

# NREN Implementation – Autonomous System & Routing

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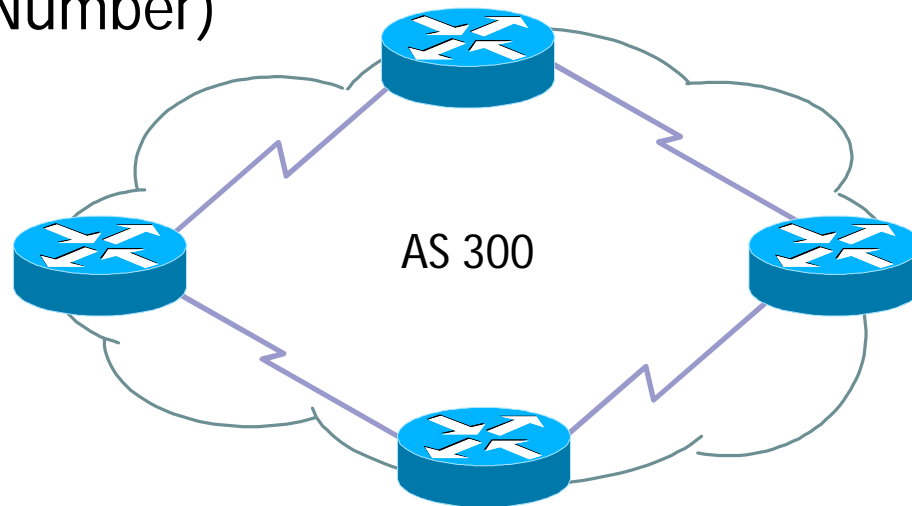
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# Autonomous System (AS)

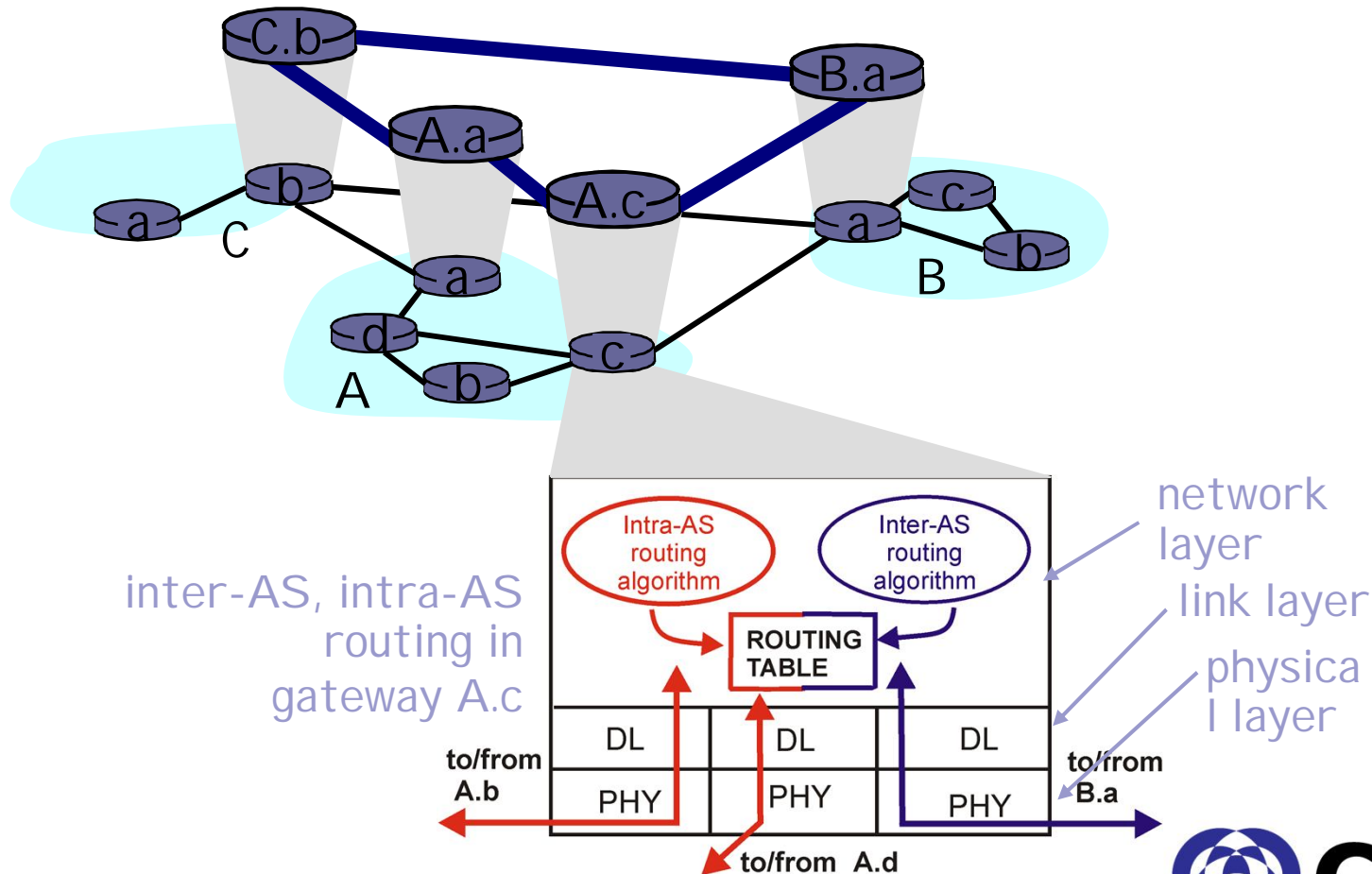
- An Autonomous System (AS) is a collection of connected Internet Protocol (IP) routing prefixes under the control of one or more network operators that presents a common, clearly defined routing policy to the Internet, usually under the control of a single entity

# Autonomous System (AS)

- Group of routers (and networks) under the same administration and with the same routing policies
- To the exterior the AS is seen as a unique entity
- Each AS has its own single identifier – ASN (Autonomous System Number)

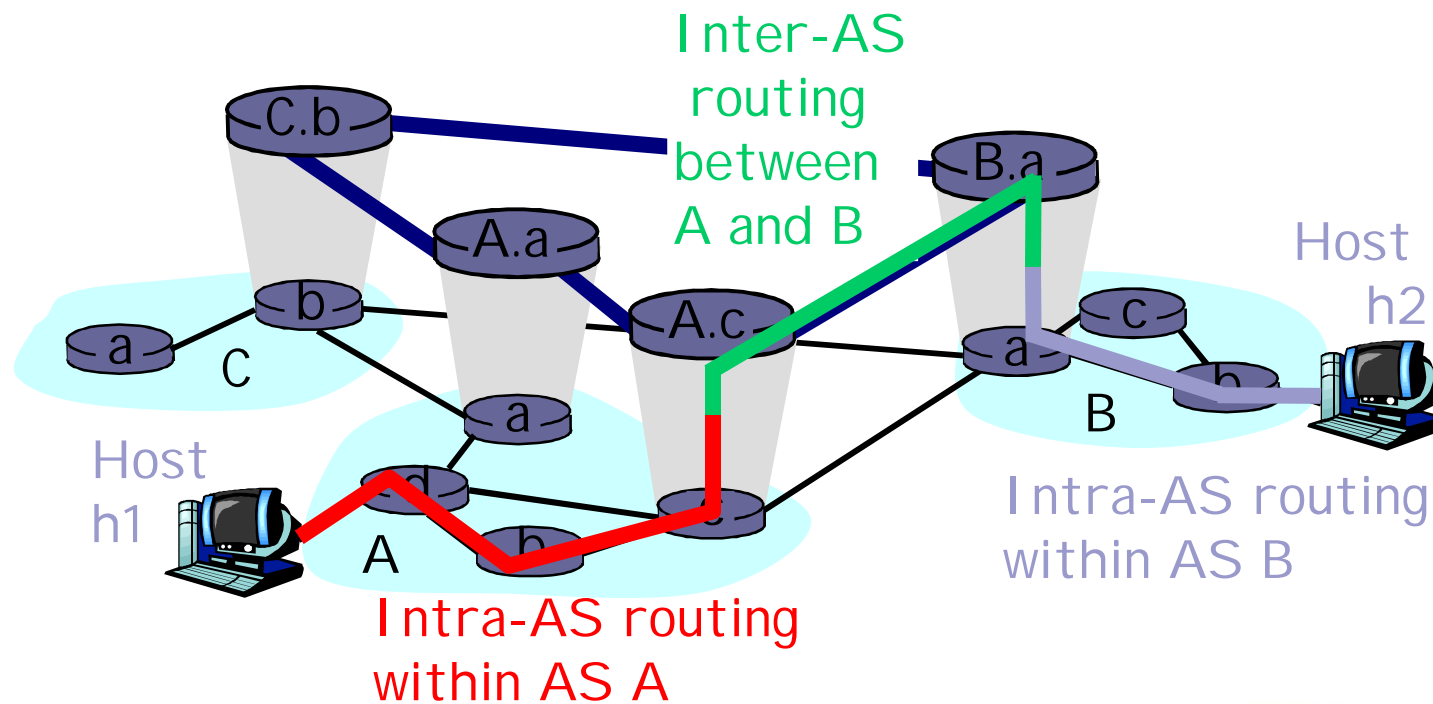


# Internet Routing



# Internet Routing

- Inter-AS and Intra-AS routing



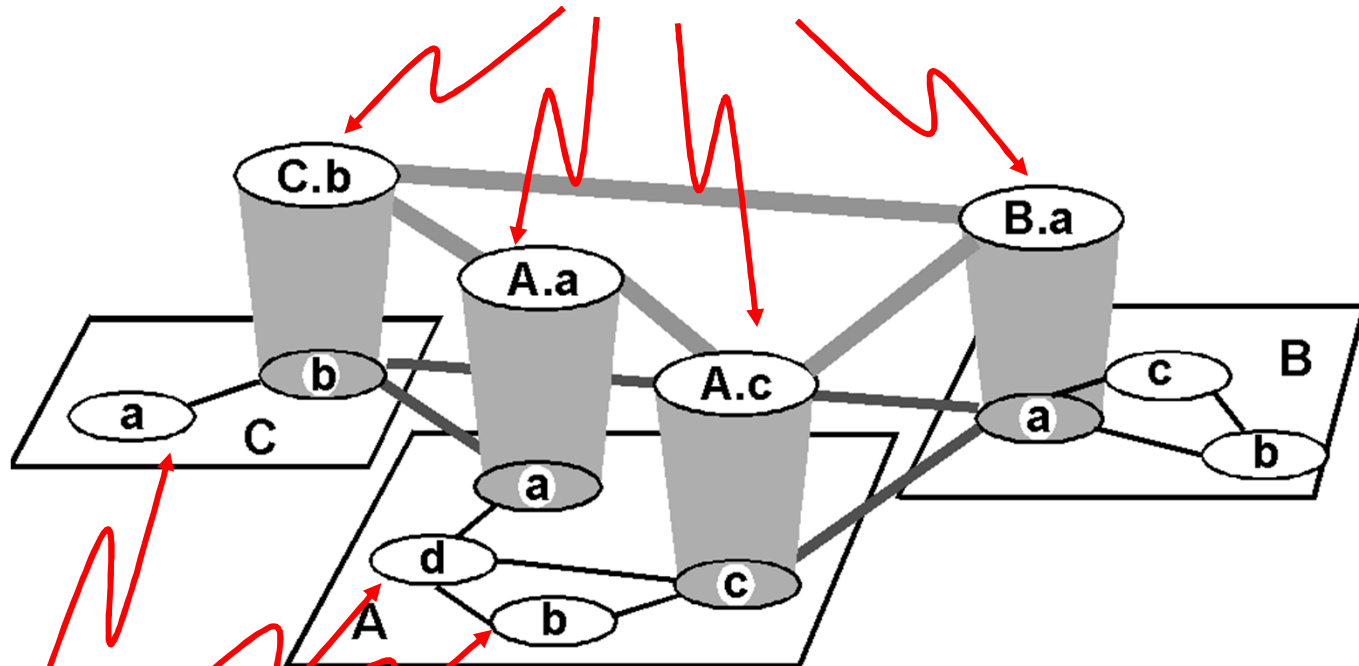
# Internet Routing

- Internet Commodity – Autonomous Systems (ASs) interconnected
  - Stub AS – small corporations
  - Multi-homed AS – great corporations (without transit)
  - Transit AS – provider
- Two level routing
  - Intra-AS – locally managed
  - Inter-AS – standard

# Internet Routing

- Routing levels

## Intra-AS border (exterior gateway) routers



## Inter-AS interior (gateway) routers

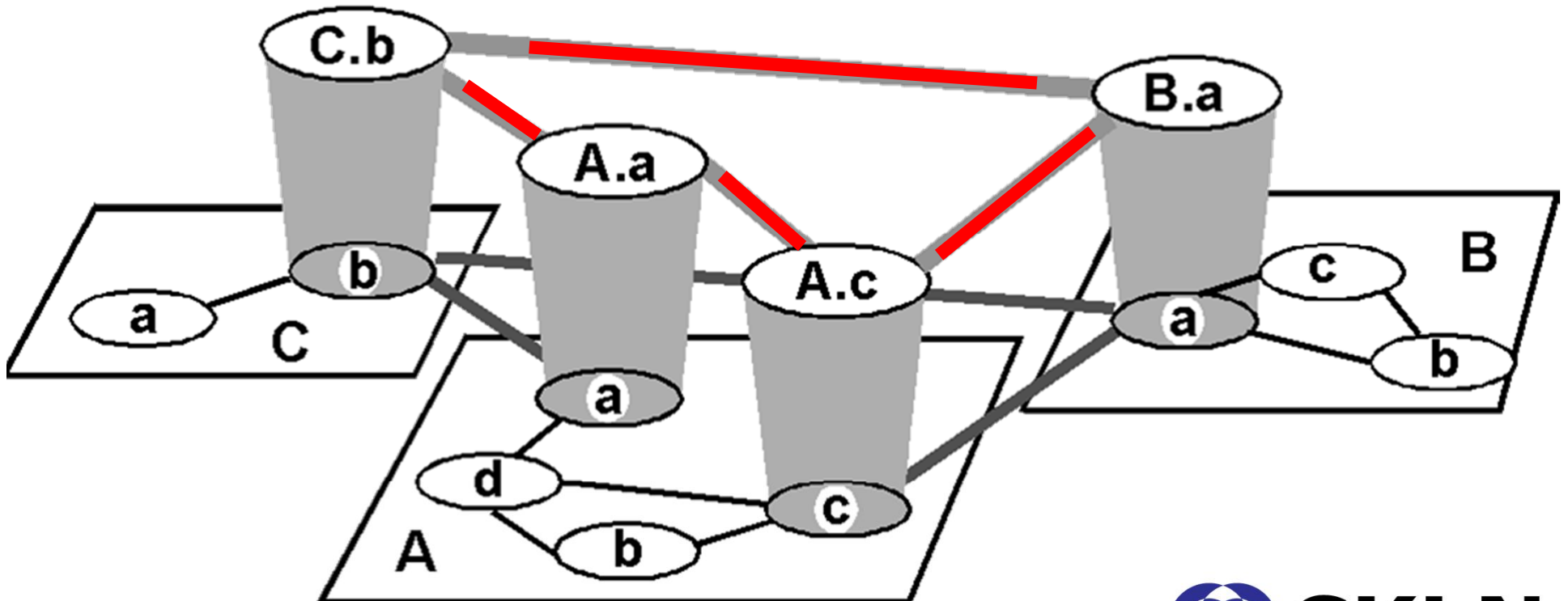
# Intra-AS Routing

- Interior Gateway Protocols (IGPs)
  - RIP – Routing Information Protocol
  - OSPF – Open Shortest Path First
  - IGRP – Interior Gateway Routing Protocol (Cisco)
  - EIGRP – Enhanced IGRP (Cisco)
  - IS-IS – Intermediate System to Intermediate System



# Inter-AS Routing

- Inter-AS Routing



# BGP

- **BGP – Border Gateway Protocol**
  - standard *de facto* – RFC 1771
- **Path Vector Protocol**
  - similar to Distance Vector Protocol
  - each Border Gateway sends to all the neighbors (*peers*) the whole path and not only the distance
  - path – sequence of ASs until the destiny
  - Example – gateway **X** sends the path until **Z**

$$\text{Path (X,Z)} = X, Y1, Y2, Y3, \dots, Z$$

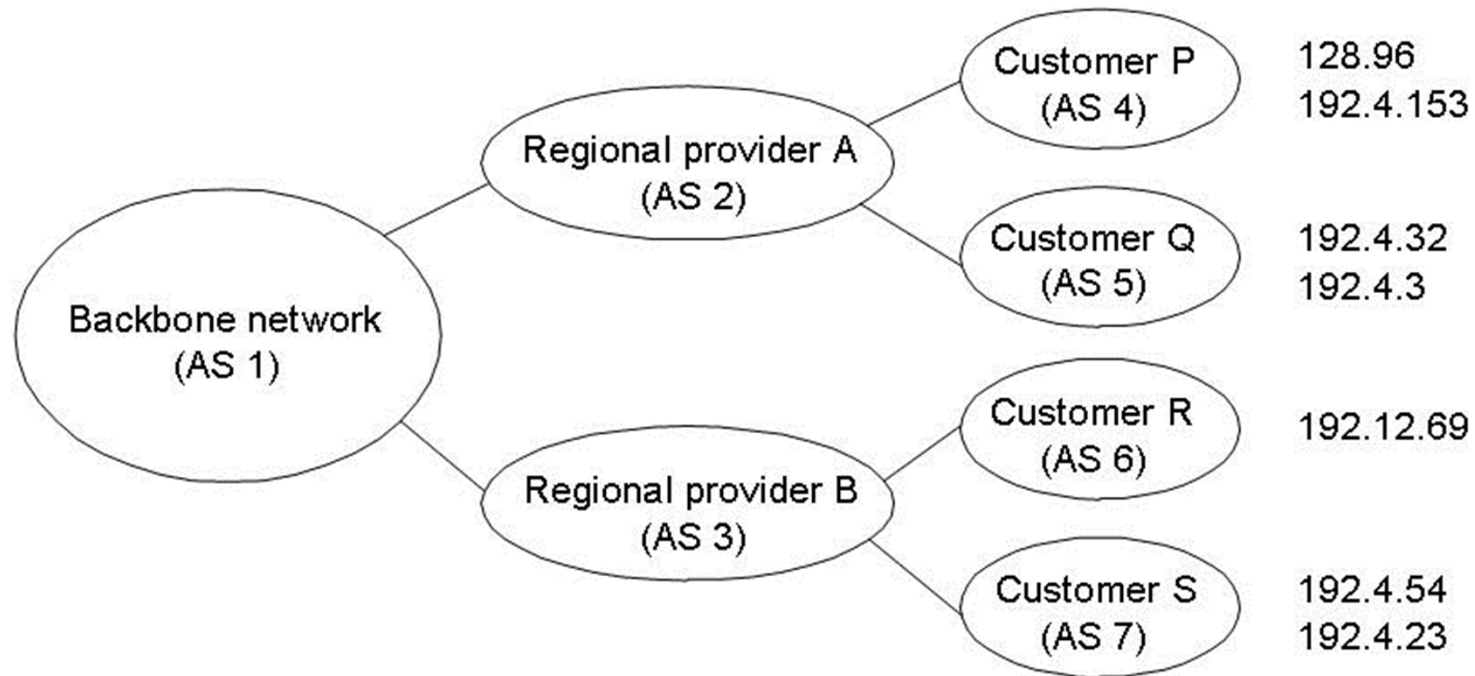
# BGP

- **Path Vector Protocol**

- gateway X sends its path for neighbour gateway W
- W could accept or not the path offered by X
- for cost reasons, political (not route through competitor AS), loops prevention
- if W selects the path announced by X, then  $\text{Path}(W,Z) = w, \text{Path}(X,Z)$
- it is possible to control the traffic that enters the network, controlling the announcements for the neighbours
- if X it does not want to route traffic from Z it is enough to don't announce the routes of Z

# BGP Prefixes

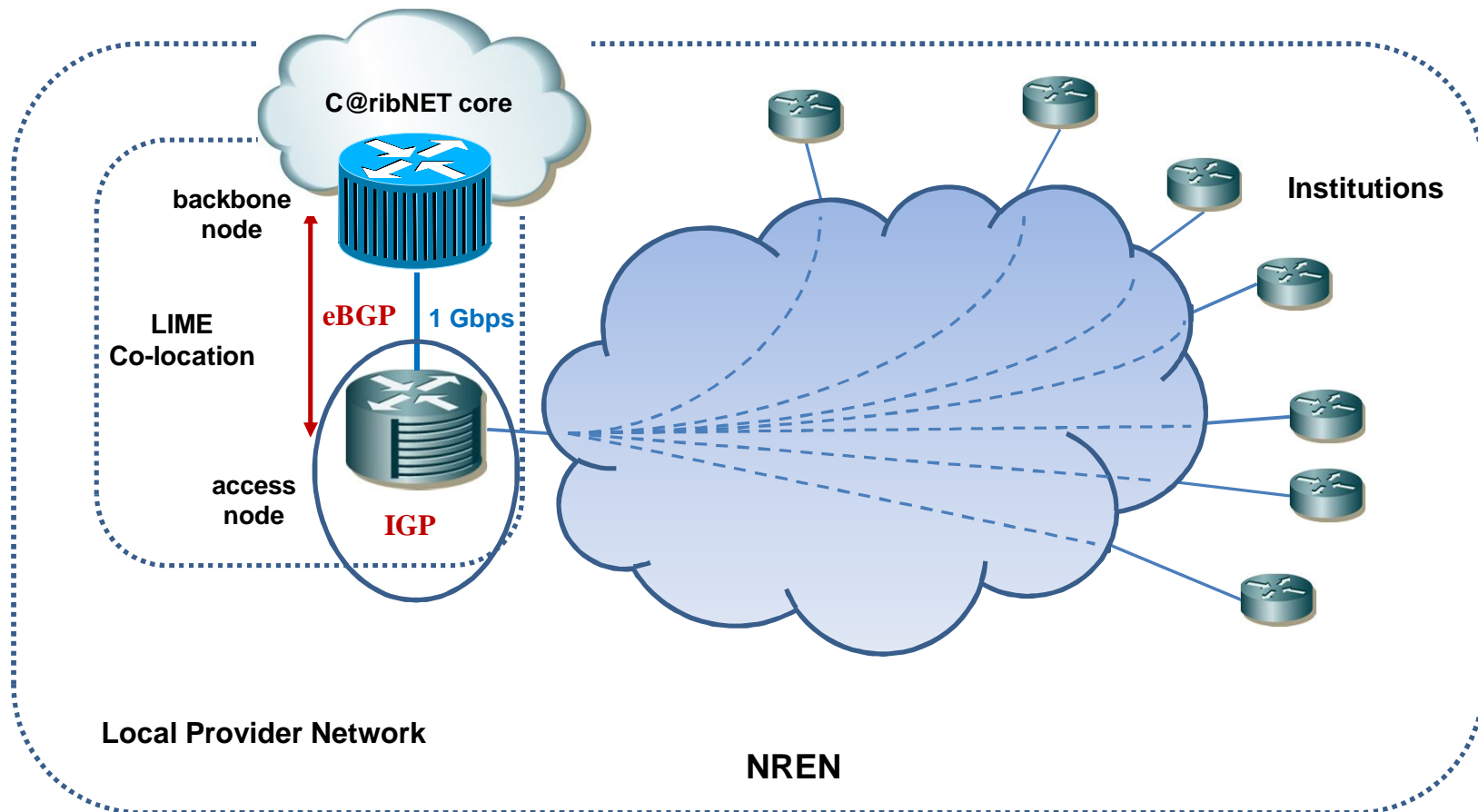
- BGP Prefixes



# NREN

- The main requirement to start the NREN is the establishment of an Autonomous System (AS) to begin exchanging traffic with the R&E community
- The implementation of the AS for the NREN will require an AS Number and a range of public IP addresses, to be used partially by the NREN and reassigned to the connected institutions
- Once the AS is established it is necessary to define the routing protocol to be used internally, and the policy for the distribution of the IP addresses range allocated from C@ribNET to the NREN

# NREN Protocols



# NREN ASN

- The NRENs will be using private AS Numbers, from the private ASN space (RFC 1930), assigned by C@ribNET
- The configuration should be addressed carefully to avoid leaking this number to other networks (***neighbor x.x.x.x remove-private-as*** router configuration command)

NREN	ASN
TTRENT	65101
JREN	65102
BBREN	65103
OECSREN	65104

# NREN IP Addresses

- The public IP address range assigned to the NRENs is a /24 (256 addresses)
- The NREN should develop a policy for utilization of the IP address range, internally and for reallocation to institutions

IPv4 Space	size	hosts	nets	usage
199.58.123.0/24				
199.58.123.0/27	/27	30	1	NREN Central Node
199.58.123.32/27	/31	2	16	Point-to-point links
199.58.123.64/26	/28	14	4	Allocation to universities
199.58.123.128/25	/28	14	8	Allocation to universities