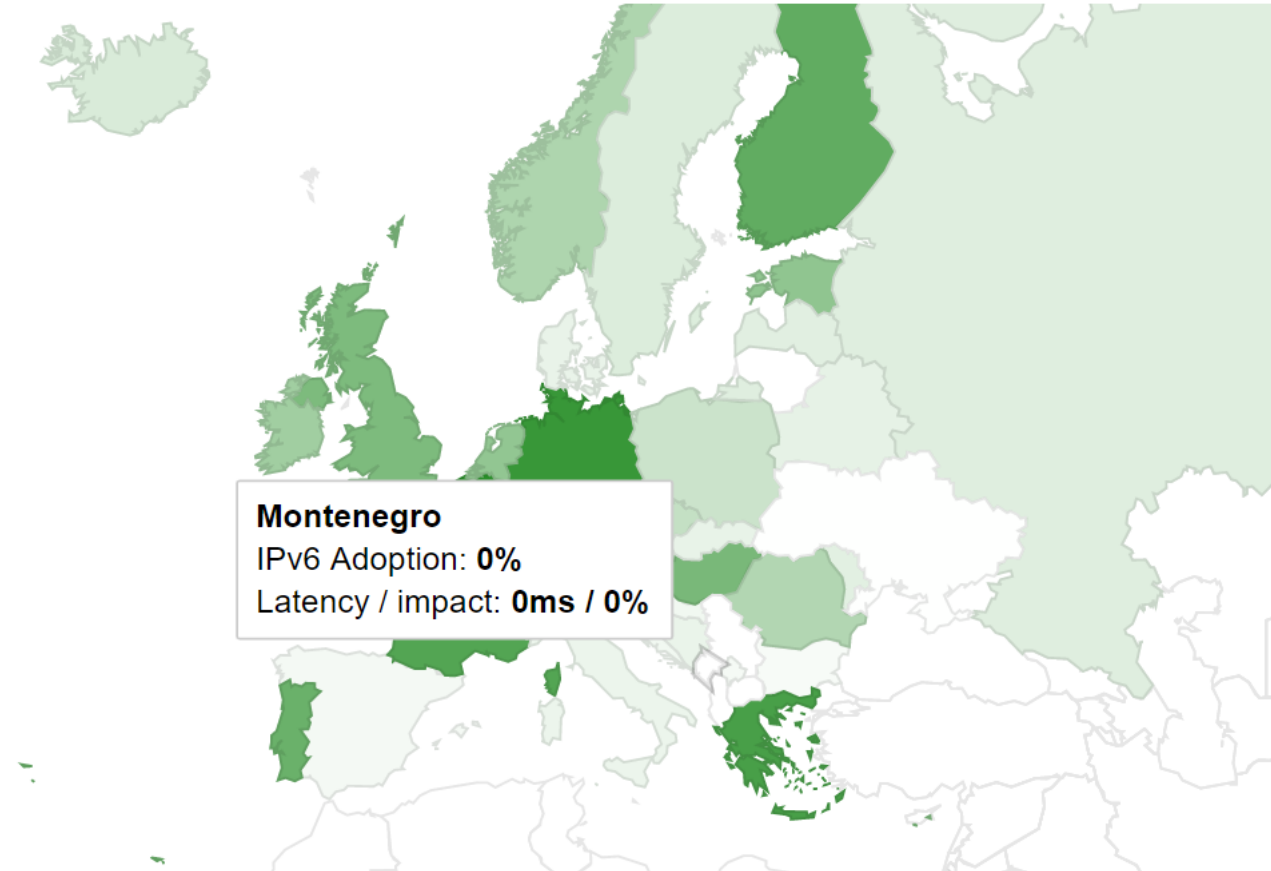
- Summary and next steps

- Reference

IPv6 introduction drivers

- Number of Internet users are rising
- More devices per user
- VoLTE/IMS
- IOT
- Internet registers do not allocate IPv4 anymore
- CG-NAT expensive and not scalable

- Market position
- Cost reduction
- Improved user experience

IPv6 introduction drivers

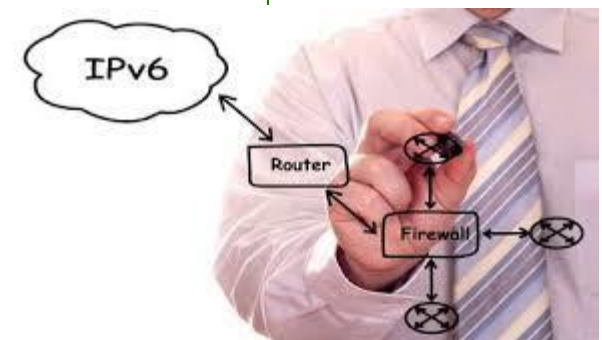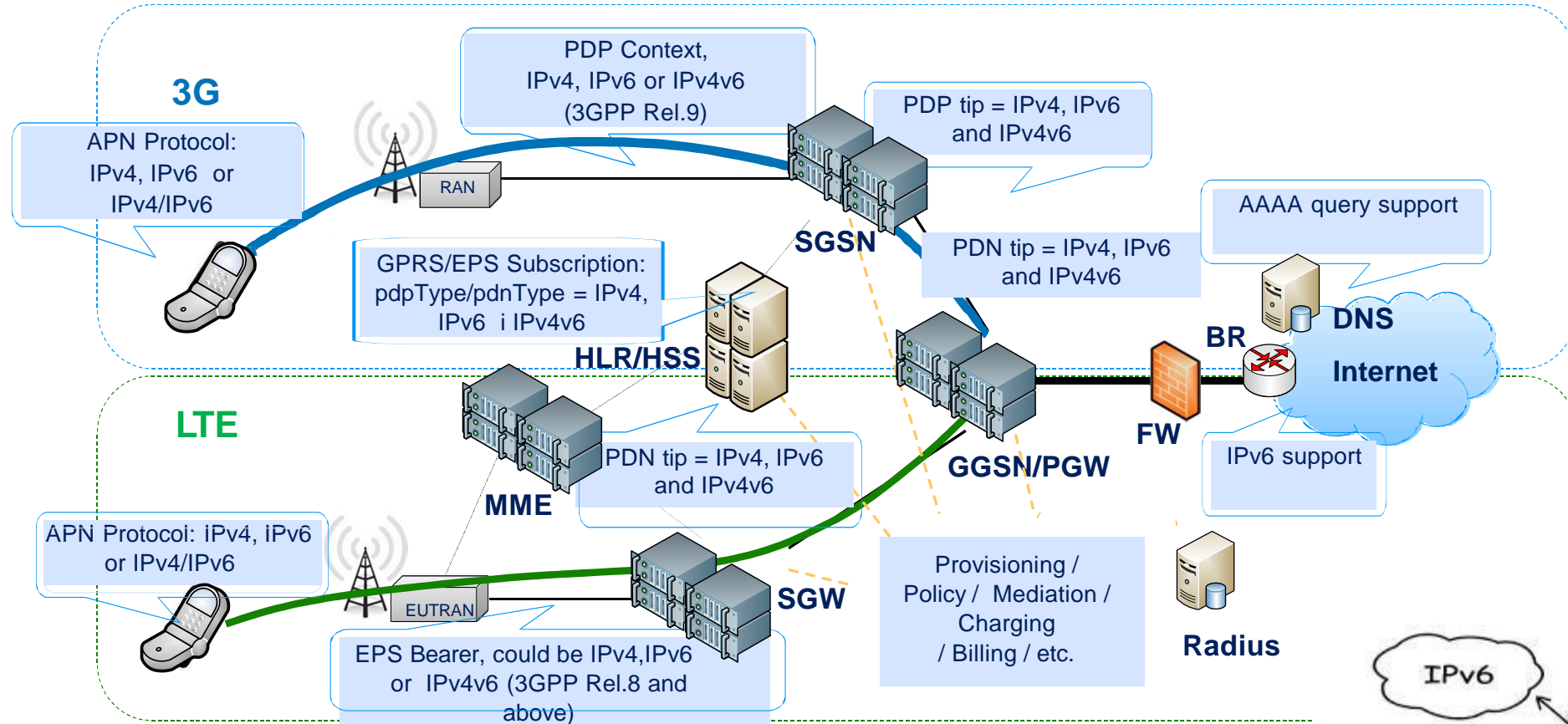**Montenegro**
IPv6 Adoption: **0%**
Latency / impact: **0ms / 0%**

Source: *https://www.google.com/intl/en/ipv6/index.html*

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Mobile handset IPv6 support

OS	Version	Claimed IPv6 ready	Installed by default	DHCPv6	ND RDNSS	Notes
Android	5.0	Yes	Yes	No	Yes	Supports ND-RDNSS in Android 5.0 and above. Does not support DHCPv6.
iOS	4.1	Yes	Yes	Yes	Yes	iOS supports stateless DHCPv6 since version 4 and stateful DHCPv6 since 4.3.1.
Windows Mobile	6.5	Yes	Yes	Lite	No	If the OEM explicitly unsets the SYSGEN_TCPIP6 pre-processor symbol, the built image will not have any IPv6 capabilities.
Windows Phone	8(.1)	Yes	Yes	Yes	No	Private lab research. No privacy extensions (RFC4941).

Source: *https://en.wikipedia.org/wiki/Comparison_of_IPv6_support_in_operating_systems*

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IPv6 network environment

3GPP 3G/LTE architecture

3G

APN Protocol:
IPv4, IPv6 or
IPv4/IPv6

RAN

PDP Context,
IPv4, IPv6 or IPv4v6
(3GPP Rel.9)

PDP tip = IPv4, IPv6
and IPv4v6

SGSN

GPRS/EPS Subscription:
pdpType/pdnType = IPv4,
IPv6 i IPv4v6

PDN tip = IPv4, IPv6
and IPv4v6

AAAA query support

DNS

BR

HLR/HSS

Internet

LTE

PDN tip = IPv4, IPv6
and IPv4v6

FW

MME

GGSN/PGW

IPv6 support

APN Protocol: iPv4, iPv6
or IPv4/IPv6

EUTRAN

SGW

Provisioning /
Policy / Mediation /
Charging
/ Billing / etc.

EPS Bearer, could be IPv4,IPv6
or IPv4v6 (3GPP Rel.8 and
above)

Radius

IPv6

Router

Firewall

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IPv6 network environment

3GPP 3G/LTE architecture – IPv6 requirements
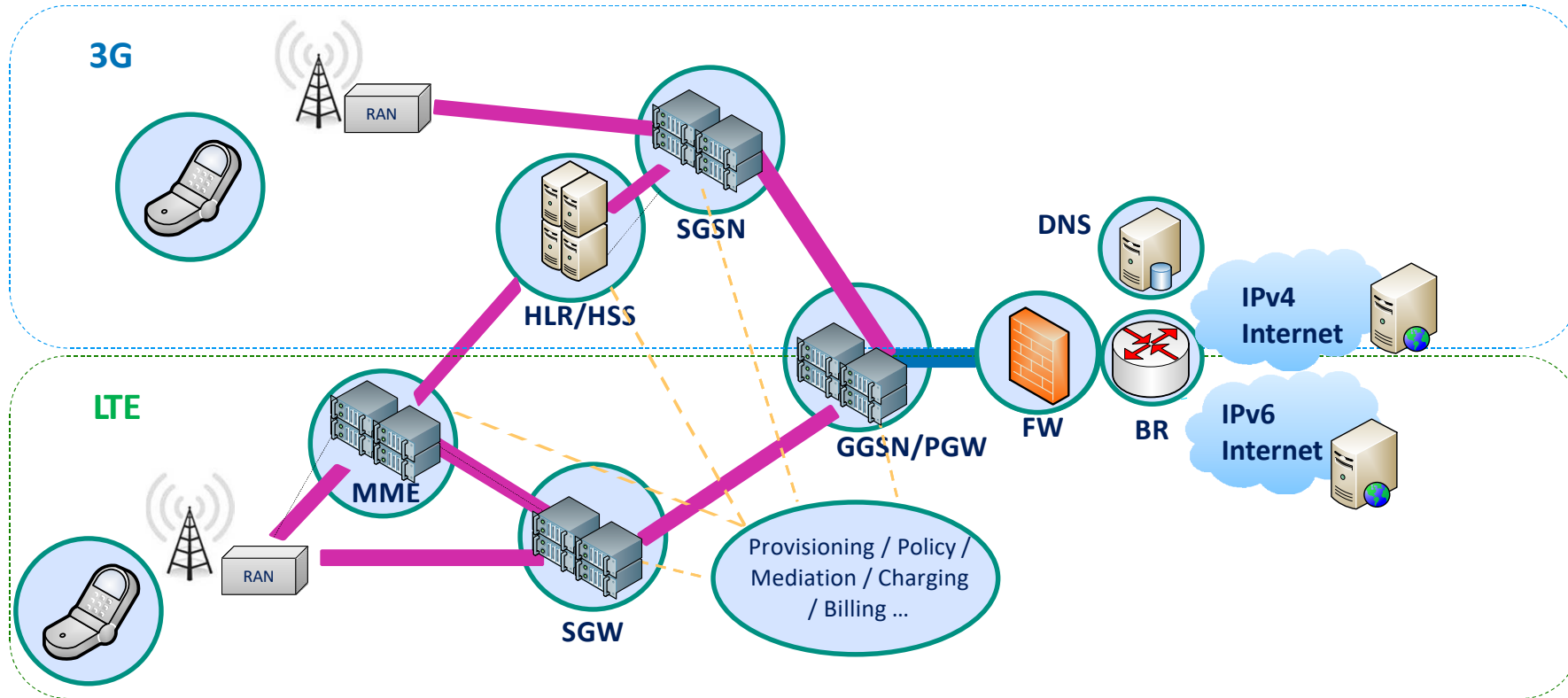
3G

RAN — SGSN

HLR/HSS

DNS

IPv4 Internet

LTE

RAN — MME — SGW — GGSN/PGW — FW — BR

Provisioning / Policy / Mediation / Charging / Billing …

IPv6 Internet

IPv6 support is must

IPv6 support optional

——— IPv6 optional

——— IPv6 not needed

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IPv6 network environment

IPv6 network environment

Firewall app

RAN

GGSN/PGW

Transport network

GiFW

BR

IPv4 Internet

IPv6 Internet

APN ACL

Block the traffic outside predefined traffic ranges

Stateful firewall

All IPv6 traffic initiated on Internet to be blocked.

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Migration options

Bearer/PDP:
IPv4 ili IPv6

GGSN/PGW

IPv4 (IPv6)
IPv6 (IPv4)

**Internet
(IPv4 &
IPv6)**

Bearer/PDP:
IPv6

GGSN/PGW

IPv6

NAT
64

IPv4
IPv6

**Internet
(IPv4 &
IPv6)**

Bearer/PDP:
IPv4 i/ili IPv6

GGSN/PGW

IPv4

IPv6

**Internet
(IPv4 &
IPv6)**
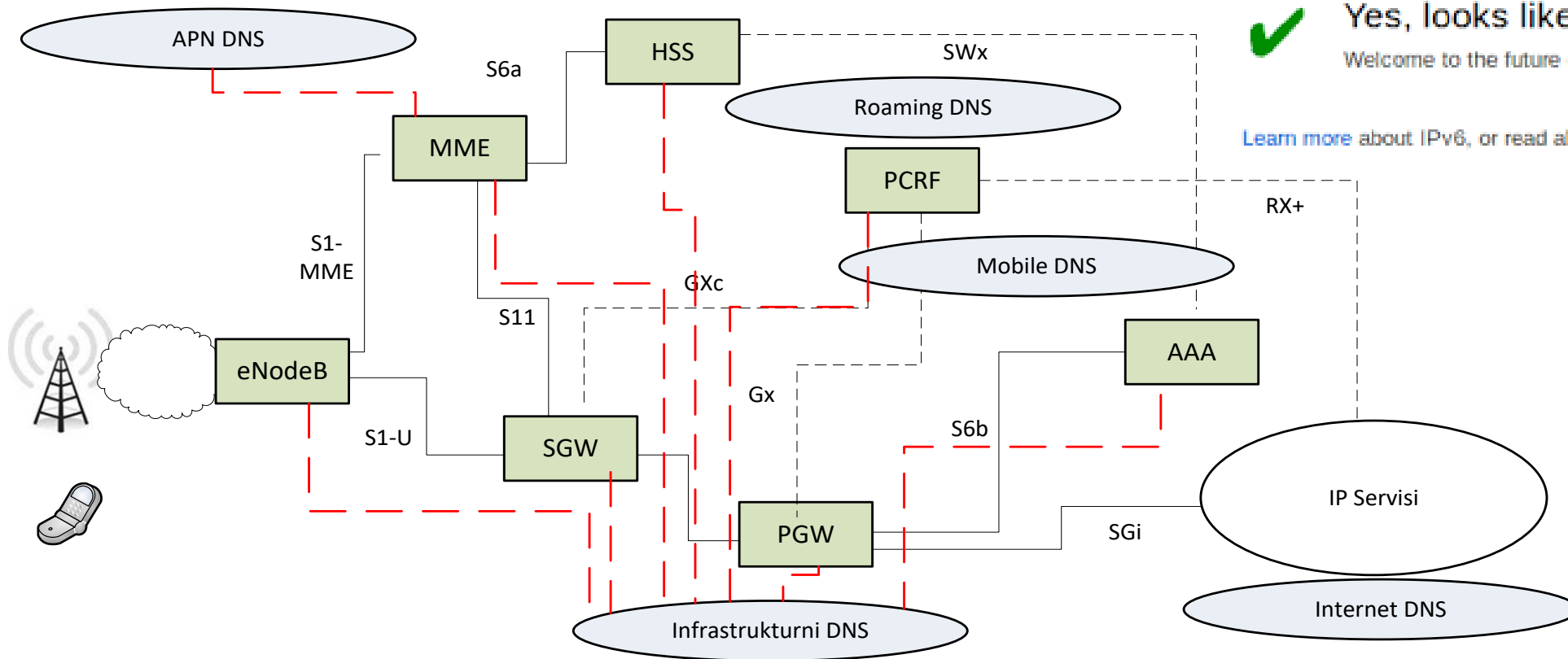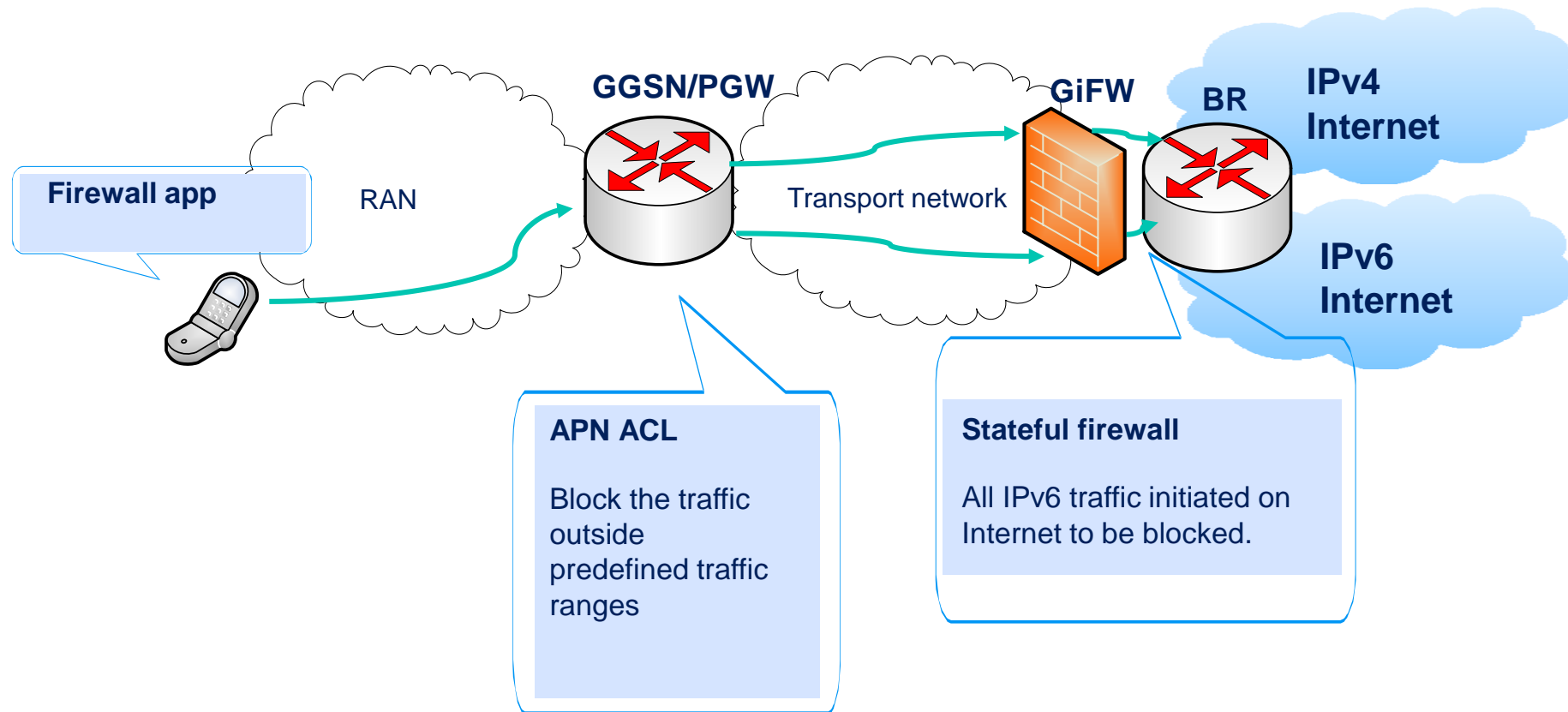
Tunneling:
- IPv6 implemented on legacy IPv4 core network or IPv4 implemented on IPv6 core network
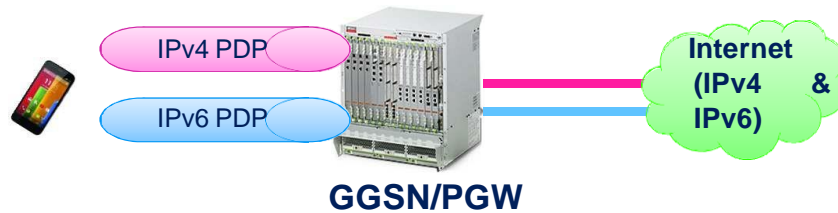- Various tunneling options (ISATAP, 6rd, GRE, etc.)

Translation:
- IPv6 to IPv4 translation
- NAT64/DNS64
- IPv6 only bearer/PDP

Dual Stack:
- IPv4 and IPv6 in parallel
- Bearer/PDP could be IPv4, IPv6 or both

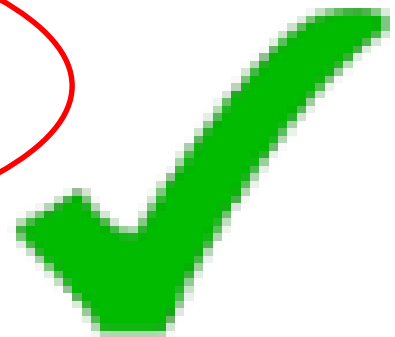**PPF**

Migration options

Bearer/PDP Context: GGSN/PGW (APN)

1a. Separate PDP context for IPv4 and IPv6:

- 2 PDP context – higher cost
- 3GPP Pre-Rel.9 compliant

IPv4 PDP

IPv6 PDP

Internet
(IPv4 &
IPv6)

GGSN/PGW

1b. IPv4v6 PDP context:

- 3GPP Rel.9 and above for 2G/3G
- Potential issues with roaming

IPv4v6 PDP

Internet
(IPv4 &
IPv6)

GGSN/PGW

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Summary and next steps

- No changes on UE

- Without impact on 3GPP network architecture

- Does not introduce overhead (tunnel)

- Transport network agnostic

- NAPT44 position and role remains the same

- No impact on QoS/bearer procedure between UE and PDN GW/SGW/GGSN

- With lowest risk on user experience during and after migration

	IPv4-only network	Dual-stack network	IPv6-only network
Application uses IPv4 only	Application works	Application works	Application doesn't work
App can use either IPv4 or IPv6	Application works	Application works	Application works
App can use IPv6 only	Application doesn't work	Application works	Application works

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Summary and next steps

- SW update and reconfiguration for IPv6 dual stack support in these domains:
    - EPC
    - Billing & Mediation
    - Provisioning
    - Gi FW, CG NAT
    - DNS
- Details security assessment
- Testing
- User migration

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Reference

- 3GPP 23.060 General Packet Radio Service (GPRS); Service description; Stage 2

- 3GPP 23.401 General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access

- **3GPP 23.975 IPv6 migration guidelines**

- 3GPP 29.002 Mobile Application Part (MAP) Specification

- GSMA IR.92 IMS Profile for Voice and SMS

- IETF 7445 Analysis of Failure Cases in IPv6 Roaming Scenarios

- IETF 6877 464XLAT: Combination of Stateful and Stateless Translation

- RFC 8106 IPv6 Router Advertisement Options for DNS Configuration

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Thank you