IPv6 Deployment Scenarios in Mobile Networks

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Outline

- Cellular IPv6 status report
- IPv6 use cases
- Some recommended tools
- Conclusions & work ahead

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Key Conclusions

- We have most or all of the technology, but commercial deployment is lacking due to operational, incentive, and compatibility reasons
- But the world is changing rapidly and some of the incentives and opportunities are appearing
- There are different use cases for IPv6 in cellular networks
- You can do many things today that result in significant IPv6 usage

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Status of IPv6 in Cellular Networks

- Deployment today involves either public IPv4 addresses or private addresses and a NAT
- But networks do support both IPv4 and IPv6
  - Supported in 3GPP releases since R5
    - Network products generally support this today
    - Some newer signaling protocols are even IPv6-only
  - Some but not all terminals support IPv6
- Many, many trials but no commercially available service yet
- The situation in cellular networks is a part of the overall IPv6 deployment situation - lack of IPv6 services is a barrier

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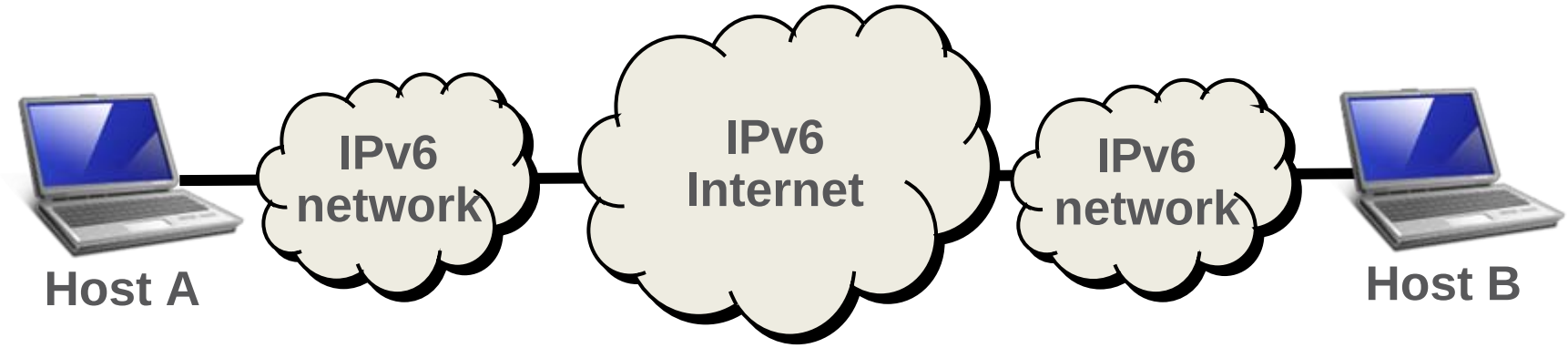
The IPv6 Deployment Challenge



- Individual adoption is possible, but actual use requires multiple stakeholders
- Very wide but not universal implementation support
- Only actual use counts!
- Need to **stop pushing IPv6 technology and pushing IPv6 use instead**

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Status of IPv6 in Cellular Networks

- Traffic patterns in the cellular networks are changing rapidly
- This affects both IPv4 and IPv6
- My conclusion is that moving to IPv6 is necessary

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The Changing Traffic Pattern

- Data users only a small fraction now, but growing rapidly 0.1% → 1% → 10% → 50% ...

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android


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amazon
smule
urbanspoon
yelp
iPhone 3G
15,000 apps. And counting.

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The Changing Traffic Pattern

- Data users only a small fraction now, but growing rapidly 0.1% → 1% → 10% → 50% ...
- Number of users ~ 4.4 billion and growing

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History Bookmarks Tools Help

http://en.wikipedia.org/wiki/List_of_mobile_network_operators

Google

Rank	Company	Main Markets	Technology*	Subscribers† (proportionate, in millions)	Subscribers (total, in millions)
1	China Mobile	China Hong Kong'Peoples[1]', Pakistan'ZONG'	GSM, GPRS, EDGE TD-SCDMA, TD-HSDPA TD-LTE (planned)		508.367 (September 2009)[1]
2	Vodafone	India, United Kingdom Germany, Italy, France, Spain, Romania, Greece, Portugal, Netherlands, Slovenia, Czech Republic, Hungary, Ireland, Albania, Malta, Northern Cyprus, Faroe Island, Iceland, USA, South Africa, Australia, New Zealand, Turkey, Poland, Egypt, Ghana, Fiji, Mozambique, India, Zimbabwe, Nepal, Bhutan and China	GSM, GPRS, EDGE, UMTS, HSDPA, LTE (planned) (CdmaOne, CDMA2000 1x, EV-DO)	264.1 (March 2009)[2]	602.6 (March 2009)[2]
3	Telefónica / Movistar / O_2	Spain Argentina, Brazil, Chile, Colombia, Ecuador, El Salvador, Guatemala, Mexico, Nicaragua, Panama, Peru, Uruguay, Venezuela, Ireland, United Kingdom, Isle of Man, Germany, Czech Republic, Morocco and Slovakia	GSM, GPRS, EDGE, UMTS, HSDPA, LTE (planned), D-AMPS (CdmaOne, CDMA2000 1x)	156.7 (December 2008)[3]	261.4 (March 2009)[3]
4	América Móvil	Mexico USA, Argentina, Chile, Colombia, Paraguay, Uruguay, Puerto Rico, Ecuador, Jamaica, Peru, Brazil, Dominican Republic, Guatemala, Honduras, Nicaragua, Ecuador and El Salvador	GSM, GPRS, EDGE, UMTS, HSDPA, D-AMPS (CdmaOne, CDMA2000 1x, EV-DO)		190.4 (April 2009)[4]
5	Telenor	Norway Sweden, Denmark, Hungary, Montenegro, Serbia, Russia, Ukraine, Thailand, Pakistan, Bangladesh, Malaysia and India	GSM, GPRS, EDGE, UMTS, HSDPA, LTE (planned)		172.0 (October 2009)[5]
6	T-Mobile	Germany USA, United Kingdom, Poland, Czech Republic, Netherlands, Hungary, Austria, Croatia, Slovakia, Macedonia, Montenegro, Puerto Rico and U.S. Virgin Islands	GSM, GPRS, EDGE, UMTS, HSDPA, LTE (planned)		162 (October 2009)[6]
7	China Unicom	China	GSM, GPRS EDGE, UMTS, HSDPA, HSUPA		142.799 (September 2009)[7]
8	TeliaSonera	Sweden Norway, Denmark, Finland, Estonia, Latvia, Lithuania, Spain, Russia, Nepal, Cambodia, Kazakhstan, Azerbaijan, Uzbekistan, Tajikistan, Georgia, Moldova,	GSM, GPRS, EDGE, UMTS, HSDPA		134.8 (February 2009)[8]

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The Changing Traffic Pattern

- Data users only a small fraction now, but growing rapidly 0.1% → 1% → 10% → 50% ...
- Number of users ~ 4.4 billion and growing
- Users employ data service only at times, but this is going to change 1% → 100%
  - Checking e-mail → chat, Google Maps, ...
  - Data is ”extra” → even voice runs on IP
    - The next generation (LTE) has no circuit switched voice
    - Data-only applications (dongles, M2M, ...)

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- Do the math

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”Houston, we have no addresses”

- In a few years, we need connectivity to ALL users at ALL times, for ~ 10 billion devices
- Clearly, we can't support everyone with public IPv4 addresses
- We could build NATs and control mechanisms to put everyone behind thousands of NATs and open ports from one to other when voice calls are made
- But its going to be horrible
  - Cross multiple NATs just to get to another subscriber in same domain
  - NAT cost no longer just the user's problem

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IPv6 Use Cases

- Actors who are affected by moving IPv6
- IPv6 usage scenarios

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The Actors – Who Does IPv6 Impact?

- The traditional 3GPP view

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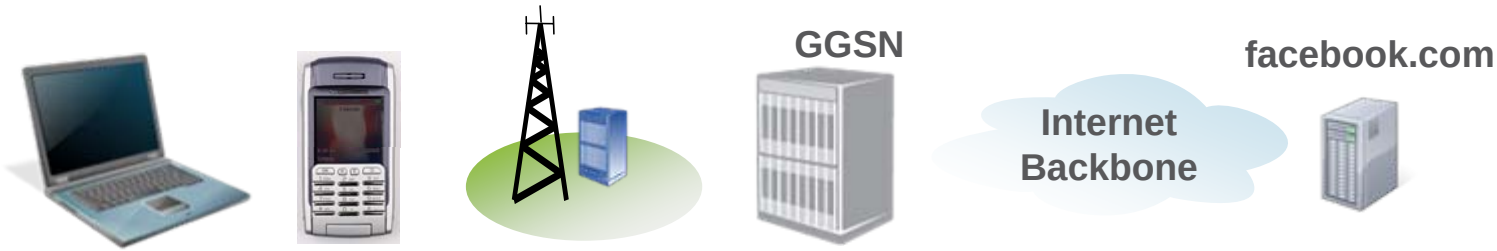

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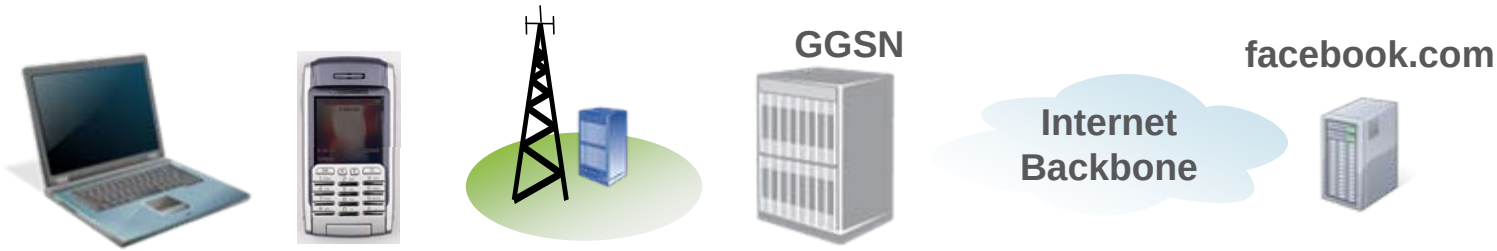

Operations Roaming agreements Support & debugging
Charging systems Legal interception
Services Transport network SLAs

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Operations Roaming agreements Support & debugging
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Services Transport network SLAs

- If you don't have a plan for all of this, it makes no sense to fix your cellular access network to do IPv6!

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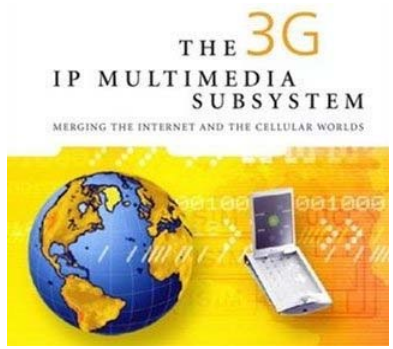
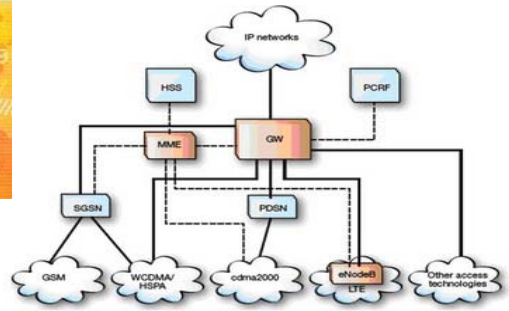
IPv6 Usage Scenarios

- Not all use cases are equal
- Different constraints and solutions may be involved





- Operator's own services
- Transport network
- Access to the Internet
- DSL replacement

facebook

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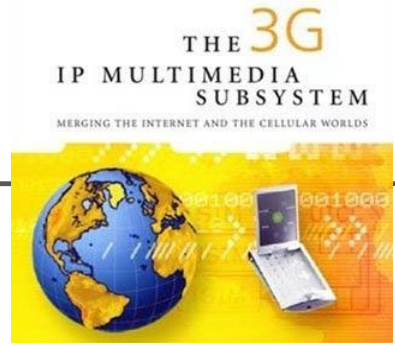
Operator's Own Services



- IPTV, IMS, ...
- Not so dependent on the rest of the Internet

Drivers:

- These services often require connectivity to ALL subscribers at ALL times
- Not enough IPv4 addresses to do this

Solutions:

- Complex NAT passthroughs or IPv6

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User's Traffic to the Internet

- Here we are very dependent on what is happening on the other side, e.g., Facebook, CNN, Microsoft

Drivers:

- One key factor is the type of the applications
- Facebook chat, Google maps, p2p, VoIP, all demand more from the network than simple web page access
  - Many (even hundreds) of TCP sessions
  - Always-on
- This is all positive for the operator... more income

User's Traffic to the Internet

- But the issue is, how do we enable all the subscribers to access the Internet, given limited IPv4 address and port resources?

Solutions:

- More aggressive address sharing & IPv4 NATs
- IPv6 and translation to IPv4
  - But on the outside you will still burn exactly the same amount of address and port resources from your NAT address pool
  - May help running out of NET10 though
- Some applications move to IPv6

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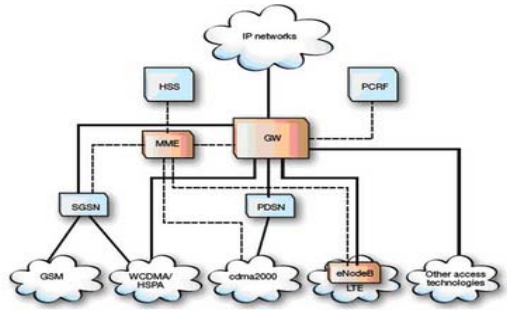
Transport Network



- User data travels in tunnels
- Network nodes employ signaling protocols

Drivers:

- Better use of valuable IPv4 address space elsewhere
- Running out of Net 10 addresses
- Simplifying network management

Solutions:

- Moving to internally IPv6-only networks
- NO effect to user traffic!

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DSL Replacement

- Cellular data is starting to replace DSL

Drivers:

- Freedom from a fixed connection, rural areas
- Connection sharing
- What is the IPv6 equivalent of the IPv4 NAT for connection sharing?
- Broadband forum has chosen the prefix delegation model – shouldn't the 3GPP do the same?

Solutions:

- Prefix delegation (not currently supported by R8)

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Looking for a Solution

- The next slides contain some recommended tools
- Taking small steps as opposed to a revolution

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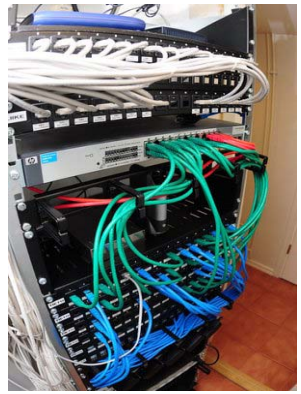
Recommended Tools – Dual Stack

- Still the IETF recommended approach
- Add Dual Stack support to hosts, and they will immediately be able to use all IPv6 services that you have
- Add IPv6 services and you'll discover that many of your hosts are IPv6 capable
- Dual Stack + plain old IPv4 NAT is a very typical configuration
- You can turn this on tomorrow – your network already supports it



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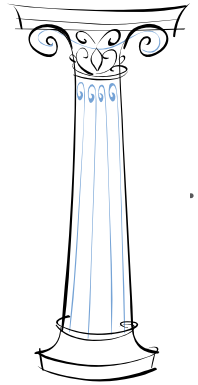
Recommended Tools – IPv6 Transport



- Want 100% IPv6 traffic in a cellular network?
- Easy – just put the all internal traffic on IPv6
  - Signaling and tunnels transported on IPv6
- No effect to end-users, and **all** packets are IPv6 within your network
- Several major operators are planning this and network equipment is being converted to support it as we speak
- Standards are already IP version agnostic

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Recommended Tools – Applications over IPv6

- ATLAS Internet Observatory Report 2009:
- Suddenly, 6% of all Internet traffic is via Google
- 10% of all Internet traffic is via the CDNs
- 150 ASNs are responsible for 50% of all traffic

- ”Google over IPv6” – opt-in use of IPv6 for popular Internet applications
- Make an agreement with Google and the CDNs, and you could have 16% of your traffic in IPv6

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Conclusions

- You should enable IPv6 for PDP contexts today
- As we move to pure IP based networks, a good application for IPv6 is operator's own services
  - Reduces the pain from managing NATs and opening ports for two hosts to talk to each other
- Transport IPv6 is another good application
- Access to Internet services requires IPv4 and NATs into the foreseeable future
  - NAT44 and NAT64 require the same # of ports
- However, some applications can move to IPv6 **now**
  - The effect of this can be significant

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Conclusions – What Needs More Work

Operational, vendor, and specification work:

- **Debugging** operational & product problems
- Many **agreements** need to be made
- **Service** implementations
  - Often IPv6 capable but untested
- How do we get the **phones** to support IPv6?
- If your transport network is IPv6, how does **roaming** work?
- Specifications for **prefix delegation**

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TAKING YOU FORWARD

Backup Slides

- ...

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