Implementation of IPv6 in Public Mobile Networks

A Mobitel Example

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Mobile Packet Core
Mobitel, d. d.

WWW.MOBITEL.SI

Mobitel, d. d.

- LTE Trial in 2011
- HSPA^{+} in 2010
- UMTS in 2003
- GPRS in 2001
- GSM in 1996
- NMT in 1991

- **IPv6 in 2011**

- More info: www.mobitel.si

Introduction

- Mobitel
- Mobile environment specific considerations
- Limitations of early implementations and workarounds
- Drivers, motivation & prospective applications
- IPv6 in Mobitel network today & tomorrow
- Concluding remarks

Mobile environment specific considerations

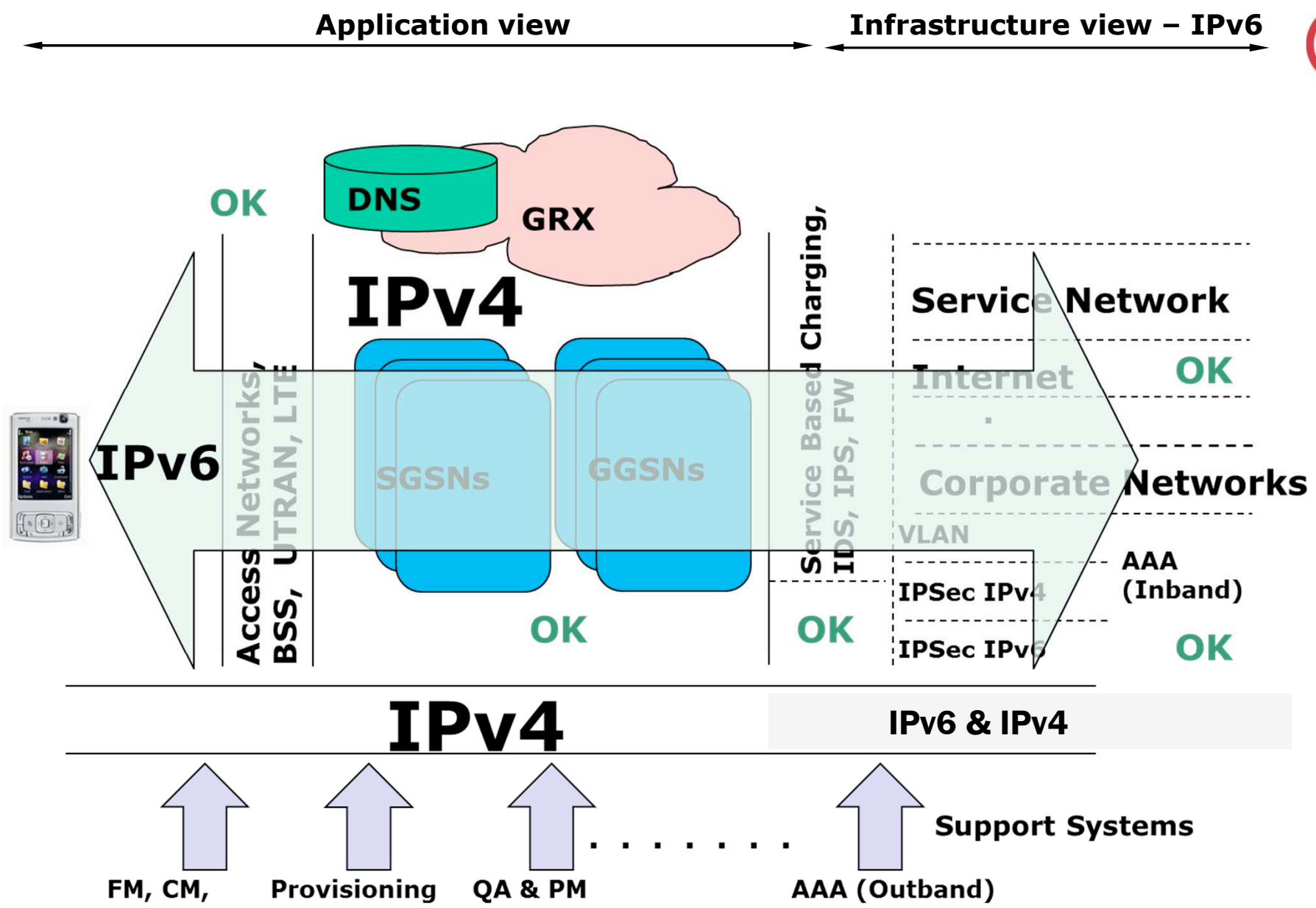
- Mobility – more entities, (HLR, SGSN …)
- International Roaming and GRX*
- Session Management somewhat **more telco-like**:

  APN & PDP context/EPS Bearer

  PDP Address Type = [~~X.25~~, IP, PPP, IPv6, IPv4v6]

  GTP … GPRS Tunelling Protocol

**GPRS Roaming Exchange*


Application view
Infrastructure view – IPv6
OK
DNS
GRX
IPv4
IPv6
Access Networks, BSS, UTRAN, LTE
SGSNs
GGSNs
Service Based Charging, IDS, IPS, FW
Service Network
Internet
OK
Corporate Networks
VLAN
AAA (Inband)
IPSec IPv4
IPSec IPv6
OK
OK
OK
IPv4
IPv6 & IPv4
Support Systems
FM, CM,
Provisioning
QA & PM
AAA (Outband)

Separate views

Application view:

- Mobile network (access, core, support systems, roaming)
- Session Management
- Charging
- Terminals
- APN Management

Infrastructure view:

- IP infrastructure (Gi interface and beyond)
- Routers, firewalls, IDS/IPS

- Usually associated with separate/different teams

If among the first to introduce IPv6

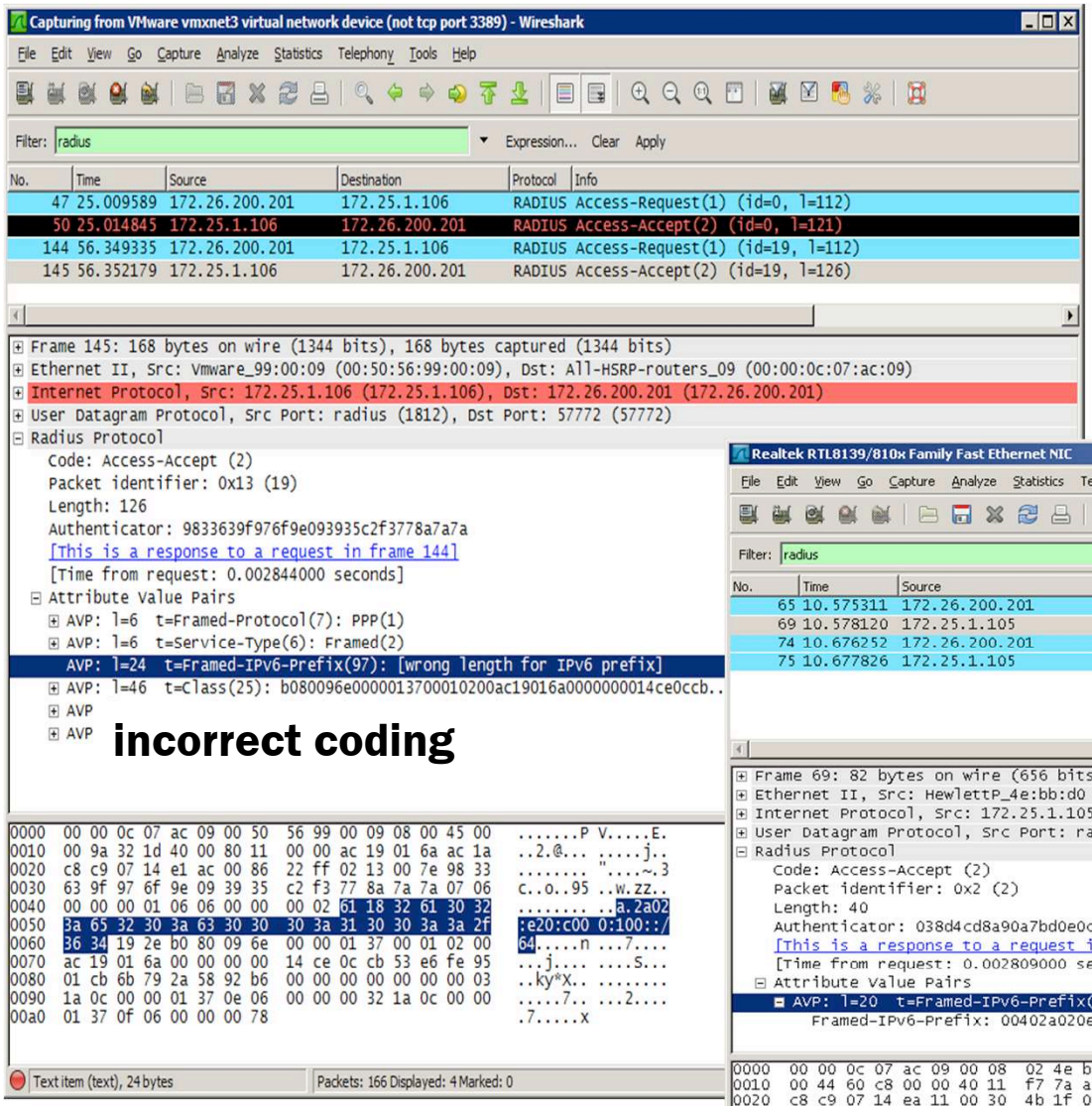
Consider a trial/test:

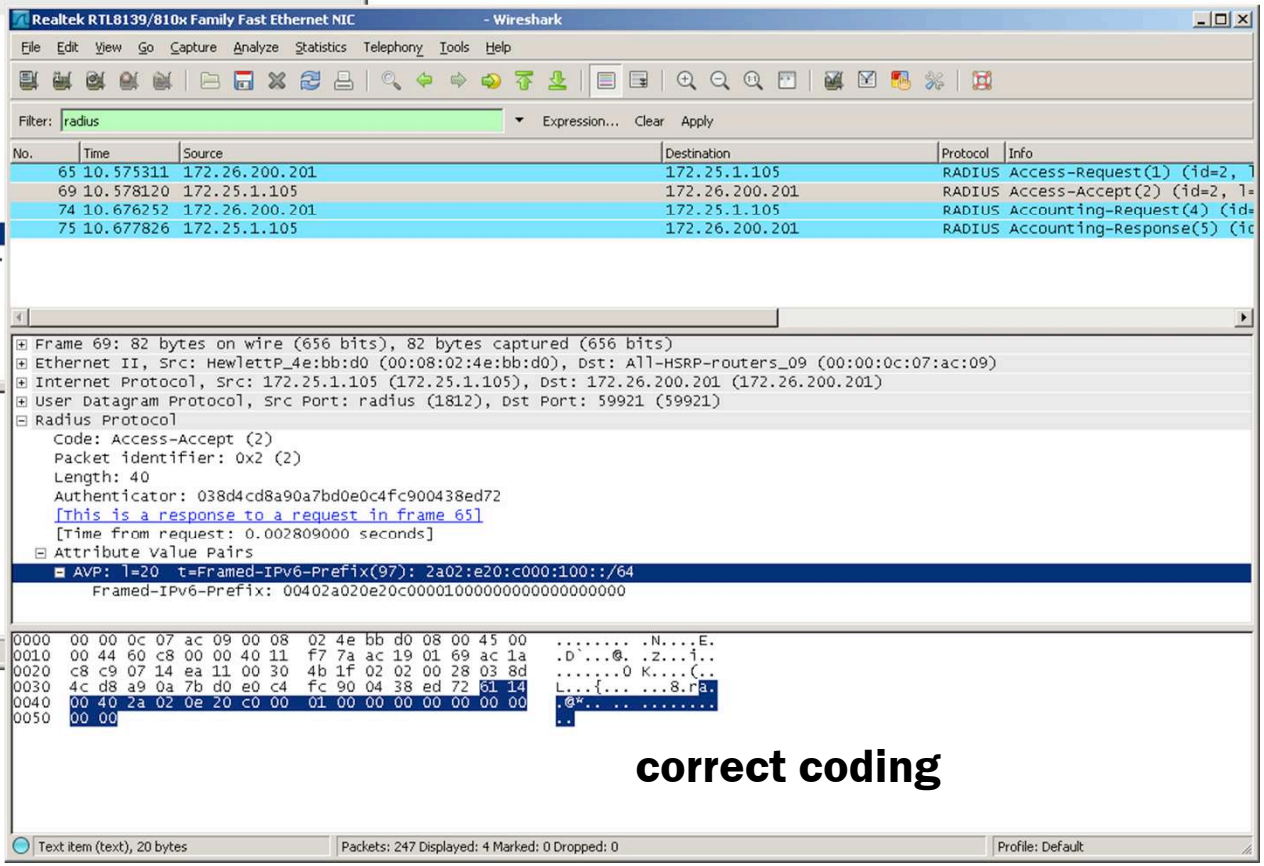
- To verify proper introduction and operation of IPv6 enabled public and private APNs
- Identify potential risks and limitations
- Find means and ways of overcoming certain known limitations of the current IPv6 state of the art in the mobile communications arena, in the interest of a valid early IPv6 deployment.
- To acquire adequate knowledge before going live

Findings (of The Trial)

- It is feasible
- Infrastructure devices might crash when activating IPv6
- Some elements (Terminals, AAA servers) do/did have IPv6 settings in the user interface, but no actual support
- NAT64/DNS64 has its limitations (IP literal references) but works fairly well in most of the cases, and is improving as pages adapt to NAT64
- Differnet IP address assignment mechanisms (/64 prefix, Interface ID assigned by GGSN)
- The case may differ with different size operators (Load vs PCU)

- But it works!


Capturing from VMware vmxnet3 virtual network device (not tcp port 3389) - Wireshark
File Edit View Go Capture Analyze Statistics Telephony Tools Help
Filter: radius
Expression... Clear Apply
No. Time Source Destination Protocol Info
47 25.009589 172.26.200.201 172.25.1.106 RADIUS Access-Request(1) (id=0, l=112)
50 25.014845 172.25.1.106 172.26.200.201 RADIUS Access-Accept(2) (id=0, l=121)
144 56.349335 172.26.200.201 172.25.1.106 RADIUS Access-Request(1) (id=19, l=112)
145 56.352179 172.25.1.106 172.26.200.201 RADIUS Access-Accept(2) (id=19, l=126)
Frame 145: 168 bytes on wire (1344 bits), 168 bytes captured (1344 bits)
Ethernet II, Src: Vmware_99:00:09 (00:50:56:99:00:09), Dst: All-HSRP-routers_09 (00:00:0c:07:ac:09)
Internet Protocol, Src: 172.25.1.106 (172.25.1.106), Dst: 172.26.200.201 (172.26.200.201)
User Datagram Protocol, Src Port: radius (1812), Dst Port: 57772 (57772)
Radius Protocol
Code: Access-Accept (2)
Packet identifier: 0x13 (19)
Length: 126
Authenticator: 9833639f976f9e093935c2f3778a7a7a
[This is a response to a request in frame 144]
[Time from request: 0.002844000 seconds]
Attribute Value Pairs
AVP: l=6 t=Framed-Protocol(7): PPP(1)
AVP: l=6 t=Service-Type(6): Framed(2)
AVP: l=24 t=Framed-IPv6-Prefix(97): [wrong length for IPv6 prefix]
AVP: l=46 t=Class(25): b080096e000001370001020 0ac19016a0000000014ce0ccb..
AVP
AVP
incorrect coding
0000 00 00 0c 07 ac 09 00 50 56 99 00 09 08 00 45 00 .....P V.....E.
0010 00 9a 32 1d 40 00 80 11 00 00 ac 19 01 6a ac 1a ..2.@... .....j..
0020 c8 c9 07 14 e1 ac 00 86 22 ff 02 13 00 7e 98 33 .... "....~.3
0030 63 9f 97 6f 9e 09 39 35 c2 f3 77 8a 7a 7a 07 06 c..o..95 ..w.zz..
0040 00 00 00 01 06 06 00 00 00 02 61 18 32 61 30 32 ....a.2a02
0050 3a 65 32 30 3a 63 30 30 30 3a 31 30 30 3a 3a 2f :e20:c00 0:100::/
0060 36 34 19 2e b0 80 09 6e 00 00 01 37 00 01 02 00 64.....n ...7....
0070 ac 19 01 6a 00 00 00 00 14 ce 0c cb 53 e6 fe 95 ...j.... ....S...
0080 01 cb 6b 79 2a 58 92 b6 00 00 00 00 00 00 00 03 ..ky*X.. ....
0090 1a 0c 00 00 01 37 0e 06 00 00 00 32 1a 0c 00 00 .....7.. ...2....
00a0 01 37 0f 06 00 00 00 78 .7.....x
Text item (text), 24 bytes
Packets: 166 Displayed: 4 Marked: 0


Realtek RTL8139/810x Family Fast Ethernet NIC - Wireshark
File Edit View Go Capture Analyze Statistics Telephony Tools Help
Filter: radius
Expression... Clear Apply
No. Time Source Destination Protocol Info
65 10.575311 172.26.200.201 172.25.1.105 RADIUS Access-Request(1) (id=2,
69 10.578120 172.25.1.105 172.26.200.201 RADIUS Access-Accept(2) (id=2, l=
74 10.676252 172.26.200.201 172.25.1.105 RADIUS Accounting-Request(4) (id=
75 10.677826 172.25.1.105 172.26.200.201 RADIUS Accounting-Response(5) (ic
Frame 69: 82 bytes on wire (656 bits), 82 bytes captured (656 bits)
Ethernet II, Src: HewlettP_4e:bb:d0 (00:08:02:4e:bb:d0), Dst: All-HSRP-routers_09 (00:00:0c:07:ac:09)
Internet Protocol, Src: 172.25.1.105 (172.25.1.105), Dst: 172.26.200.201 (172.26.200.201)
User Datagram Protocol, Src Port: radius (1812), Dst Port: 59921 (59921)
Radius Protocol
Code: Access-Accept (2)
Packet identifier: 0x2 (2)
Length: 40
Authenticator: 038d4cd8a90a7bd0e0c4fc900438ed72
[This is a response to a request in frame 65]
[Time from request: 0.002809000 seconds]
Attribute Value Pairs
AVP: l=20 t=Framed-IPv6-Prefix(97): 2a02:e20:c000:100::/64
Framed-IPv6-Prefix: 00402a020e20c000010000000000000000
0000 00 00 0c 07 ac 09 00 08 02 4e bb d0 08 00 45 00 .... .N....E.
0010 00 44 60 c8 00 00 40 11 f7 7a ac 19 01 69 ac 1a .D`...@. .z...i..
0020 c8 c9 07 14 ea 11 00 30 4b 1f 02 02 00 28 03 8d .... 0 K....(..
0030 4c d8 a9 0a 7b d0 e0 c4 fc 90 04 38 ed 72 61 14 L...{... ...8.ra.
0040 00 40 2a 02 0e 20 c0 00 01 00 00 00 00 00 00 00 .@*.. .. ..
0050 00 00 ..
correct coding
Text item (text), 20 bytes
Packets: 247 Displayed: 4 Marked: 0 Dropped: 0
Profile: Default

Limitations of early implementations

- Terminals (almost none available – WLAN ≠ mobile)
- Service based (online) charging – upgrade
- Impractical „true“ dual stack (multiple PDP contexts, terminals)
- Impractical M2M implementation (Terminals/modules, interface ID allocation, IPv6 over IPv4 IPSEC) ☹

Workarounds

- NAT64/DNS64 – works with limitations
- Multiple primary PDP Contexts – impractical but feasible, possible licence issues (multi RAB, PDP licences)
- If service based/online charging doesn‘t work, either depend on „offline“ CDRs or give it away for free (we did neither, but waited for upgrade).
- No workaround for terminals ☹

Drivers

- *If it be now, ‘tis not to come …*
  …, yet it will come: the readiness is all!

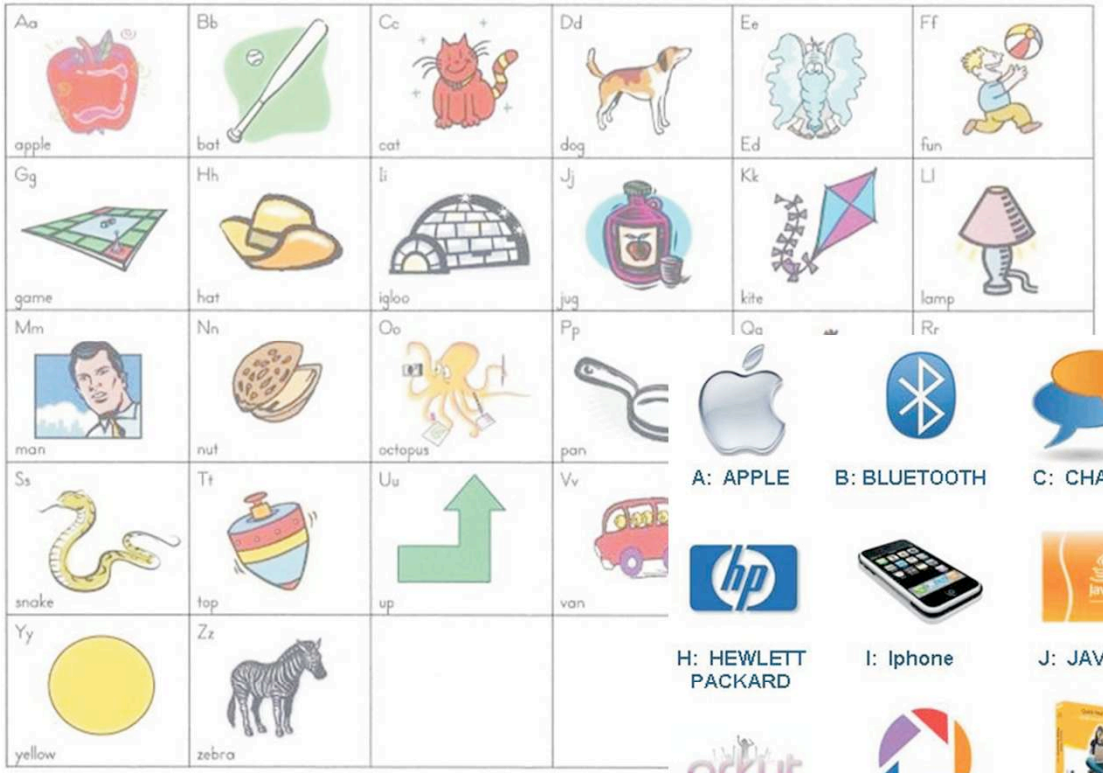
Ipv6 is not an opportunity, it is a necessity!*

Motivation & contributing factors

- The importance of learning by actually doing it yourself
- No major investment needed (minor upgrades/features)*
- Testing oneself and the state of the art in the (mobile) industry
- Encouragement from go6
- Competitiors can have it, too ☺

** The case may differ with the size of an operator!*

The Alphabet



Once

Today

Prospective Applications for IPv6

Always on:

- **M2M**
  - Custom made
  - No question of content and dual stack
  - Huge potential for growth (kPPS, kPDP)

- Smartphones (et al)
  - Chatty
  - Contributing to further growth (kPPS, kPDP)

- **LTE**

Just how much longer do they have to remain prospective?

IPv6 in Mobitel network today

- Commercial since April 2011 (same data plans as IPv4)
- Roaming demonstrated – requires visiting network SGSN‘s IPv6 support. No need for „infrastructure“ IPv6 suport due to GTP
- Self provisioned (text IPv6 to 1918) – moderate demand
- Lack of terminals supporting IPv6 on 2G/3G stack is a show stopper
- Backed by NAT64/DNS64
- IPv6 access to Mobitel portals from the outside ☺

IPv6 in Mobitel network tomorrow

- Look forward to higher loads → anxious for more terminals
- Dual stack by means of PDP Type IPv4v6 – more user/network friendly (not to forget the terminals, of course)
- Anxious for industrial type modems‘ IPv6 support and M2M applications
- Learning continues – more load, more mechanisms, more users, more feed-back

Concluding Remarks

- Users should ultimately become „version agnostic“
- IPv6 is yet another protocol – Not a feature, not an opportunity*. One day however, it will become a necessity
- Implementing IPv6 has not been an ordeal (thus far at least, save the terminals)
- LTE, M2M, Smartphones → Always on → Huge demand for address space in the (near) future

Terminal remark

- Terminal is King; it holds the keys to:
  - User friendliness with IPv6 and dual stack
  - M2M
  - Success of IPv6 in mobile environment

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