



The Networked Car: Boosting early IPv6 adoption

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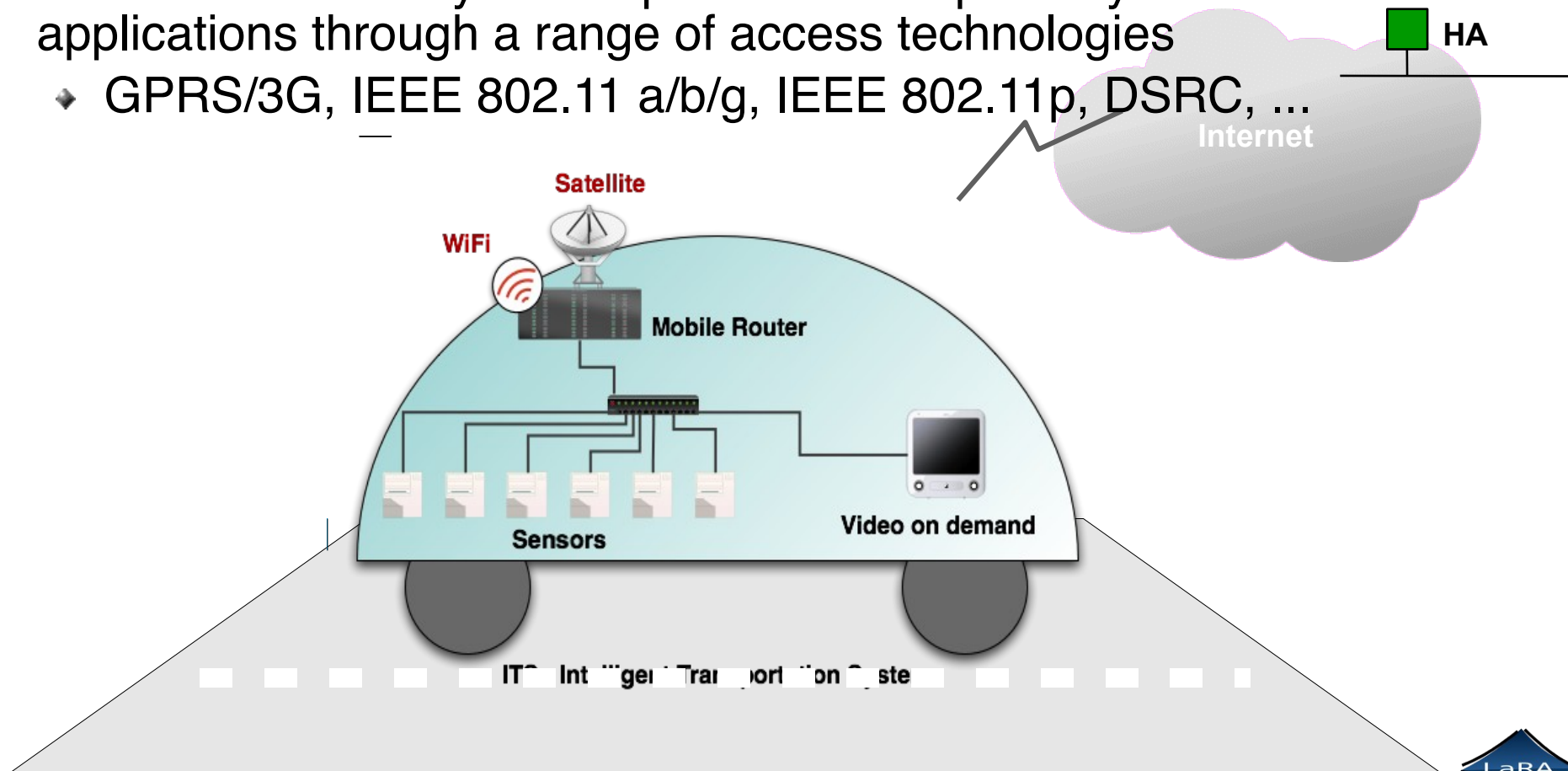
<http://www.lara.prd.fr>

ITS Vision: The fully networked car

- ◆ We are aiming at the “Always Connected World”
 - ◆ Always connected phone
 - ◆ Always connected car
 - ◆ Always connected individual
- ◆ Communications needs & benefits
 - ◆ Road safety
 - ◆ **collision avoidance**
 - ◆ **emergency calls**
 - ◆ Remote control and monitoring
 - ◆ **fleet management**
 - ◆ **call-back vehicles for repair**
 - ◆ Road efficiency
 - ◆ **navigation**
 - ◆ **vehicular congestion avoidance**
 - ◆ **cutting Earth warming gas emission**
 - ◆ **road access control**
 - ◆ **billing**
 - ◆ Infotainment

ITS Vision: In-vehicle network

- ◆ V2V & V2I communication crucial for ITS
- ◆ Vehicles will be fully networked / in-vehicle network
- ◆ In-vehicle devices will require (continuous) Internet connectivity
- ◆ Internet connectivity will be provided transparently to the applications through a range of access technologies
 - ◆ GPRS/3G, IEEE 802.11 a/b/g, IEEE 802.11p, DSRC, ...



ITS Vision: Communications and Standards

- ◆ We need **standards**
 - ◆ uniformized vehicular cooperative systems (V2V & V2I)
 - ◆ uniformized exchange of information between vehicles and servers in the Internet

AND ALSO

- ◆ uniformized exchange with anything on the network anywhere
 - ◆ **Not only in the automotive sector: ITS is just one small portion of all data exchanges**
 - ◆ **Interoperability between communication systems developed in all sectors must be ensured**
- ◆ The **Internet Protocol (IP)** is the de facto standard
 - ◆ ITS communication architectures must interoperate with it

ITS Vision: Why an IP-based communication architecture ?

- ◆ IP provides an **unification layer** of underlying technologies
 - ◆ 2G/3G, 802.11 a/b/g, 802.11p, 802.16, satellite, ...
 - ◆ Any application running over IP is media-agnostic
- ◆ IP ensures **interoperability**
 - ◆ IP everywhere: ITS, education, health-care, army
 - ◆ Not limited to dedicated ITS application
 - ◆ End-host running in a vehicle can communicate directly with an end-host running at the car manufacturer's HQ, parking lot, emergency crews, driver's home
- ◆ IP ensures **portability**
 - ◆ Ordinary uses of the Internet can be brought to the vehicle (web browsing, video streaming, peer-to-peer, etc)
- ◆ IP ensures **wider deployment**
 - ◆ IP equipments are cheaper to develop
 - ◆ Products can be updated constantly (security holes, new features)

- ◆ Number of cars worldwide
 - ◆ 1997: 600 millions
 - ◆ 2030: 1200 millions (at present trend)
- ◆ Vehicles will be connected to the Internet
 - => Several IP addresses per vehicle**
 - ◆ On-board units (**OBU / Router**) maintaining **Internet access** through **several** medias (3G, 802.11p, ...)
 - ◆ Application Units (**AU / Host**) running **ITS applications**
 - ◆ Hand-held devices running **multimedia applications**
 - ◆ OEM: Gateway between IP and CAN

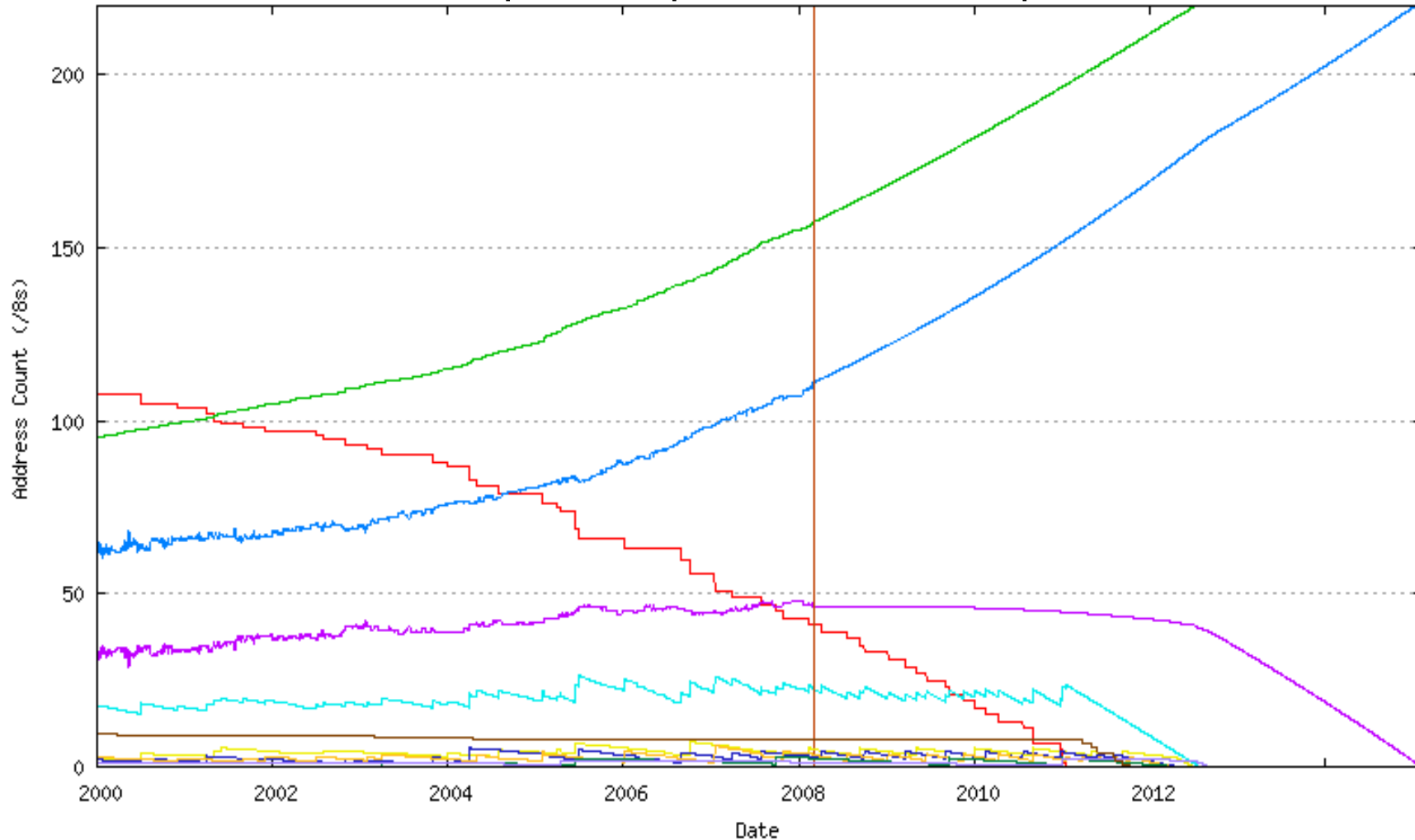
ITS: Why not IPv4 ?

- ◆ IPv4 is the Internet Protocol version currently deployed in the Internet as we know it.
- ◆ IPv4 is a non-go for ITS deployment
 - ◆ $2^{32} = 4,294,967,296$ addresses
 - ◆ Too many vehicles for NAT
 - ◆ Limited mechanisms for IP session continuity (**NEMO**, mobile edge multihoming, etc.)
- ◆ IPv4 address space exhaustion projection recently revised
 - ◆ IANA count down set to around Dec. 2009
 - ◆ <http://www.potaroo.net/tools/ipv4/>
 - ◆ <http://xkcd.com/c195.html>
 - ◆ <http://www.arin.net/statistics/statistics.pdf>
 - ◆ <http://www.arin.net/announcements/20070521.html>

ITS: Why not IPv4 ?

Exhaustion prediction: IANA Dec.2009 - 1st RIR: Aug. 2010

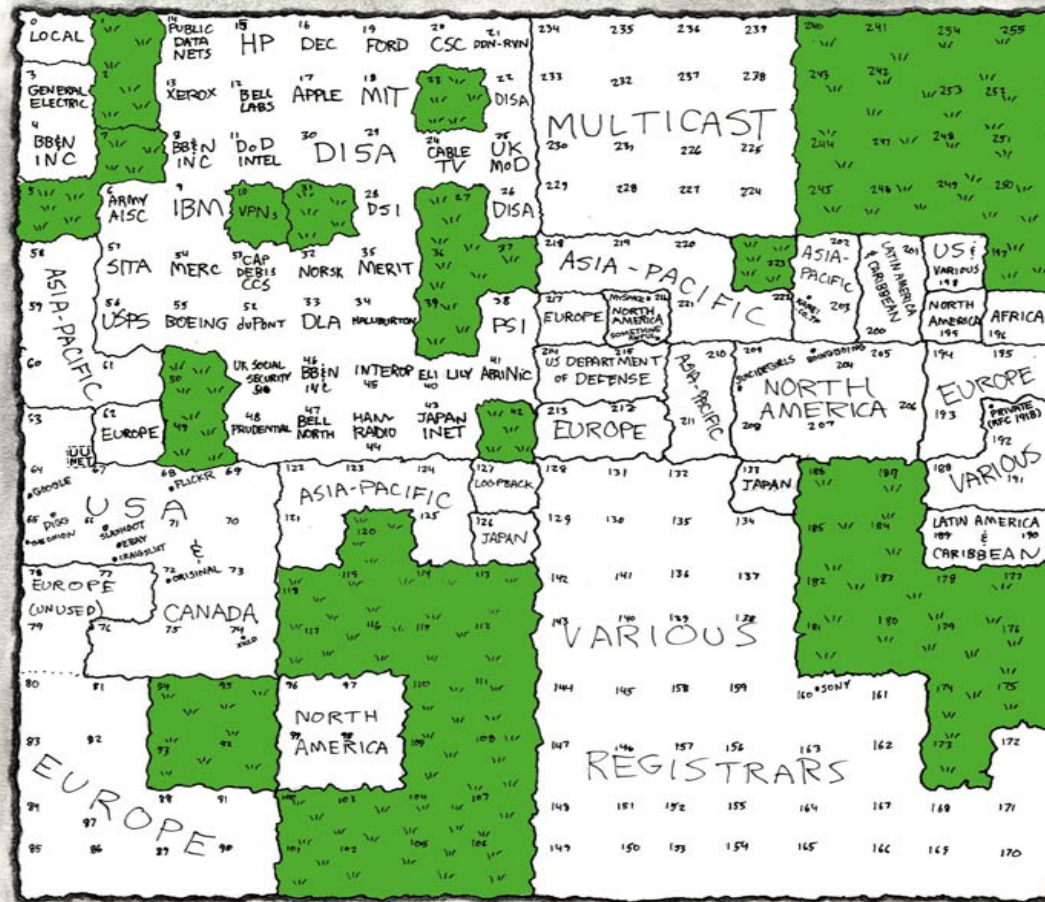
<http://www.potaroo.net/tools/ipv4/>



IANA Pool	Advertised	RIR Pool	Arin Pool	APNIC Pool
Assigned	Unadvertised	Projection	RIPE Pool	Lacnic Pool

IPv4 Address Depletion: Remaining unallocated blocks

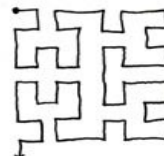
MAP OF THE INTERNET
THE IPV4 SPACE, 2006



THIS CHART SHOWS THE IP ADDRESS SPACE ON A PLANE USING A FRACTAL MAPPING WHICH PRESERVES GROUPING--ANY CONSECUTIVE STRING OF IP'S WILL TRANSLATE TO A SINGLE COMPACT, CONTIGUOUS REGION ON THE MAP. EACH OF THE 256 NUMBERED BLOCKS REPRESENTS ONE /8 SUBNET (CONTAINING ALL IP'S THAT START WITH THAT NUMBER). THE UPPER LEFT SECTION SHOWS THE BLOCKS SOLD DIRECTLY TO CORPORATIONS AND GOVERNMENTS IN THE 1990'S BEFORE THE RIR'S TOOK OVER ALLOCATION.

from <http://xkcd.com/195/>

0	1	14	15	16	19
3	2	13	12	17	18
4	7	8	11		
5	6	9	10		



 = UNALLOCATED BLOCK

ITS: What is IPv6 ?

- ◆ **IPv6**: Internet Protocol version 6
 - ◆ Designed by the IETF since 1995 as a replacement of IPv4
 - ◆ IPv6 is an **evolution** of IP
 - ◆ **128 bits instead of 32 (2^{128} addresses instead of 2^{32})**
 - ◆ **New IP header**
 - ◆ **New features**
 - ◆ Fully specified, implemented, operational deployment started

IPv6: Announcement and reports from government bodies

- ◆ Address penury
 - ◆ 2007-10: IPv6 factsheet (ICANN)
 - ◆ 2007-10: Impact analysis on vertical markets (EC)
 - ◆ 2008-04: Survey (CAIDA-ARIN)
- ◆ Announces (technical)
 - ◆ 2007-10: ICANN
 - ◆ 2007-10: RIPE
 - ◆ 2008-02: IANA (Root servers in root zones)
- ◆ Announces (government bodies)
 - ◆ 2007-11: UNO (Internet Governance Forum): “challenges & opportunités”
 - ◆ 2008-05: EC “réalités et perspectives”
 - ◆ 2008-06: OECD “les pouvoirs publics doivent agir”
 - ◆ 2008-07: CGTI (France)
 - ◆ 2008-10: Plan France Numérique 2012

Conclusions

- ◆ When do we need to start to think about IPv6 ? NOW !
 - ◆ IPv6 is currently being deployed (not an utopia)
 - ◆ May take some time to spread everywhere but will be fully deployed by the time ITS architectures get deployed
 - ◆ IPv6 doesn't require to shut down IPv4
 - ◆ Developing IPv6 awareness at all levels is crucial
- ◆ Ignoring IPv6 will bring costs
 - ◆ IPv6 will boost innovation
 - ◆ IPv6 compatibility must be ensured now with IPv4 and non-IP systems
 - ◆ Avoid disruption of business due to bad design and lack of vision
 - ◆ Developing such mind-set in the earlier stages will further ease the transition from IPv4 to IPv6
 - ◆ The later we transition from IPv4 to IPv6, the harder it will be
 - ◆ **IP-based products are just emerging = limited deployment**
 - ◆ **User's acceptability / Training and know-how / Business continuity**

- ◆ IPv6: Enabling the Information Society
 - ◆ http://ec.europa.eu/information_society/policy/ipv6/index_en.htm
- ◆ Action Plan for the deployment of Internet Protocol version 6 (IPv6) in Europe
 - ◆ http://ec.europa.eu/information_society/policy/ipv6/docs/european
- ◆ IPv4 address depletion
 - ◆ <http://www.potaroo.net/tools/ipv4/>