

# Analysis of Fragmentation of the Legacy Space

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# Agenda

- **General description of the work.**
- Analysis and resolution of inconsistencies about the information.
- Detection of free blocks and evaluation of the fragmentation degree.
- Conclusions.

# Introduction

- Some /8 IP address blocks of B class and C class were partially assigned to diverse entities before the constitution of the Regional Internet Registries (RIR), in what was called “early registrations”.
- In 1997 Internic delegates to ARIN the administration of addresses for Latin America and south of Africa, and the blocks are transferred to ARIN.

# Introduction

- Since then, several organizations register in the local RIR, and another do it in ARIN, what causes inconsistencies and administrative difficulties.
- In order to solve the problems that arise, the Early Registration Transfer Project (ERX) process is launched, and it intends to transfer the corresponding forty five /8 blocks to the corresponding RIRs.

# Motivations for the study

- It is of interest to evaluate the free capacity of the ERX blocks (Legacy Space).
- But it is also very important to minimize:
  - the quantity of routes in the routing tables, in order to minimize searching times and required resources.
  - the quantity of advertisements that the routing protocols exchange so as to insure the least bandwidth consumption in the links and the least processing time of the received information.

# Motivations for the study

- To achieve this objective, the addresses should be announced by means of the shortest prefixes (corresponding to greatest blocks).
- Thus, besides the quantity of free addresses in a block, it is important to know the possibility they give to optimize their advertisement (route aggregation or route summarization).

# Scope and objectives of the study

- Analysis of the information consistency of the Early Registration Transfer Project (ERX) blocks.
- Evaluation of the quantity of free addresses.
- Verification of the fragmentation level of the free addresses in each block, with a high degree of certainty.

# Methodology

- Information consistency analysis.
- Inconsistency resolution.
- Detection of the not assigned address spaces.
- Evaluation of the level of fragmentation of the not assigned address spaces.



# Information sources

- The information has been obtained from:
  - ARIN  
(<ftp://ftp.arin.net/pub/stats/arin/delegated-arin-latest>)
  - LACNIC  
(<ftp://ftp.lacnic.net/pub/stats/lacnic/delegated-lacnic-latest>)
  - RIPE  
(<ftp://ftp.ripe.net/pub/stats/ripenncc/delegated-ripenncc-latest>)
  - APNIC  
(<ftp://ftp.apnic.net/pub/stats/apnic/delegated-apnic-latest>)
  - IANA  
(<http://www.iana.org/assignments/ipv4-address-space>)

# Employed tools

- Queries to the "whois" RIR databases by means of ftp transfers.
- Applications developed to detect not assigned blocks and to compute the level of fragmentation
- Platforms: Linux (Mandrake 9.1)
- Platforms: Windows XP

# Terminology

- ***Block***: adjacent addresses set that can be expressed in CIDR format.

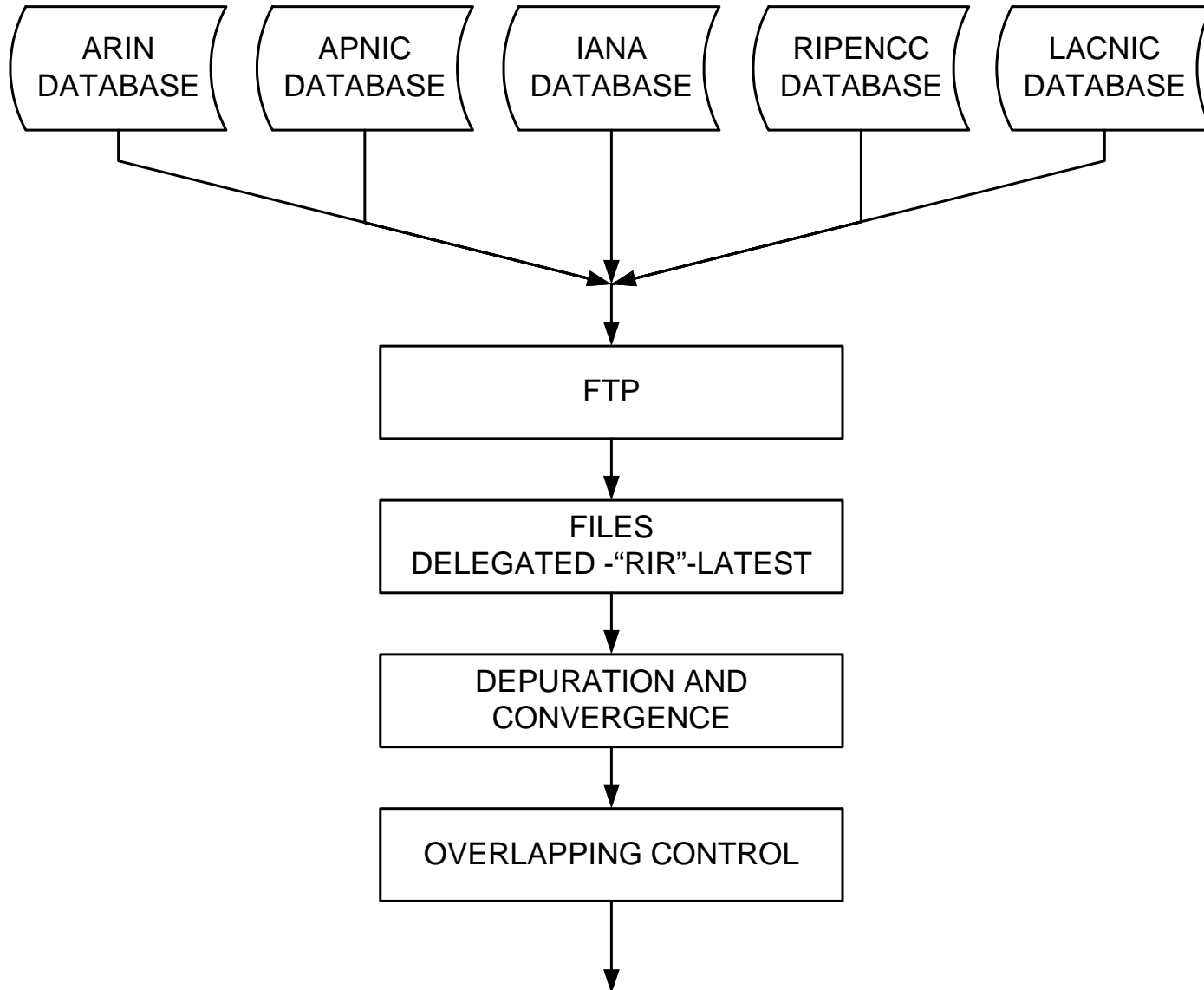
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# Consistency analysis

- The consistency of the IANA and each RIR (APNIC, ARIN, LACNIC and RIPE) assigned addresses publications is verified.

# Consistency analysis



# Detected inconsistencies

- Appear in IANA publications as “Various Registries” but do not appear either in ARIN or in LACNIC publications as part of the ERX project, the following blocks:
  - 172/8, 188/8 y 191/8.
- The information of ARIN and the one of the other RIR present some differences for the ERX blocks.

# Treatment of the inconsistencies referred to the Legacy Space

- Detection of blocks with partial assignment to ARIN and simultaneously to another RIR (overlapping).
- Application of the "to the other RIR" criteria. That is, the RIR to which the information is being transferred has the most updated data.

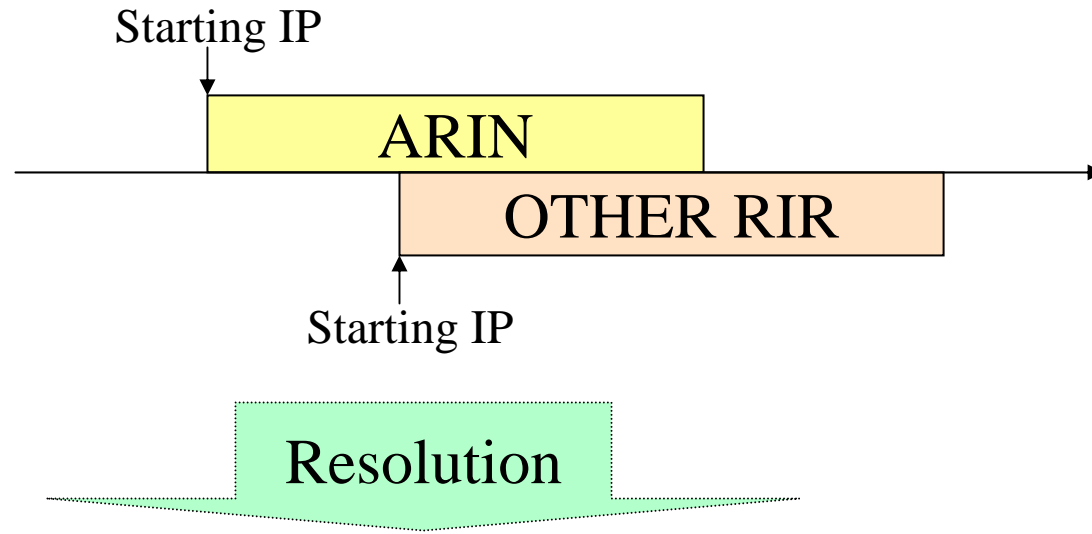


# Treatment of the inconsistencies referred to the Legacy Space

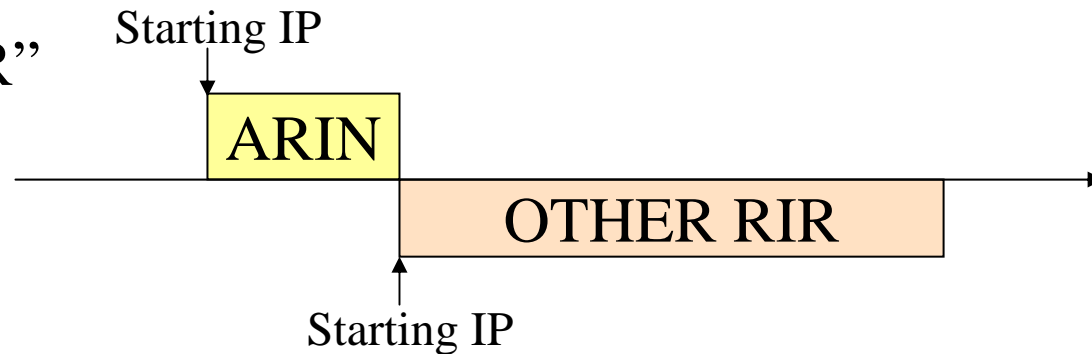
- Verification if any address assignment ceased to appear in ARIN and it does not appear in the other RIR yet.
- If that is the case, the address is considered as assigned to the other RIR.

# Inconsistencies resolution

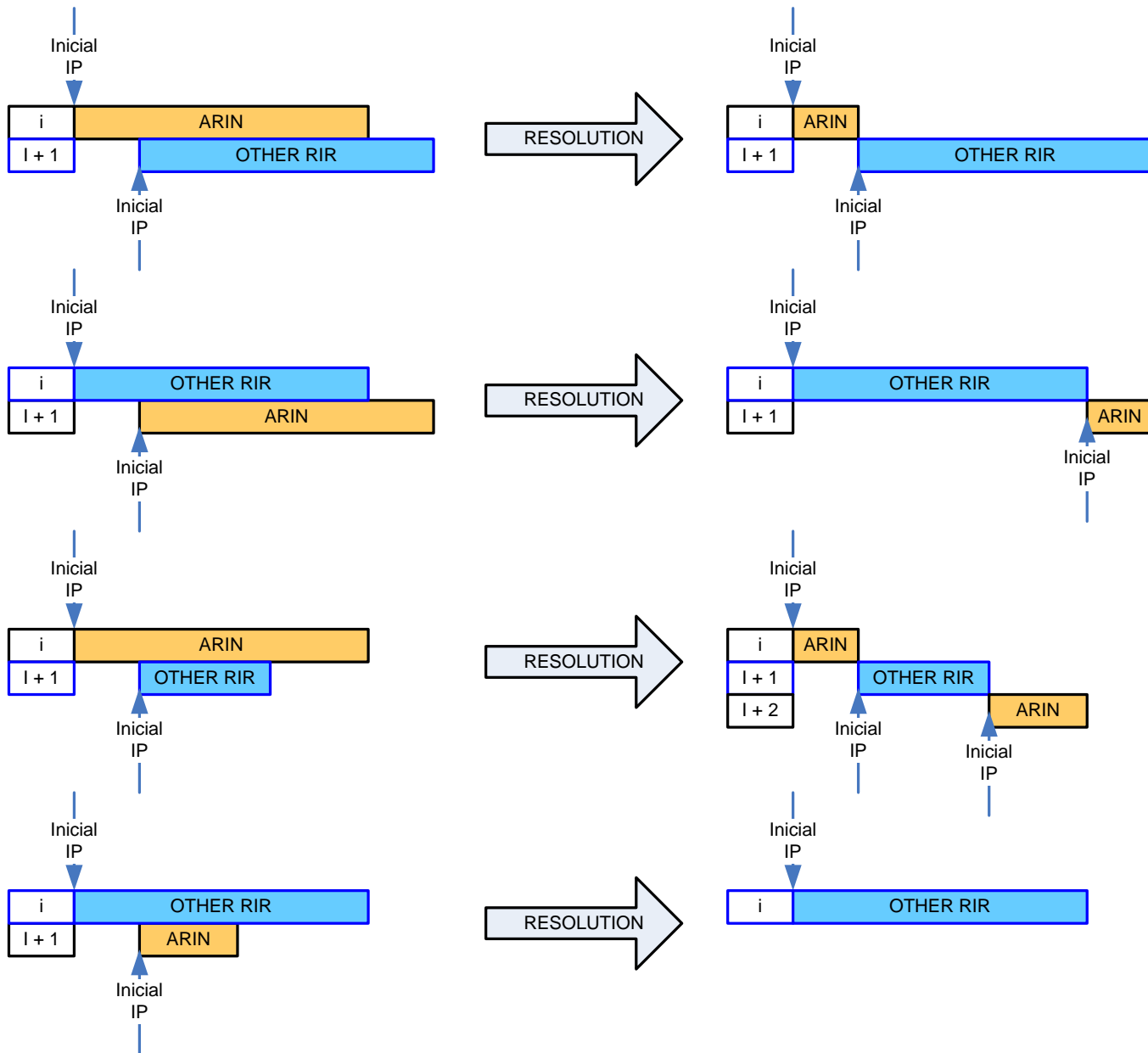
Overlapping  
spaces



Assignment  
“to the other RIR”



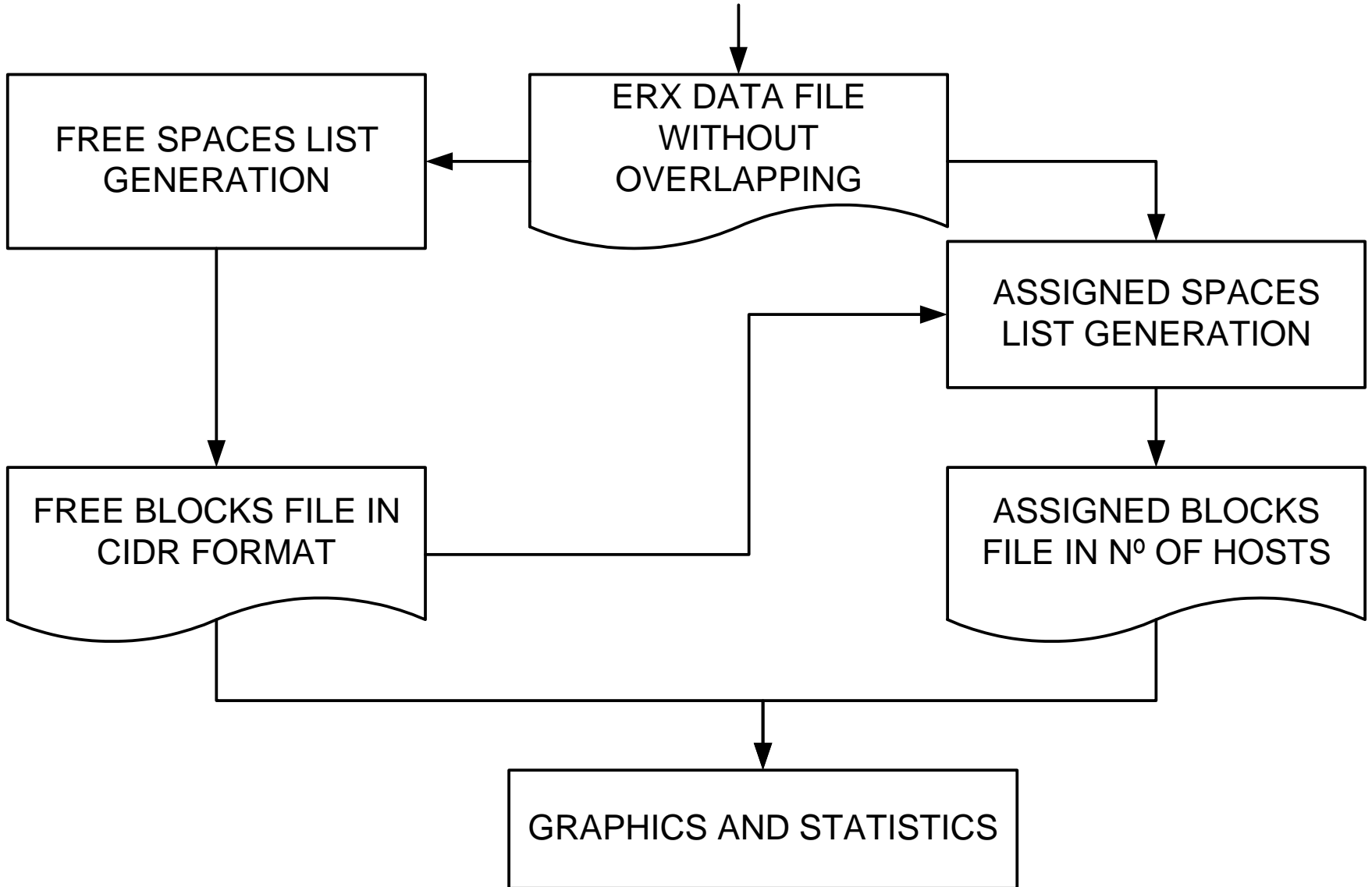
# Inconsistencies resolution



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# Free address blocks detection



# Free block detected sizes

## Distribution profiles

- Distribution profile of each  $\frac{1}{8}$  block
  - Profile A: minimum free block size equal to  $\frac{1}{16}$  (nearly 90% of  $\frac{1}{8}$  blocks)
  - Profile B: other cases (for about 10% of  $\frac{1}{8}$  blocks, its size is never less than  $\frac{1}{24}$ )

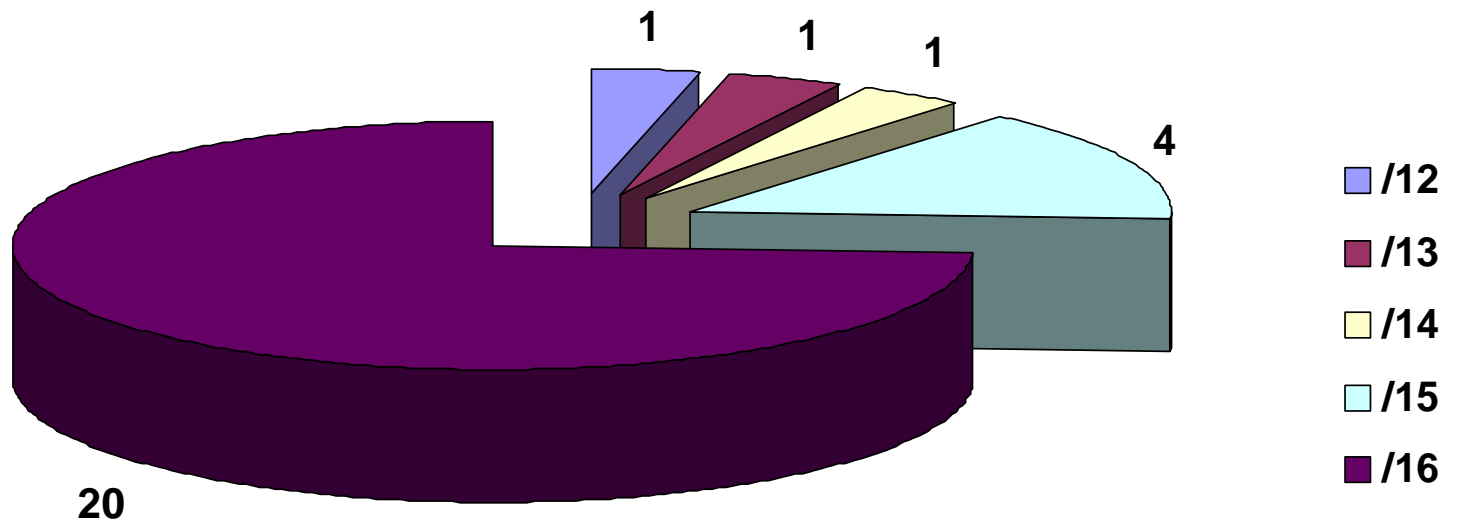
# Detected free blocks

## Distribution of block sizes

- Sample of an A profile:
  - Free addresses of 139 /8 block.
- Sample of a B profile:
  - Free addresses of 192 /8 block.
- Total addresses of the Legacy Space
  - Number of addresses assigned to each RIR.
  - Number of free addresses.

# Profile A

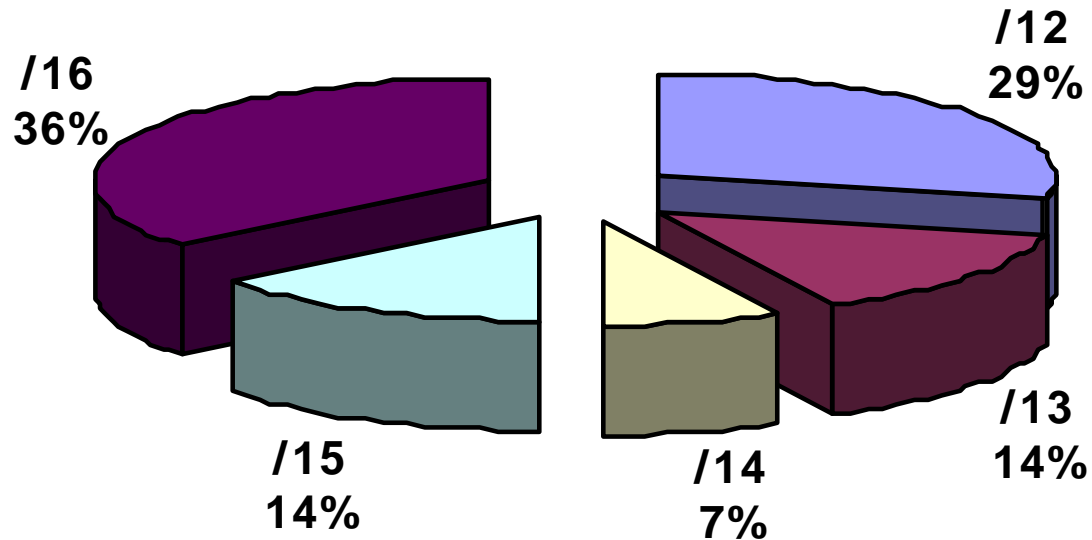
139/8 block - Free blocks quantities, by  
block size





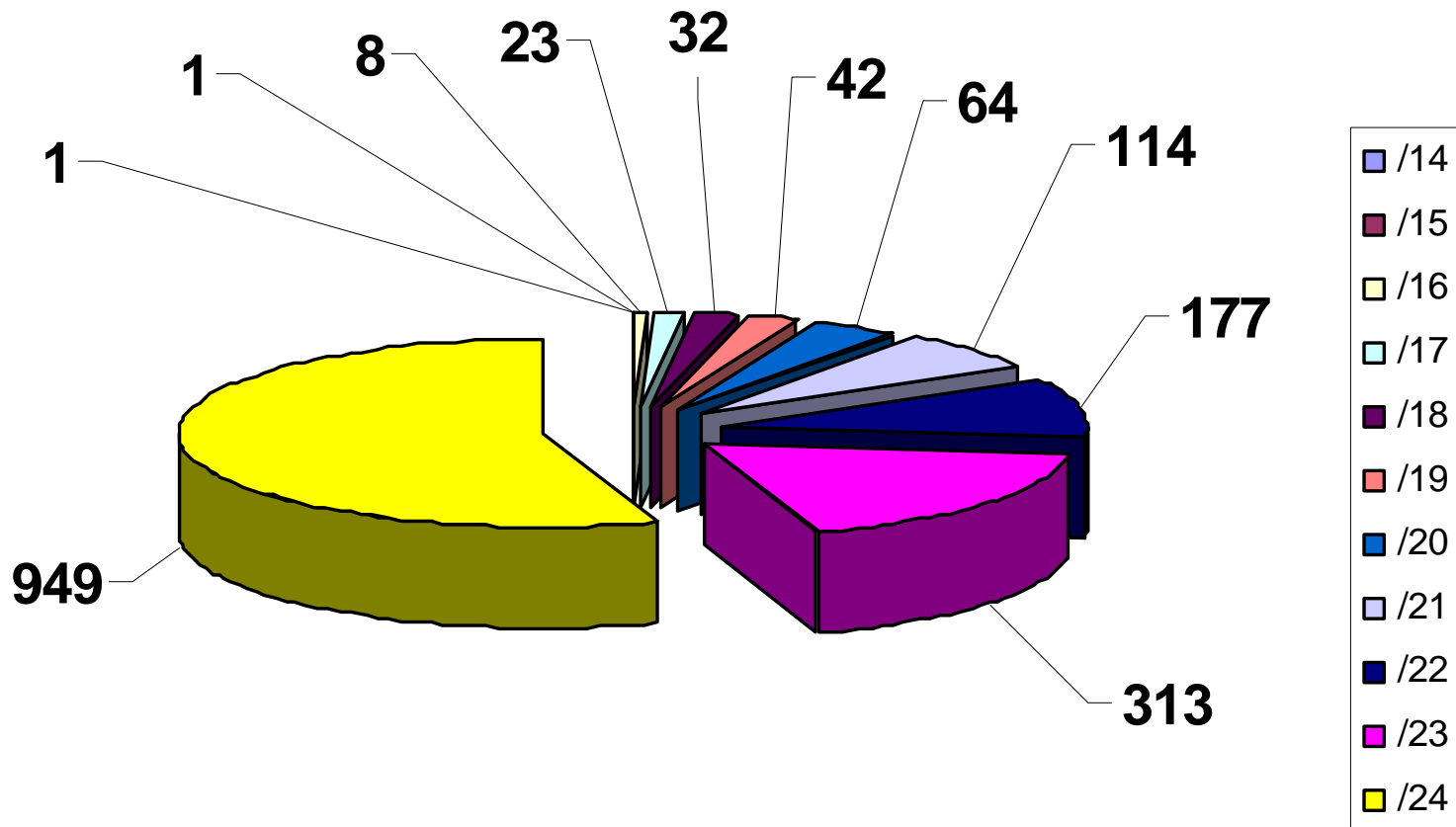
# Profile A

139/8 block - Free addresses percentage  
for each block size



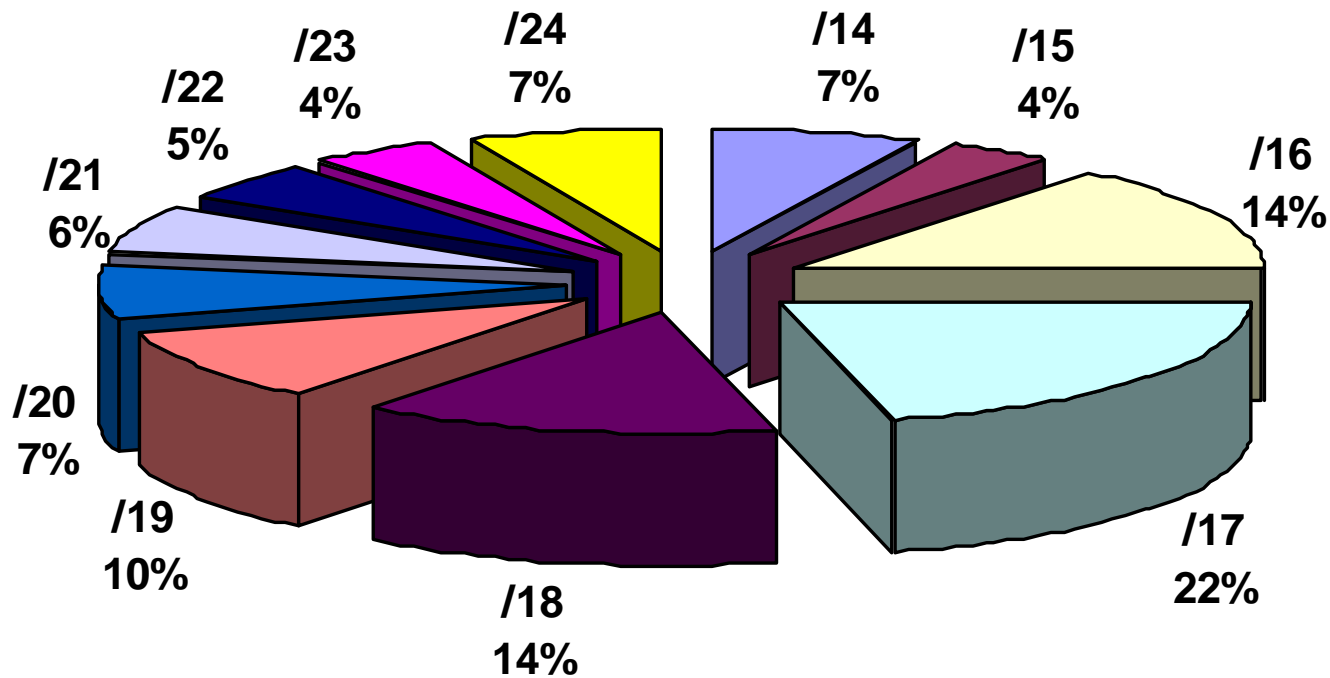
# Profile B

192/8 block - Free blocks quantities, by block size



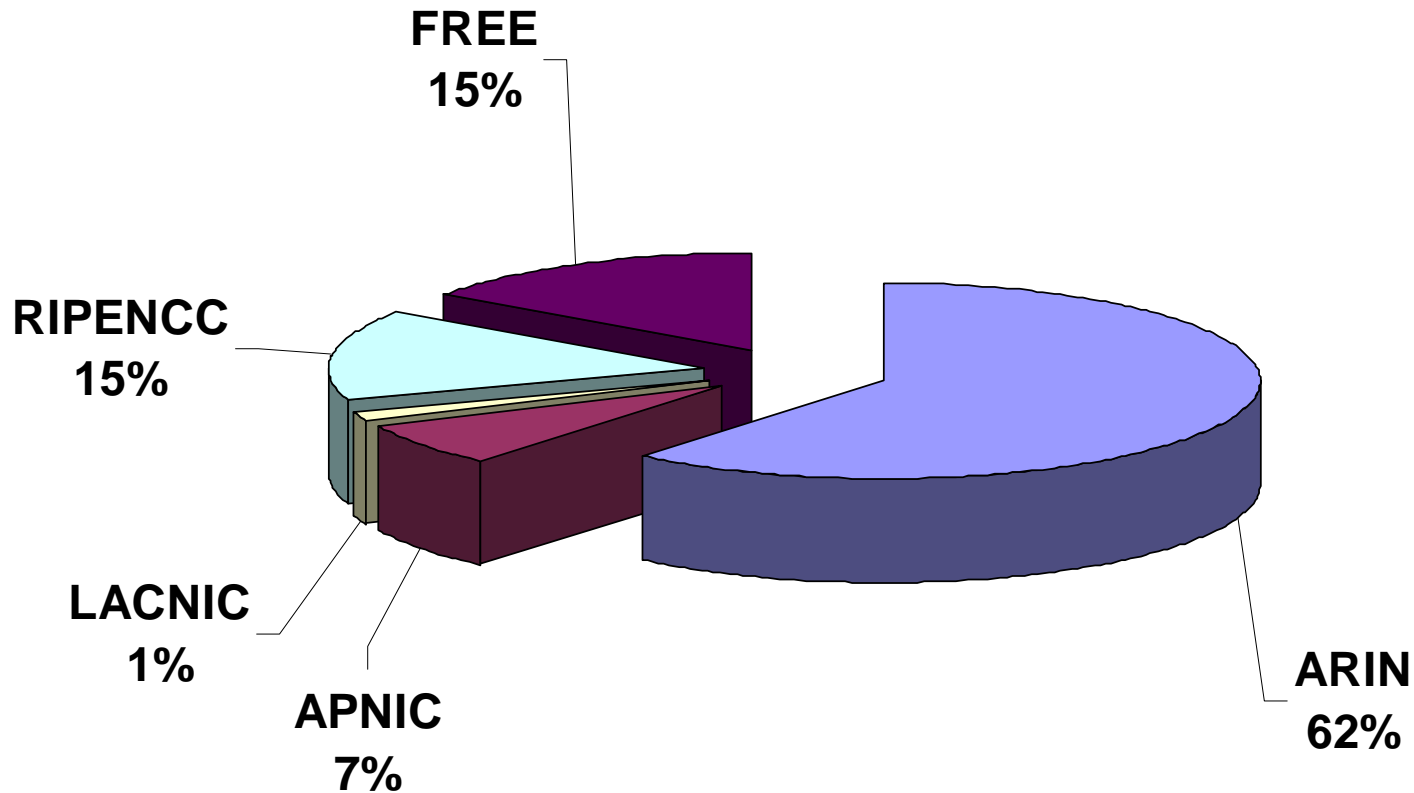
# Profile B

192/8 block - Free addresses percentage for each block size



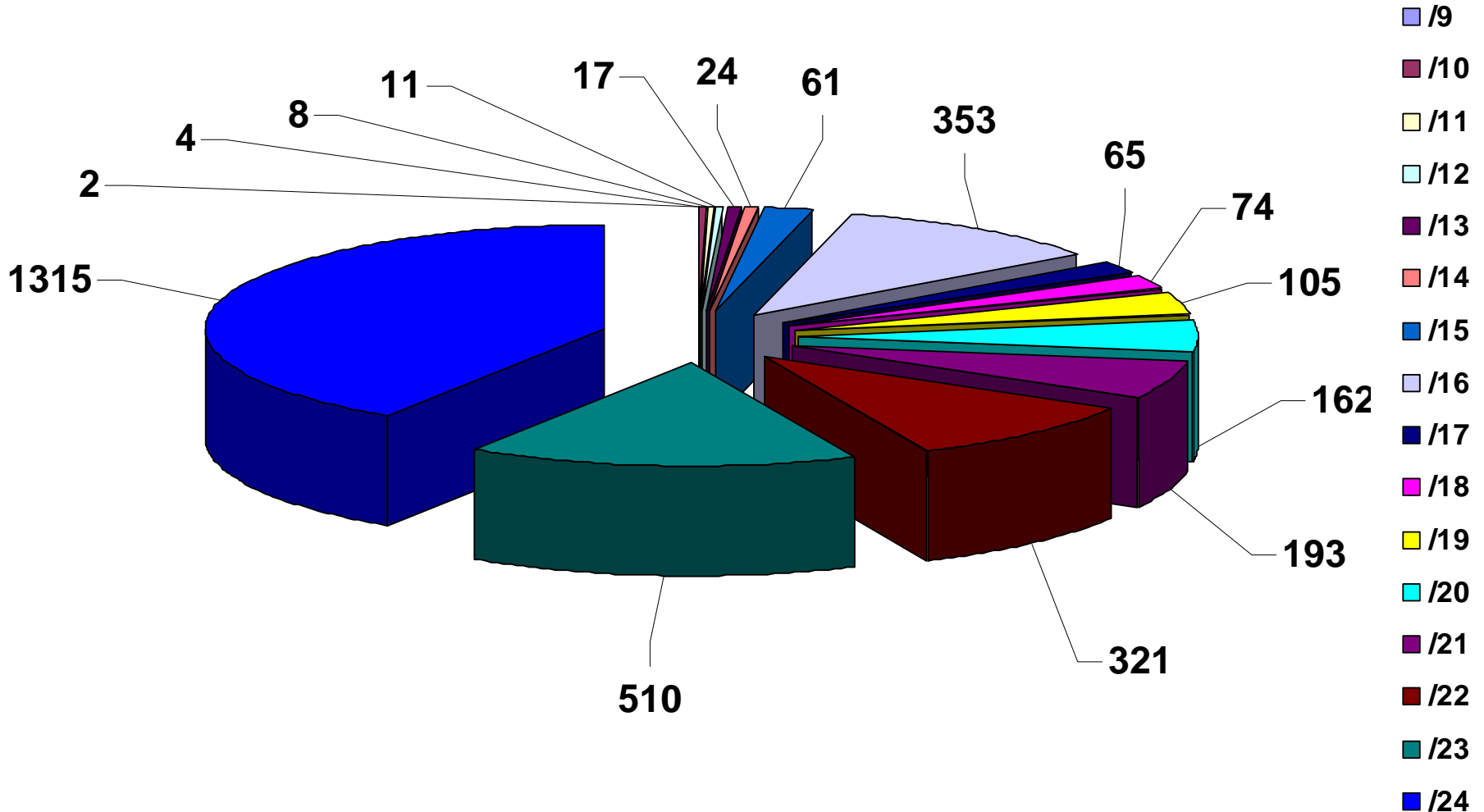
# Legacy Space

Assigned to each RIR percentages and free addresses percentages



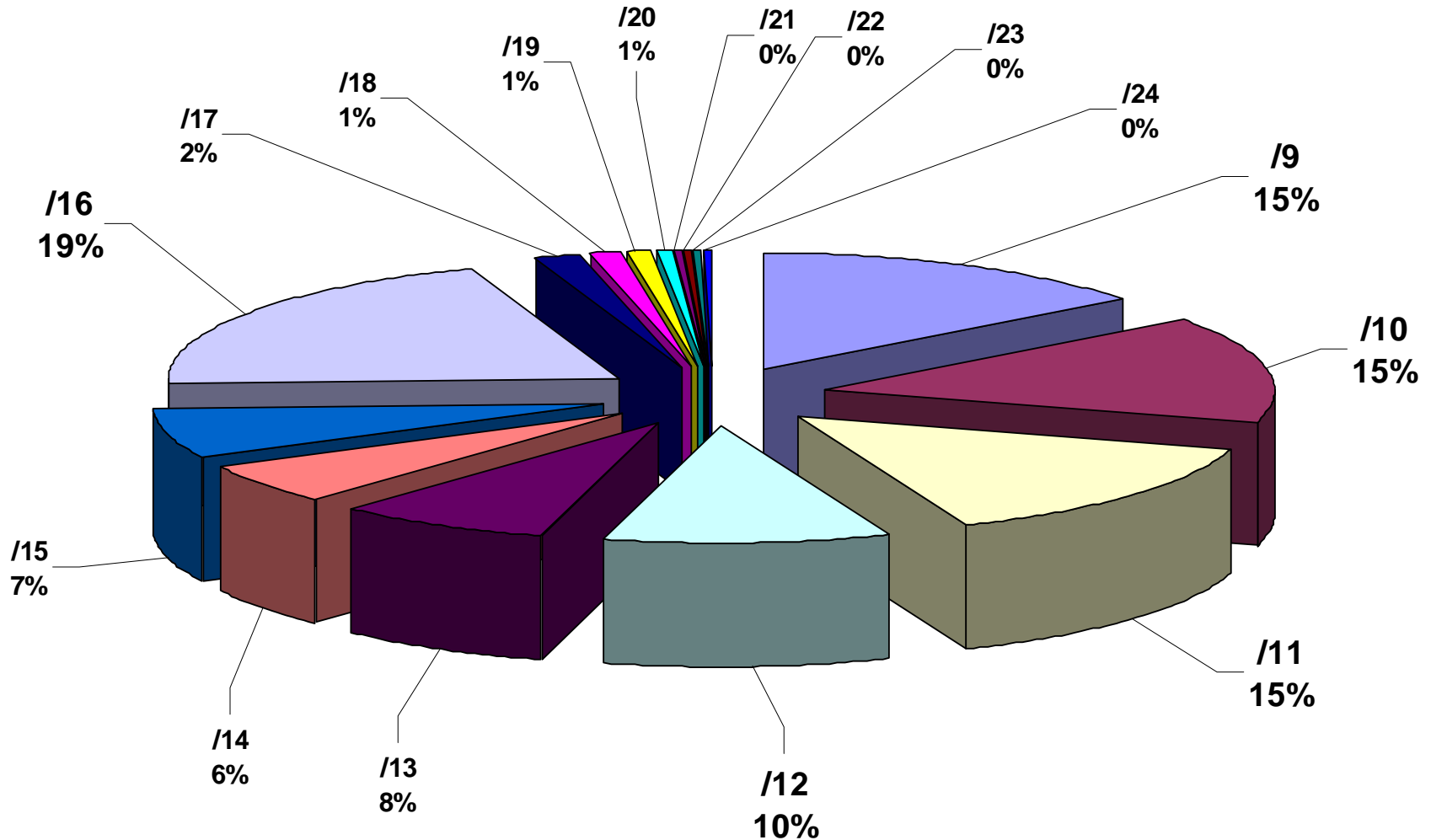
# Legacy Space

Total free blocks quantities, by block size



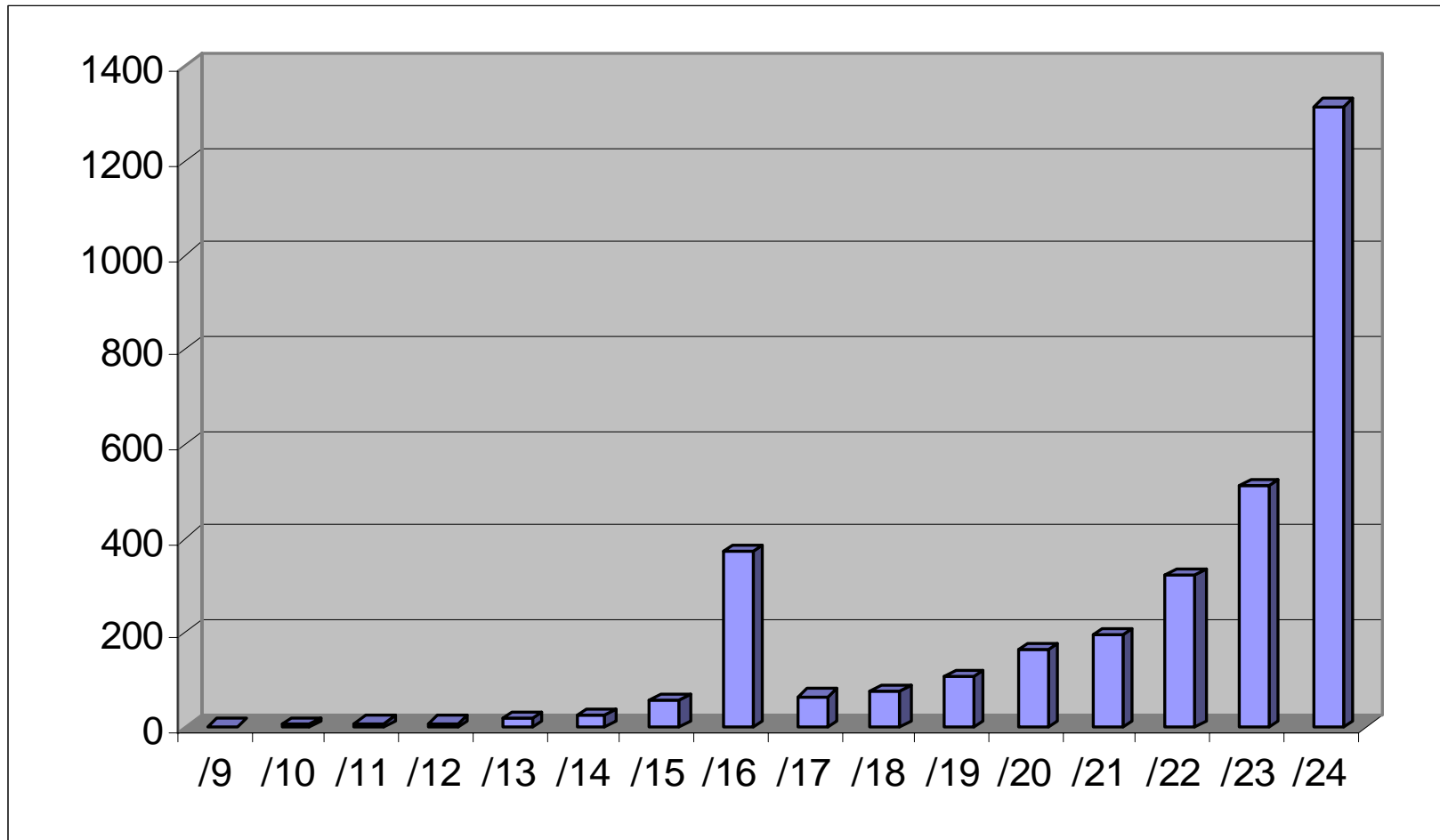
# Legacy Space

Free addresses percentage for each block size



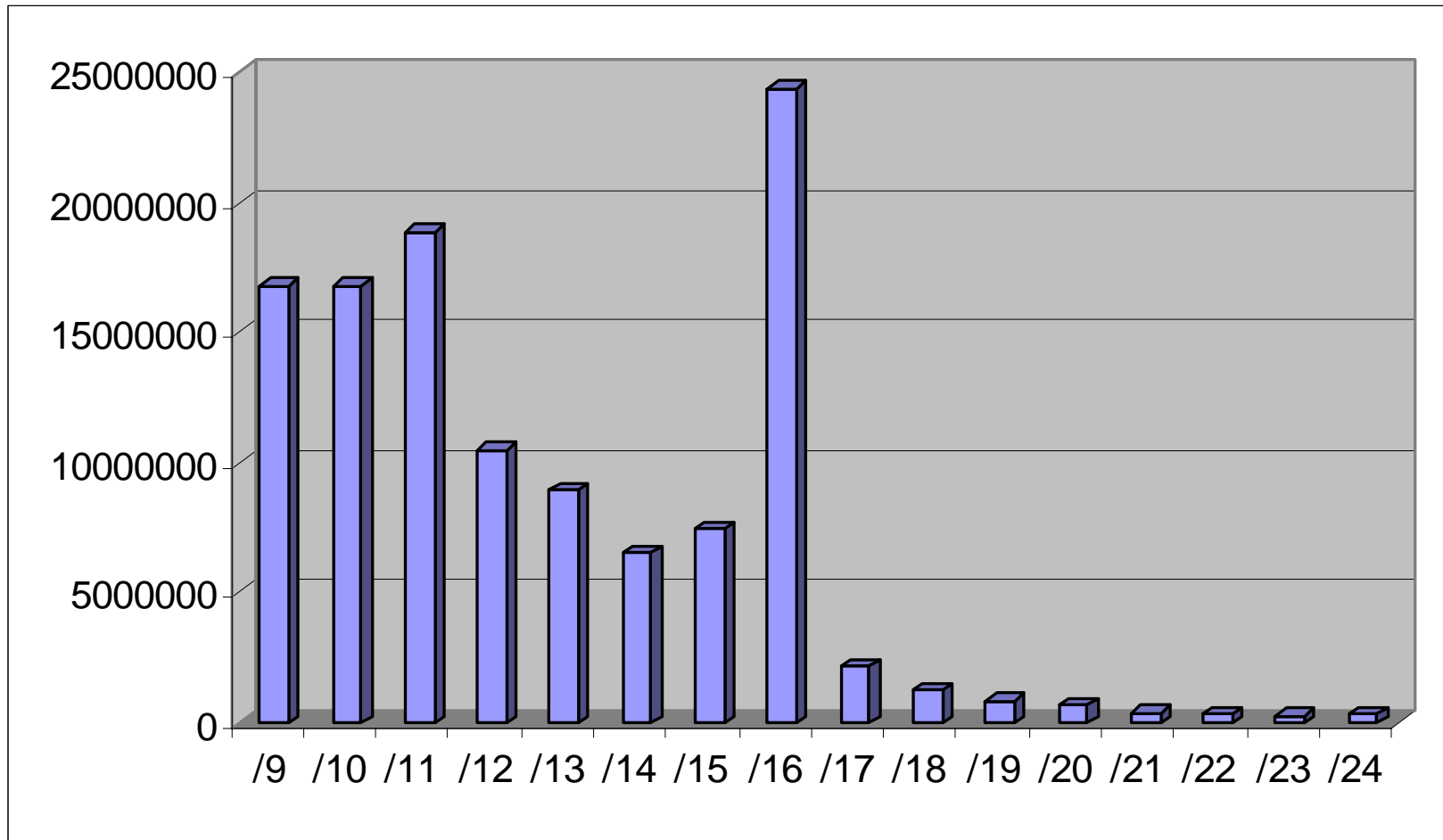
# Legacy Space

Total free blocks quantities, by size



# Legacy Space

Total free addresses quantity for each block size





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# Free addresses

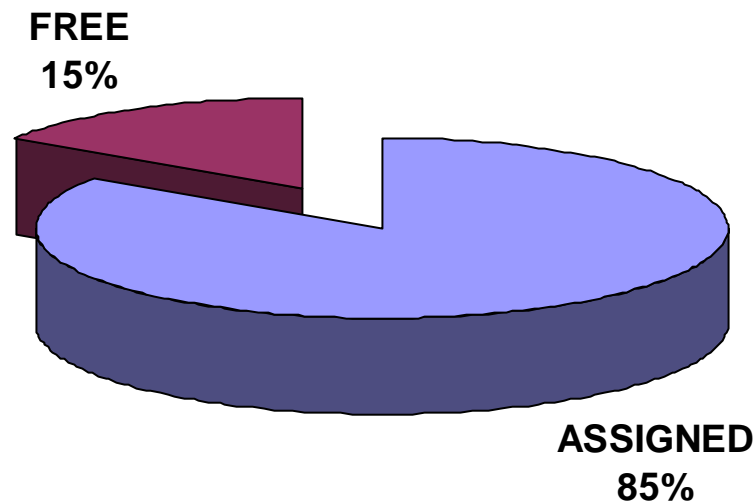
## Distribution of block sizes

- The minimum free block size in the whole free Legacy Space is /24.
- In almost 90 percent of the /8 ERX blocks the minimum free block size is /16.
- In address quantities, the /16 size is the most important, followed by /11 and then by /9 and /10.

# Free addresses

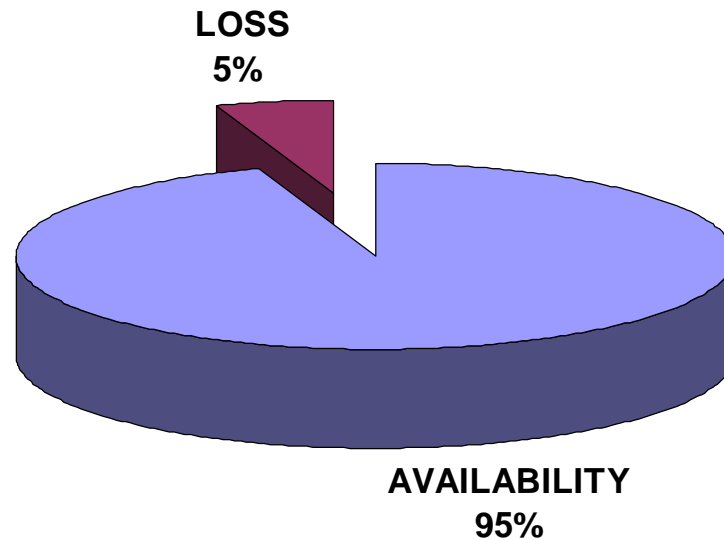
## Total

- As a whole, up to April 15 2004, the forty five ERX /8 blocks sum up a total of free addresses equivalent to **about seven /8 blocks**, with the following distribution:



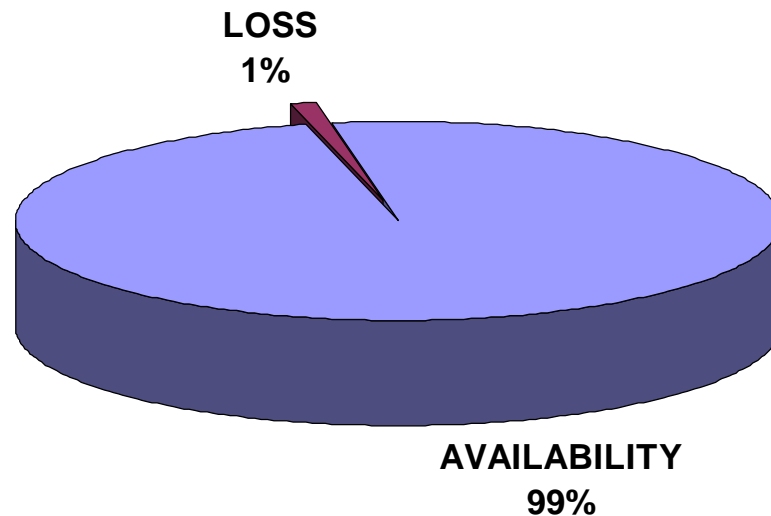
# What if the minimum assignable size was /16 ?

Free address space:



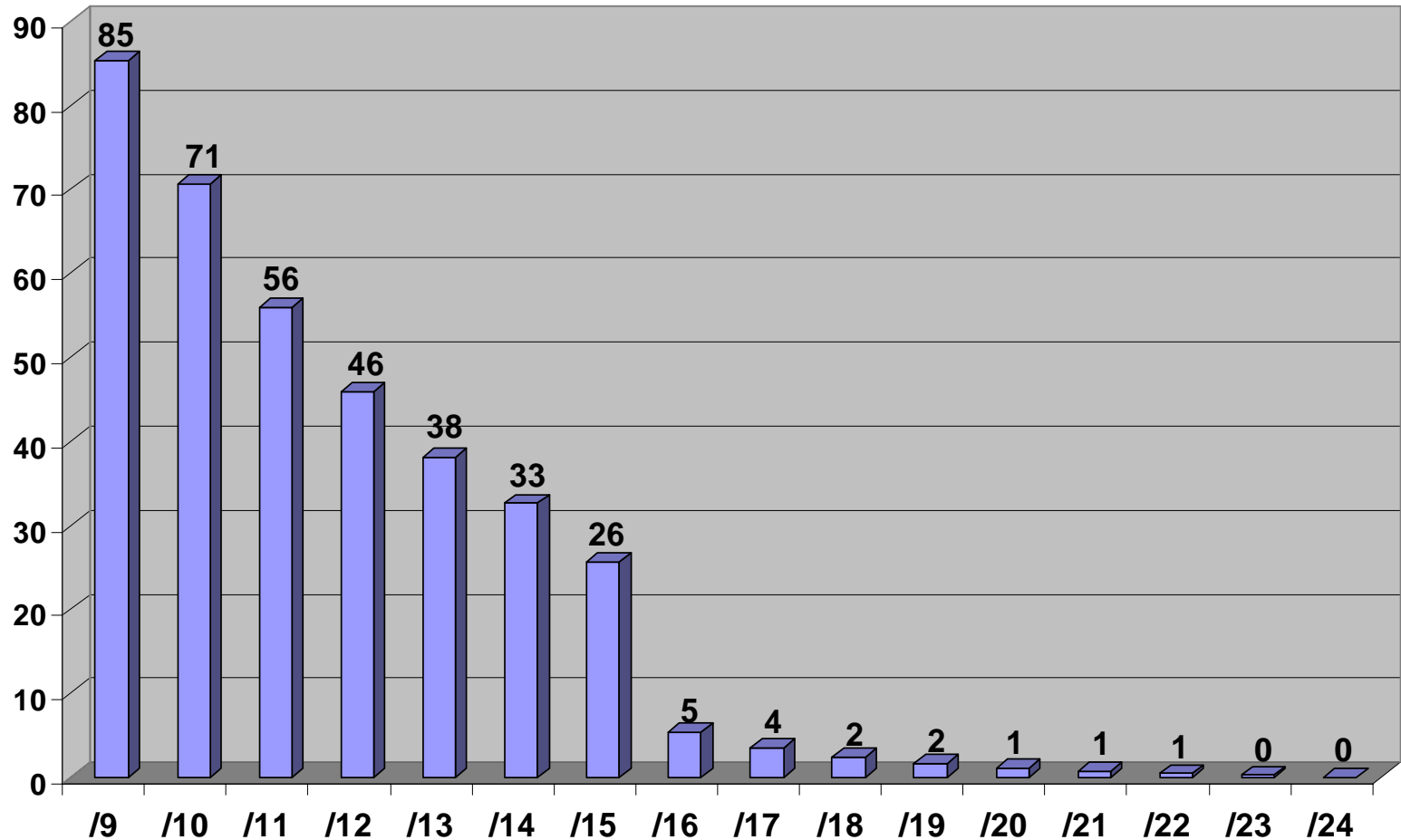
# What if the minimum assignable size was /20 ?

Free address space:



# Address loss

For different minimum assignable sizes



# Thank you for your attention

Presentation at:

[http://athenea.ort.edu.uy/ingenieria/cartelera/eventos/arin/Legacy\\_Space\\_Vancouver.zip](http://athenea.ort.edu.uy/ingenieria/cartelera/eventos/arin/Legacy_Space_Vancouver.zip)

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