IAB/IESG Recommendations on IPv6 Address Allocation

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14 September 2000

RIPE Meeting

(Brian Carpenter, 3 Oct., ARIN)

OVERVIEW

- Introduction
- Background
- Recommendation
- Address Space Conservation
- Multihoming
- Summary

INTRODUCTION

- RIRs asked the IETF for advice on IPv6 prefix assignment
  - Service Providers
  - Edge Networks
- IPng working group discussed issue July 2000
- IPv6 Directorate developed recommendation
- IAB & IESG Reviewed and Approved

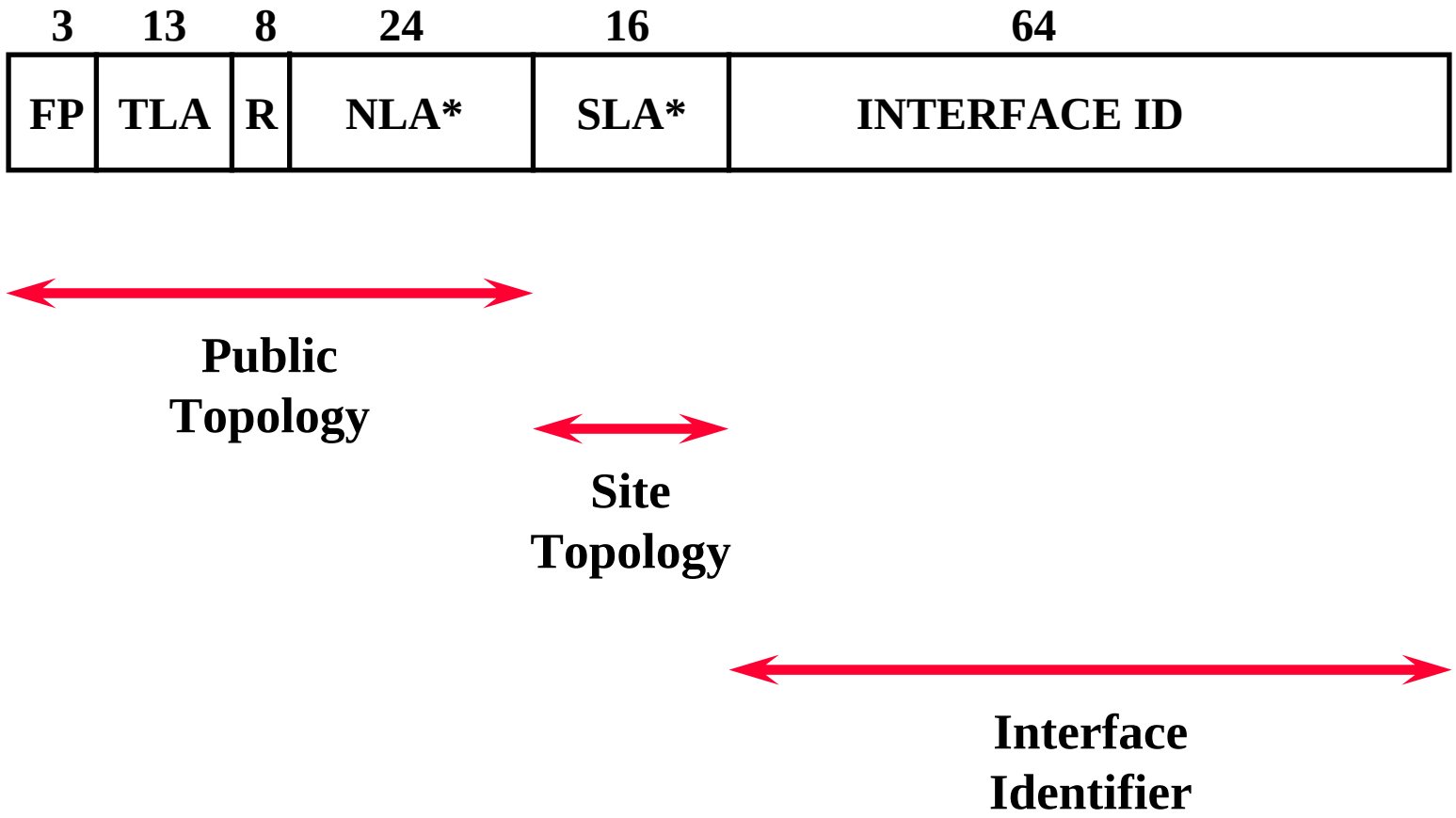
PREVIOUS DISCUSSION

- Discussion at Adelaide IETF
- Suggestion to allocate /56 prefixes instead of /48 for homes and small businesses
- Subsequent analysis shows significant advantage to uniform /48 allocations

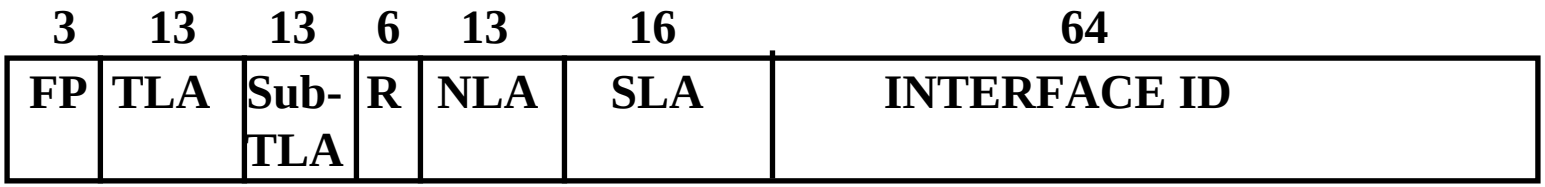
BACKGROUND

- Address allocation is a balance
  - Responsible allocation practices
  - Easy access
- Allocation practices have significant effect on deployment and usage
- Important for the deployment of IPv6 to make allocations easy and not slow deployment

IPv6 UNICAST ADDRESS



INITIAL ALLOCATIONS



- Initial “show start” allocations out of
  - FP = 001
  - TLA = 0x0001

IPv6 RENUMBERING

- Renumbering in IPv6 is considerably improved (from IPv4)
- However
  - Not invisible, painless, or automatic
- Renumbering still not free

IPng W.G. RECOMMENDATION

- Defined in RFC2374 & RFC2450
- Subnetted sites should be allocated /48 prefix
  - Allows 2^{16} subnets
  - Large enough for almost all sites
- Issue is size of prefix for smaller sites
  - /64 for single subnet sites?
  - Single hosts? Mobile phone?
  - Temporary vs. permanent usage?
  - How to judge usage?

RECOMMENDATION

- Recommend /48 fixed boundary for all subscribers
- Except
  - Very large subscribers (receive multiple /48 allocations, i.e. /47 or /46…)
  - Transient nodes (receive /64)
  - No interest in subnetting (receive /64)
- Consistent with responsible stewardship of the IPv6 Address space

JUSTIFICATION

- Fixed boundary guarantees change of ISP does not require restructuring of subnets
- Facilitates straightforward renumbering
- Compatible w/ all known IPv6 Multihoming proposals
- Allows easy growth of subscriber networks
  - Eliminates need to go back to ISP for more addresses

JUSTIFICATION (2)

- Removes burden on ISPs and RIRs to judge customers' need for space
  - ISPs do not need to ask for details of customer networks
  - ISPs and RIRs do not have to judge rates of customer address consumption
  - Makes RIR operations more efficient
- Subscriber address space no longer scarce resource
  - Removes incentive for IPv6/IPv6 NAT

JUSTIFICATION (3)

- Allows site to maintain single reverse-DNS zone covering all prefixes
  - Same subnetting structure allows same zone file for all prefixes
  - Using RFC2874, reverse mapping data can be used in “forward” (named-keyed) zone

ADVANTAGES OF /48

- Keeps open the possibility of GSE (a.k.a. 8+8) proposal for separating locators and identifiers
  - IRTF Name Space Research Group is looking at this general area
- Maintains 1 to 1 mapping of subnets with Site local prefix (fec0::/48)
- Maintains 1 to 1 mapping of subnets with 6to4 proposal

CONVERVATION OF ADDRESS SPACE

- Does giving a /48 to all subscribers waste too much IPv6 address space?
- No, the IPv6 address space is very large
  - Aggregatable Unicast Address format supports 45 variable bits
    - 2^{45} or 35 Trillion
  - Assuming one /48 prefix per person
    - Utilization is 0.03%

ANALYSIS

- RFC1715 defines an “H” ratio based on address space assignment in various networks
- Applied to 45 bit address space and world population of 10.7 billion in 2050*

$$H = \log^{10} (1.07 * 10^{10}) / 45 = 0.22$$

- Less than the “H” ratio of
  - US Telephone numbers (0.24), France Telephone numbers (0.26), DECnetIV (0.26), or IPv4 addresses mid 1990 (0.23)

* http://www.popin.org/pop1998/

ANALYSIS (2)

- We are only discussing assignments from Aggregatable Global Unicast Format Prefix (001)
  - 85% of remaining address space is unassigned
- If in the future our analysis proves to be wrong
  - Our successors have option of imposing more restrictive allocation policies

TRANSIENT USAGE

- Single dialup nodes that prefer transient addresses
  - /64 prefix is OK
- Subscriber who wants static assignment or plans multiple subnets
  - Receive /48 even if dialup

IPv6 MULTIHOMING

- IPv6 multihoming is work in progress
- IPv4 multihoming techniques can be applied
  - One prefix advertised by multiple ISPs
  - Routing table grows with number of multihomed subscribers
- IPng working group looking at other approaches

MULTIHOMING APPROACHES

- IPv4 Style
  - How to scale backbone routing?
- Host Mechanisms
  - Site receives a prefix from each ISP
  - Prefixes carried by site routing
  - Nodes select addresses to use
  - How to pick best Source and Destination addresses?
- Border Router Mechanisms
  - Tunneling
  - Route injection

MULTIHOMING FUTURES?

- Other approaches?
- Better ideas?

SUMMARY

- Careful stewardship of IPv6 address space is important
- Allocation of /48 prefixes has many advantages
- Allocation of /48 prefixes to all subscribers is consistent with careful stewardship
  - Size of IPv6 address space supports this approach

IP Addressing guidelines for GPRS Network Infrastructure

Jarnail Malra, BT Cellnet UK
on behalf of GSM Association IREG GPRSWP

RIR introduction to GPRS Mobile Operator network addressing guideline document
ARIN VI : 2-4 October 2000

Contents

- Aims of presentation
- GSM Association overview
- Story so far…..
- GPRS overview
  - What is GPRS?
  - What is GPRS roaming?
  - Scale of IP address requirements
- Guideline document overview
  - Why is document required?
  - Document objectives
  - What does it mean to Internet Registries?

Aims

- Introduce to RIR members
  - GPRS network infrastructure guideline document for: -
    - IPv4 addressing
    - Autonomous System Numbering (ASN)
  - For use by GPRS mobile network operators
    - Not applicable to Mobile terminals
- Seek acceptance of guidelines by all RIRs
  - Common ‘policy’ document for use by all Mobile network operators world-wide when requesting Registered addresses and Public ASNs
- ‘Business as usual’ for Internet Registries

Scope

- In scope
  - GPRS network infrastructure
    - IPv4 addressing
    - Autonomous System Numbering
- Out of scope
  - IP addressing for Mobile Terminals
  - IPv6
  - 3rd Generation mobile networks

GSM Association overview

- Guideline document produced by GSM-A IREG GPRSWP
  - GSM Association
    - Represents interests of over 450 GSM: network operators, manufactures, regulators and admin bodies
    - Members provide service to more than 330m customers (June-2000) across the world
    - Responsible for development, deployment and evolution of GSM system
  - IREG - International Roaming Experts group
    - A working group of the GSM-A
  - GPRSWP - GPRS Working Party of IREG

Story so far……..

- Nov ‘99-Feb ‘00
  - BT Cellnet identified initial requirements for an IP addressing policy to GSM-A
- Feb ‘00 - RIPE 35
  - GSM-A submitted initial proposal to RIPE NCC for discussion/assistance
  - RIPE suggested a Task force be set up to investigate matter
- April ‘00 - IP Addressing Working Party meeting
  - Members attended from Mobile networks and Internet communities
  - Objective: clarify/understand/define requirements
- May ‘00 - RIPE 36
  - Task Force Working Party presented its findings
  - Findings agreed by RIPE

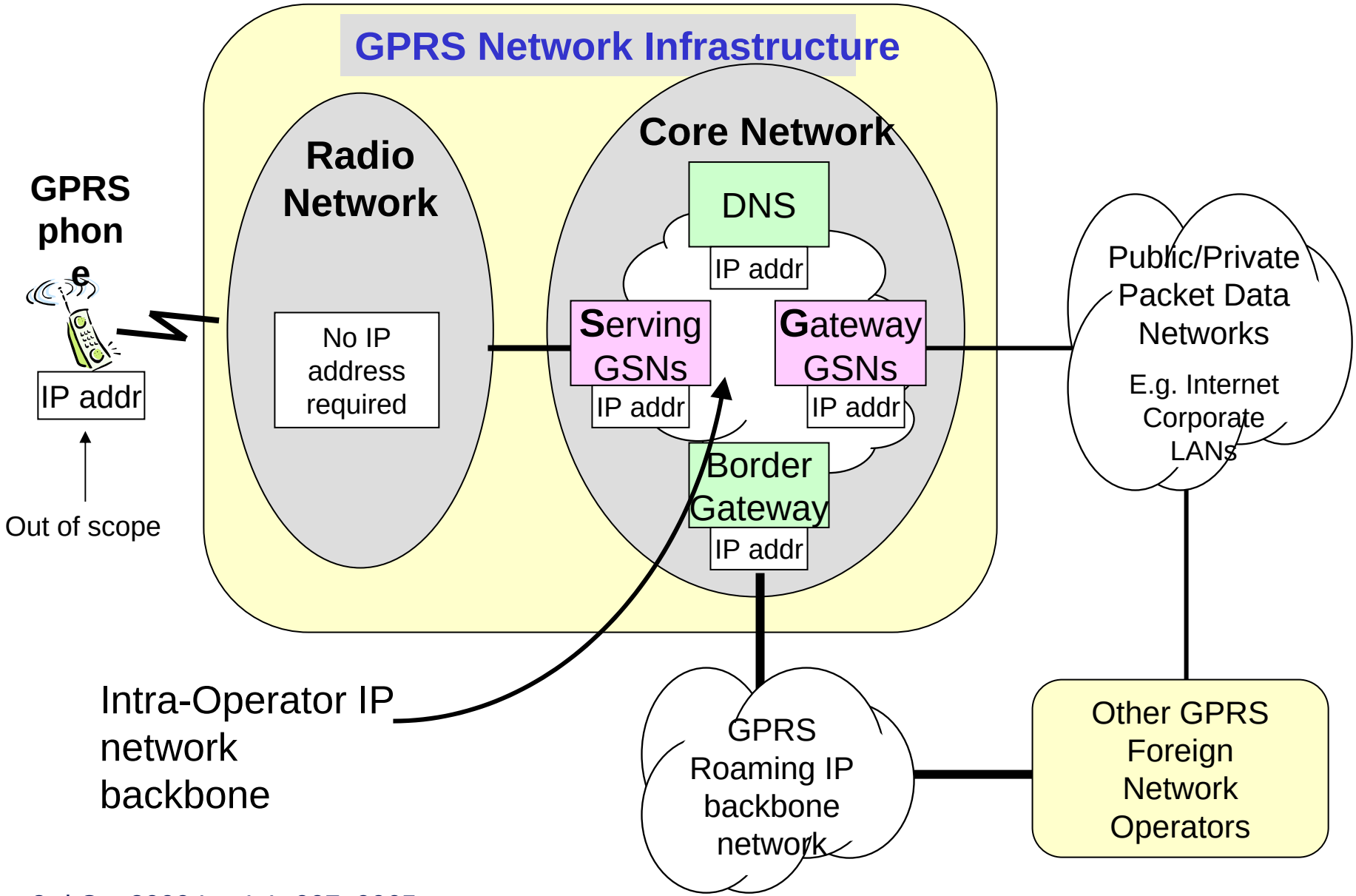
Story so far……

- 19 July ‘00 - Milestone
  - Joint GSM-A/RIPE NCC press release issued
    - Public IPv4 addresses can be used in parts of GPRS network infrastructure
    - Existing IP address allocation procedures apply
- Today
  - Working with other RIRs to get their similar acceptance/endorsement of guideline document
    - ARIN VI meeting: 2-4 Oct 2000
    - APNIC meeting: 25-27 Oct 2000

What is GPRS?

- General Packet Radio Service (GPRS)
- Enhancement of existing GSM (Digital) circuit switched voice-based network
- TCP/IP-based: allows data packets to be conveyed across the mobile network using packet switching
- “Always on” / always connected
  - After initial ‘log-on’ - User is constantly connected to end service
  - Network resources only used when information ready to be exchanged

GPRS Network



GPRS Network

- GPRS phone
  - E.g. GPRS WAP phone; connected to PC terminal; GPRS PDA device (e.g. PSION organiser)
  - Requires IP Addresses - out of scope/to be addressed separately
- GPRS Infrastructure (Radio/Core networks)
  - Radio Network
    - Existing GSM radio network infrastructure with added GPRS functionality
    - No IP addresses required

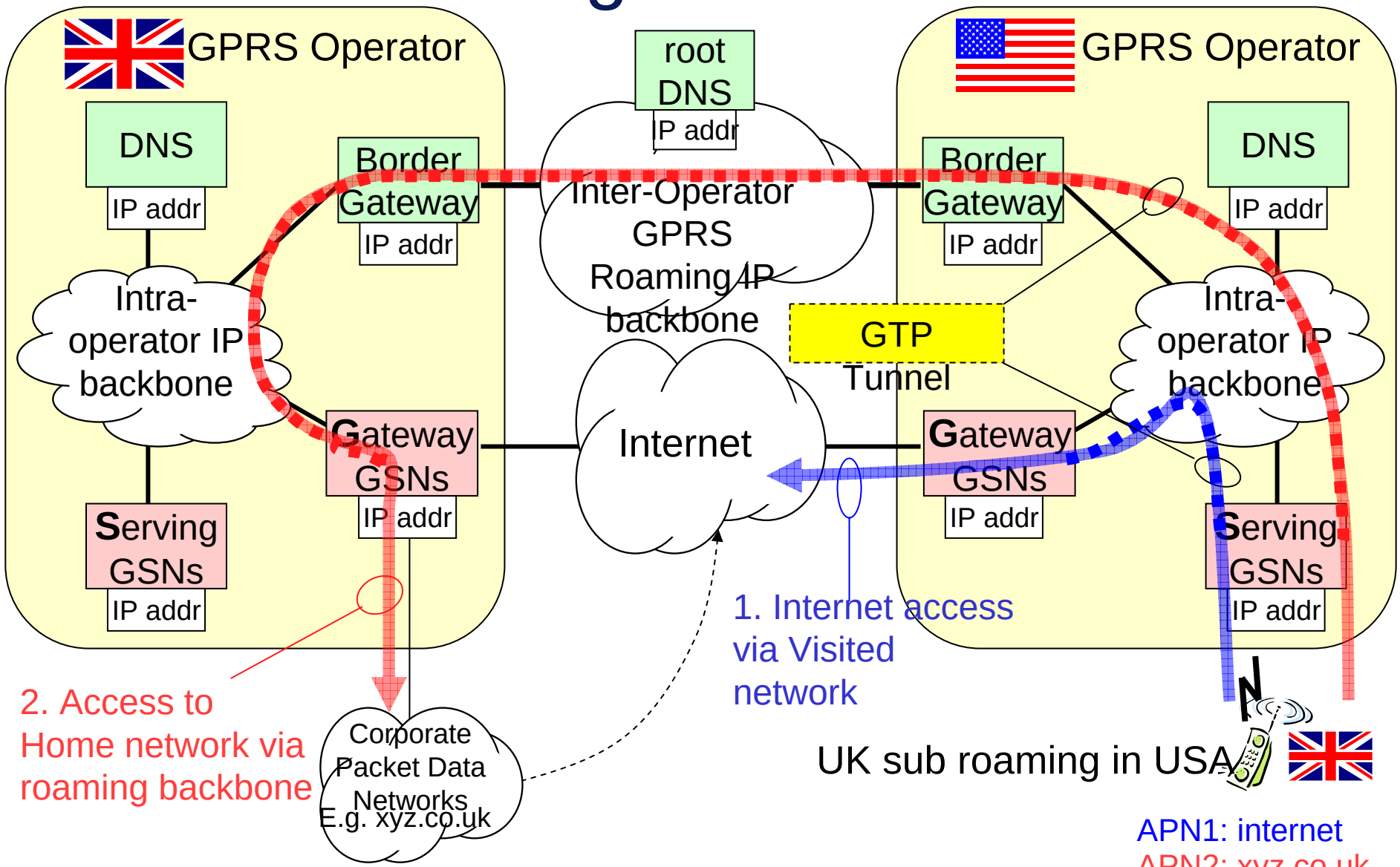
GPRS Network

- Core Network
  - SGSN - Serving GPRS Support Node
    - Serves mobile terminal over radio interface
    - IP addresses required
  - GGSN - Gateway GPRS Support Node
    - Gateway form Operator's GPRS network to land-based IP networks, e.g. Internet, corporate networks
    - IP addresses required
  - DNS - Domain Name Service Server
    - Logical name/IP address resolution
    - IP addresses required
  - Border Gateway
    - Gateway access to other GPRS FNOs via GPRS roaming backbone

What is GPRS roaming?

- Allows subscriber to access GPRS services when ‘roaming’ in another Foreign Network Operator’s (FNO) network, e.g.
  - Access to local internet from FNO network
  - Access to a subscriber’s corporate site/services in Home network
- Roaming services supported will be defined in roaming agreement between two operators

GPRS Roaming Network



GPRS Roaming Network Requirements

- Inter-Operator (roaming) IP backbone interconnects IP backbones of each operator
- All GPRS core network elements must be uniquely addressed for roaming interaction
- Addressing activity must be co-ordinated on a global basis
- Possible future convergence with Internet
- Registered addressing most practical

GPRS roaming services - example

- UK sub roaming in USA, services available: -
  - 1. Access to Internet via Visited USA GPRS operator
  - 2. Access to GPRS services via Home UK operator across the roaming backbone, e.g. to access subscriber's corporate site
- DNS look-up system
  - Resolves Access Point Name (logical name) to IP address, e.g.
    - Internet apn = "internet"
    - XYZ corporate's apn = "xyz.co.uk"
  - Local DNS per operator network
  - Root DNS in Roaming backbone (e.g. Global IP carriers)
- GPRS Tunnel established between visited SGSN and
  - Visited GGSN for Local access to Internet, or
  - Home GGSN for access to networks/services in Home operator's network via inter-operator roaming backbone
    - Uses GPRS Tunnelling protocol (ETSI standard not IETF)

Addressing scheme requirements

- Addressing scheme options
  - Registered/Public or Private addresses
- Common addressing scheme required for all mobile operators (globally)
- Unique addressing for GPRS elements
- Not possible to use Network Address Translation (NAT)
  - NAT does not support GPRS Tunnelling Protocol (ETSI)
- IPv6 not yet supported by GPRS

Addressing scheme options

- Private addresses
  - Not scalable
    - Limited range of private addresses
    - Only one /8 and few /16s
  - Not addressable via Internet
  - Unique addressing cannot be guaranteed
- Registered/Public addresses
  - Scalable
  - Addressable via Internet
  - Unique addressing can be guaranteed
  - Can use existing IR admin procedures

Scale of IP address requirements

- Total number of IP address for global GPRS network infrastructure dependencies: -
  - Number of GPRS operators
    - 400 potential GPRS operators today
  - No. of addressable items per operator, variable:-
    - Size of operator's network
    - System supplier (one Supplier's system may use less/more IP addresses than another)
    - E.g. over five-year period: BT Cellnet requires approx. 1000 IP addresses whilst Telfort requires only 255.
- Expect 280k Total IP addresses over five year period
  (assuming 400 GPRS operators x 700 addresses per operator = 280k

Guideline doc - Why required?

- Initial uncertainty if all IRs would accept requests for Registered addresses from all mobile operators
  - Requirement for Registered addresses identified for GPRS infrastructure
  - But, global GPRS network might be considered as a large ‘Private’ network, i.e. independent of Internet

Guideline doc - Why required?

- Hence, requirement to establish common understanding for addressing policy to request registered addresses
  - Agreed by Internet Registries and GSM-A
  - Used by any mobile network operator on a global basis

Document objectives

- For use by both Mobile operators & IRs
- Operators
  - Overview of Internet Registry System
  - IPv4 addressing and ASN implementation guidelines for GPRS infrastructure
    - Promotes conservative use of address space
      - Registered addresses for GPRS network elements
      - Private addresses for other parts of network
  - Identification of IPv4/ASN request procedures
    - Registered IPv4 addresses from IRs
    - Private ASN from GSM-A
    - Public ASN from IR
  - Note: Guideline document does not automatically guarantee registered address space to an operator

Document objectives

- Internet Registries
  - Visibility/better understanding of requirements when mobile operator make requests from IRs for: -
    - Registered addresses
    - Public ASNs
  - Business as usual
    - Existing IR administration processes will apply

Summary

- Guideline document produced in conjunction with RIRs and GSM-A
- Guidelines for Mobile operators on conservative use and requesting: -
  - IPv4 addresses and Public ASN from IRs
  - Private ASN from GSM-A
- Business as usual for IRs
- Acceptance/approval of guideline document requested from all RIRs

Close

Thank you

…… Questions?


ARIN
American Registry for Internet Numbers

Legacy Network Transfers

Background

- ARIN maintains network records for all legacy space (Class A's, B's, C's)
- Includes record holders outside ARIN's region
- Registrations from outside ARIN's region to be transferred to the appropriate regional registry

Legacy Network Transfers

Benefits

- Record holders deal with only one RIR
- Eliminates POC maintenance in multiple DB's
- Keeps records in like time zones
- Reduces language barriers
  - National IP Registries (NIRs) available at RIPE NCC and APNIC

Legacy Network Transfers

Necessity for Sharing Zones

- Legacy networks not contiguous by region
- Top-level root zone in-addr will have separate DNS entries for each /8
- Blocks with legacy networks in multiple regions must be shared
- RIR having majority of network space for a /8 will have primary responsibility
- Other RIRs must be able to provide updates to zones maintained by other registry

Legacy Network Transfers - Preliminary Statistics

Class A (0.0.0.0 - 127.255.255.255)

(2)	to APNIC
(21)	to ARIN
(5)	to RIPE NCC
(24)	to corporate/institution name servers
(76)	Reserved to IANA

Legacy Network Transfers - Preliminary Statistics

Zone Splits - Class B (128.0.0.0 - 191.255.255.255)

(4)	ARIN
(3)	RIPE NCC
(1)	APNIC
(35)	Shared - ARIN Primary
(2)	Shared - RIPE NCC Primary
(2)	Shared - APNIC Primary
(17)	Reserved

Legacy Network Transfers - Preliminary Statistics

Zone Splits - Class C (192.0.0.0 - 223.255.255.255)

(4)	APNIC
(6)	RIPE NCC
(6)	ARIN
(6)	Reserved
(10)	Shared (ARIN Primary for All)

RIR Coordination Efforts

- Planning and preparation
  - Sample dump was provided in April
  - Candidate list of transfer networks provided 08/22
  - Companion dump of all network data provided 08/23
- Mechanism for updating shared zones
  - Preliminary agreement to use dynamic updates (RFC 2136) and TSIG (RFC 2845)
  - Independent testing by RIRs
- Mechanism to reproduce a shared zone file
- Interface testing

Legacy Network Transfers

Next Steps

- ARIN, RIPE NCC and APNIC integration testing
- Notify holders of the networks to be transferred
- Cut-over: target date 1Q2001-2Q2001

Legacy Network Transfers

Preliminary Numbers

- Total ARIN network records 455,149
- To transfer to RIPE NCC 8,406 (1.85%)
- To transfer to APNIC 2,352 (0.05%)

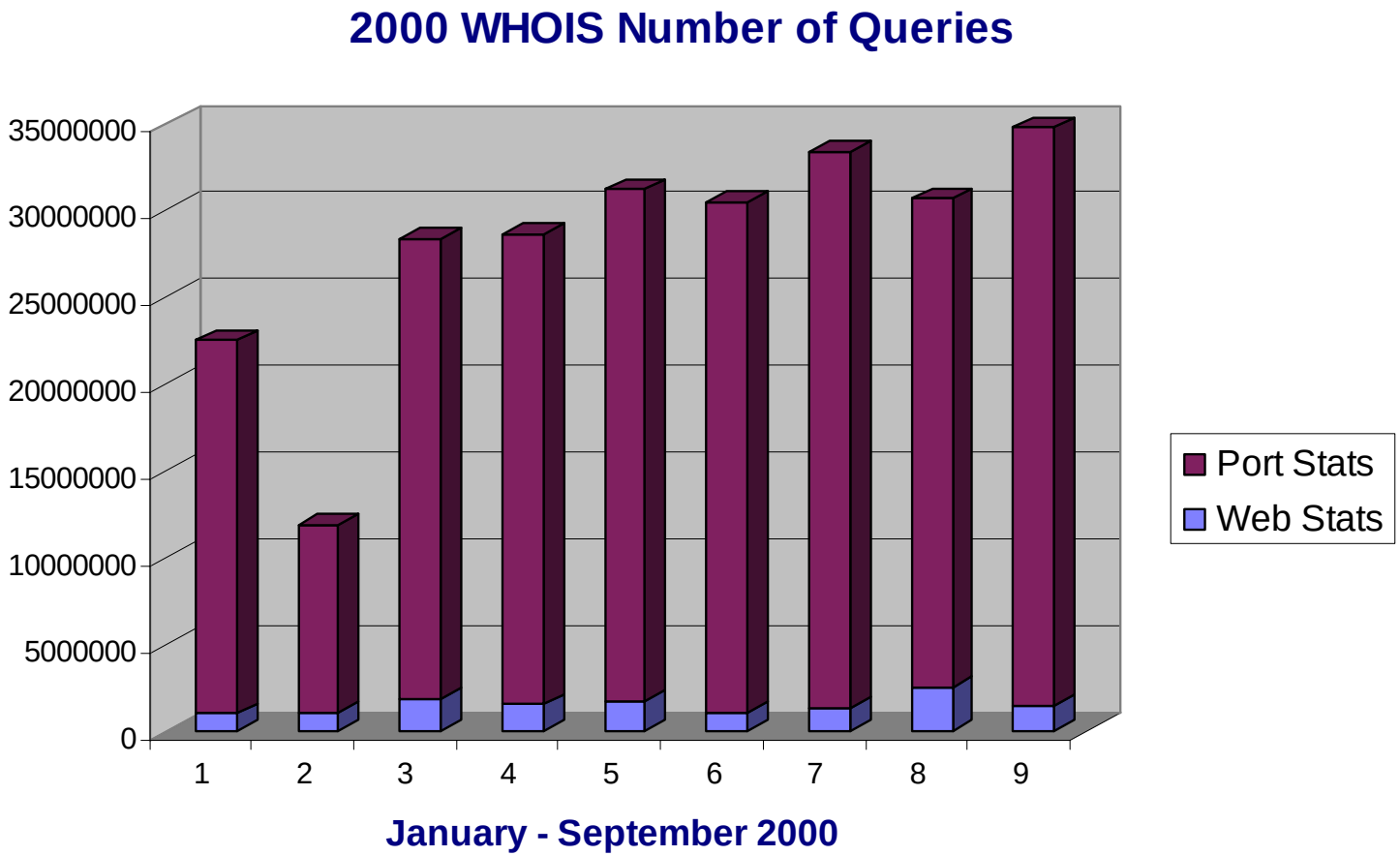

ARIN
American Registry for Internet Numbers

Exporting ARIN's database

Information Provided by Other Registries

- IPv4 Network Registration Data
- IPv6 Network Registration Data
- ASN Registration Data
- Maintainer Data
- PGP Key Data
- Various Routing Data
- RIPE NCC **ftp://ftp.ripe.net/ripe/dbase/**
- APNIC **ftp://ftp.apnic.net/pub/apnic/dbase/data/**

Exporting ARIN's database



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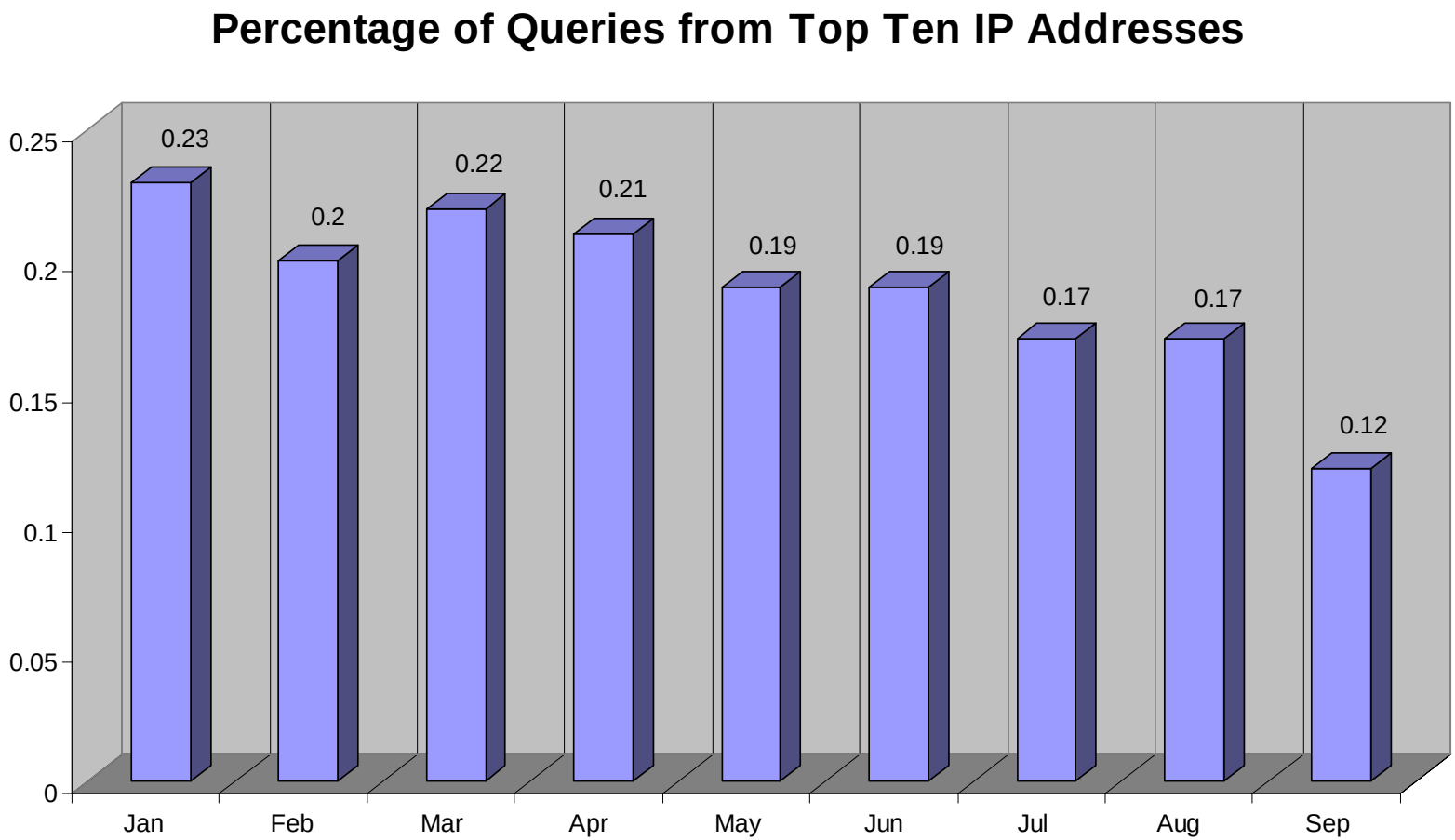

Exporting ARIN's database

Size of ARIN's database

- 182 MB for a sample RPSL-like format
- 30 MB compressed

Exporting ARIN's database

Should ARIN consider making its database available?

- PROs?
- CONs?
- Privacy Concerns?
  - Would not include POC data


ARIN
American Registry for Internet Numbers