IPv6 Multicast

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Introduction

- Multicast is inherent to the IPv6 protocol
- No broadcasts
  - Multicast used instead
- But some parts need to be configured
  - for building the multicast trees
  - for topology information (routing)

Outline

- **Multicast Addressing**
- Multicast Listener Discovery
- Protocol Independent Multicast
- Inter-domain Multicast
- Current IPv6 Multicast Deployment

Generic Multicast Group Addresses (RFC 3513)

- IPv6 multicast addresses are in the range of **FF00::/8**
- **Flag** field:
  - 000**T** values
    - T = 0, for permanent addresses defined by IANA
    - T = 1, for transient addresses
- **Scope** field: Allows limiting the scope of the multicasting
  - 0 - Reserved
  - 1 – Node-local
  - **2 – Link-local**
  - 3 – Subnet-local
  - 4 - Admin-local
  - 5 - Site-local
  - 8 - Organization-local
  - **E - Global (Internet)**

Generic Multicast Group Addresses - Examples

- IANA allocated addresses

  http://www.iana.org/assignments/ipv6-multicast-addresses

  – Flags = 0000

  – Scope

  – Group ID = 101 → NTP servers

    - FF01:0:0:0:0:0:0:101 : All NTP servers on the sender's host
    - FF02:0:0:0:0:0:0:101 : All NTP servers on the sender's link
    - FF05:0:0:0:0:0:0:101 : All NTP servers on the sender's site
    - FF0E:0:0:0:0:0:0:101 : All NTP servers on the Internet

IPv6 Multicast Address Assignments (RFC 2375)

- Addresses available only for a given scope
  - FF02::1 : All nodes of the link
  - FF02::2 : All routers of the link
  - FF05::1:3 : All DHCP servers of the site
  - FF02::D : All PIM routers of the link
  - ...
- Addresses available for all scopes
  - FF0X :: 101 : Network Time Protocol (NTP)
  - FF0X :: 109 : MTP Multicast Transport Protocol
  - ...

Multicast Unicast Prefix-Based Addresses (RFC 3306)

11111111	Flags	Scope	Resrv	Plen	Prefix	Group ID
8 bits	4 bits	4 bits	8 bits	8 bits	64 bits	32 bits

- Addresses are in the range of FF30::/12
- Flags = 00**PT**
  - P=0, for address not based on a unicast prefix
  - P=1, for address based on the unicast prefix
  - If P=1, then T=1 because address is not allocated by IANA
- Resrv : researved, always 0000
- Plen : prefix length
- Prefix : an unicast prefix

Multicast Unicast Prefix-Based Addresses - Example

- RENATER address prefix

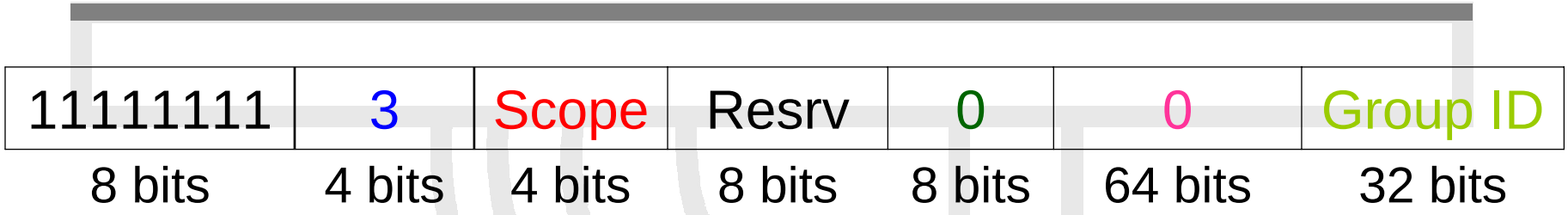
  2001:660::/32

- IPv6 Unicast Prefix-Based Address

  FF3E:20:2001:660::1234:abcd

11111111	Flags	Scope	Resrv	Plen	Prefix	Group ID

SSM Addresses (RFC 4607)



- SSM addresses are a subset of unicast prefix-based addresses
- SSM addresses are in the range of FF3x::/96
- Flags = 00**PT**
  - T=1, for for transient addresses
  - P=1, for address based on the unicast prefix
- Plen : prefix length always 0
- Prefix : always 0

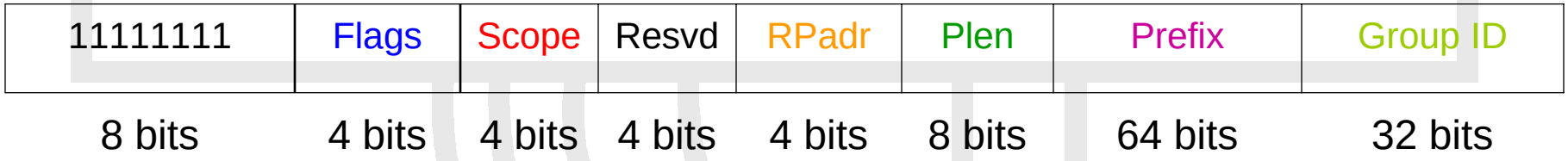
SSM Addresses - Example

- SSM Address

FF3E:::1234:abcd

11111111	3	Scope	Resrv	0	0	Group ID

Multicast Embedded RP Addresses (RFC 3956)



- Addresses are in the range of FF70::/12
- Flags = 0**RPT**
  - R=1, for address that enbeds RP address
  - R=0, for address that do not enbed RP address
  - If R=1, then (P,T)=(1,1).
- PRaddr : last four bits of RP address
- Plen : prefix length
- Prefix : a unicast prefix

Multicast Embeded RP Address - Example

- GRNET address prefix

  2001:648::/32

- GRNET RP address

  2001:648::a/128

- Embedded RP Address

  FF7E:a20:2001:648::199

11111111	Flags	Scope	Resvd	RPadr	Plen	Prefix	Group ID
8 bits	4 bits	4 bits	4 bits	4 bits	8 bits	64 bits	32 bits

Solicited Multicast Addresses (RFC 4291)

- Nodes build their own solicited multicast address using their unicast / anycast addresses
- Concatenate **FF02::1:FF00:0/104** with the 24-low-order bits of a unicast / anycast address
- Solicited multicast address are used …
  - … by Neighbor Discovery Protocol
  - … for Duplicate Address Detection management

Solicited Multicast Addresses - Example

Concatenation of **ff02::1:ffxx:xxxx** with the last 24 bits of the IPv6 address

IPv6 address: 2001:648:1a:4002:4421:21FF:FE24:87c1

Sol. Mcast address: FF02::1:FF24:87c1

Ethernet address: FF-FF-FF-24-87-c1

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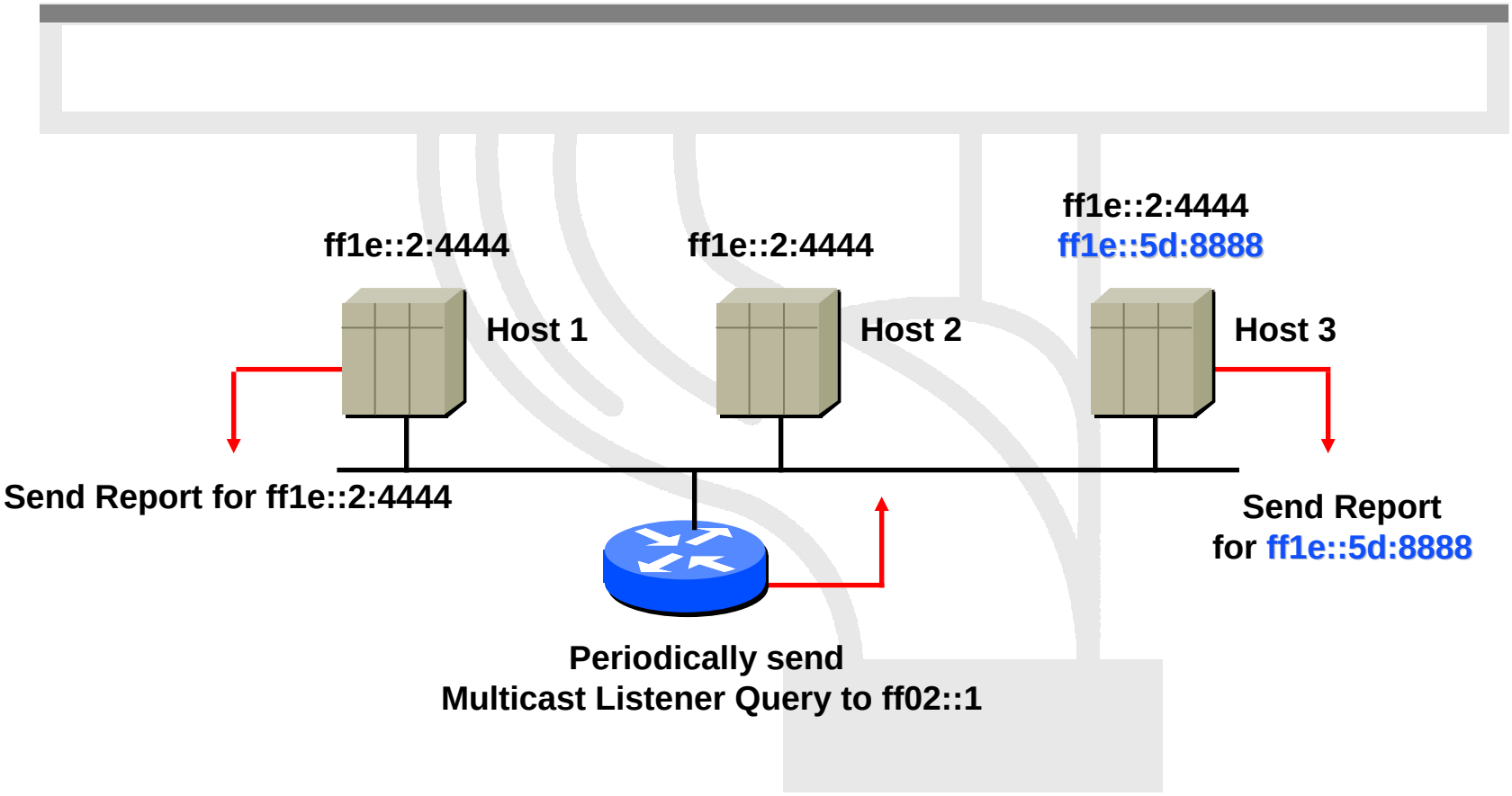
Multicast Listener Discovery

- MLD is used among multicast-enabled routers and hosts to signal which groups (and sources) a host is interested in.
- MLDv1 (RFC 2710) supports only ASM, similar to IGMPv2.
- MLDv2 (RFC 3810) also supports SSM, similar to IGMPv3.
- MLD messages are sent in ICMPv6 packets

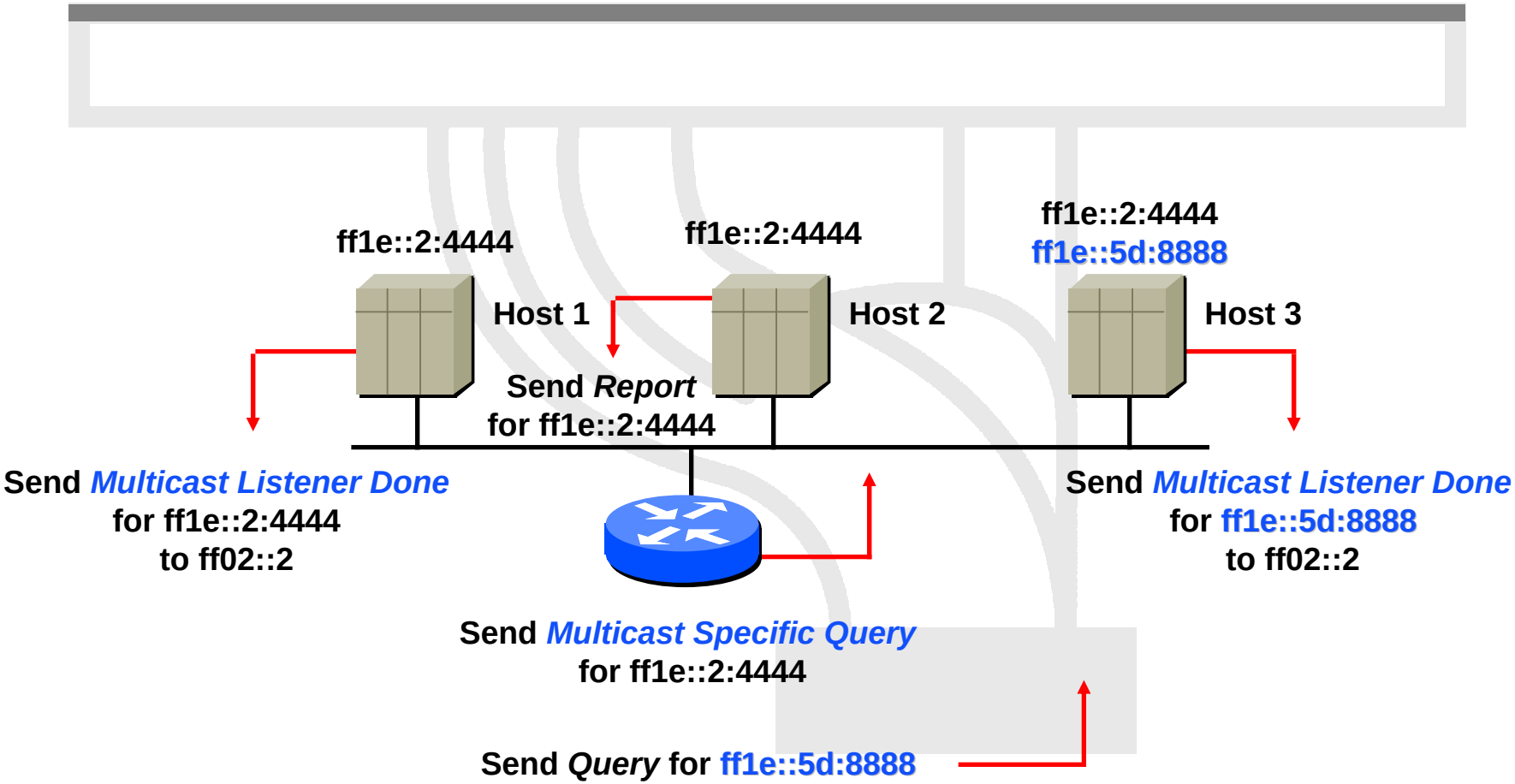
MLDv1 messages

- Multicast listener Query (130)
  - Identify whether a group has listeners on a link
- Multicast Listener Report (131)
  - Response to a query
- Multicast Listener Done (132)
  - Indicate that a host stopped listening to a multicast address

MLDv1 : Join a group



MLDv1 : Leave a group



MLDv2 (RFC 3810)

- Management of groups **& sources**
  - *INCLUDE* : to receive packets from sources specified in the MLDv2 message
  - *EXCLUDE* : to receive packets from all sources except the ones specified in the MLDv2 message
- 2 types of messages
  - Multicast listener query messages
  - Multicast listener report messages
- Interoperable with MLDv1

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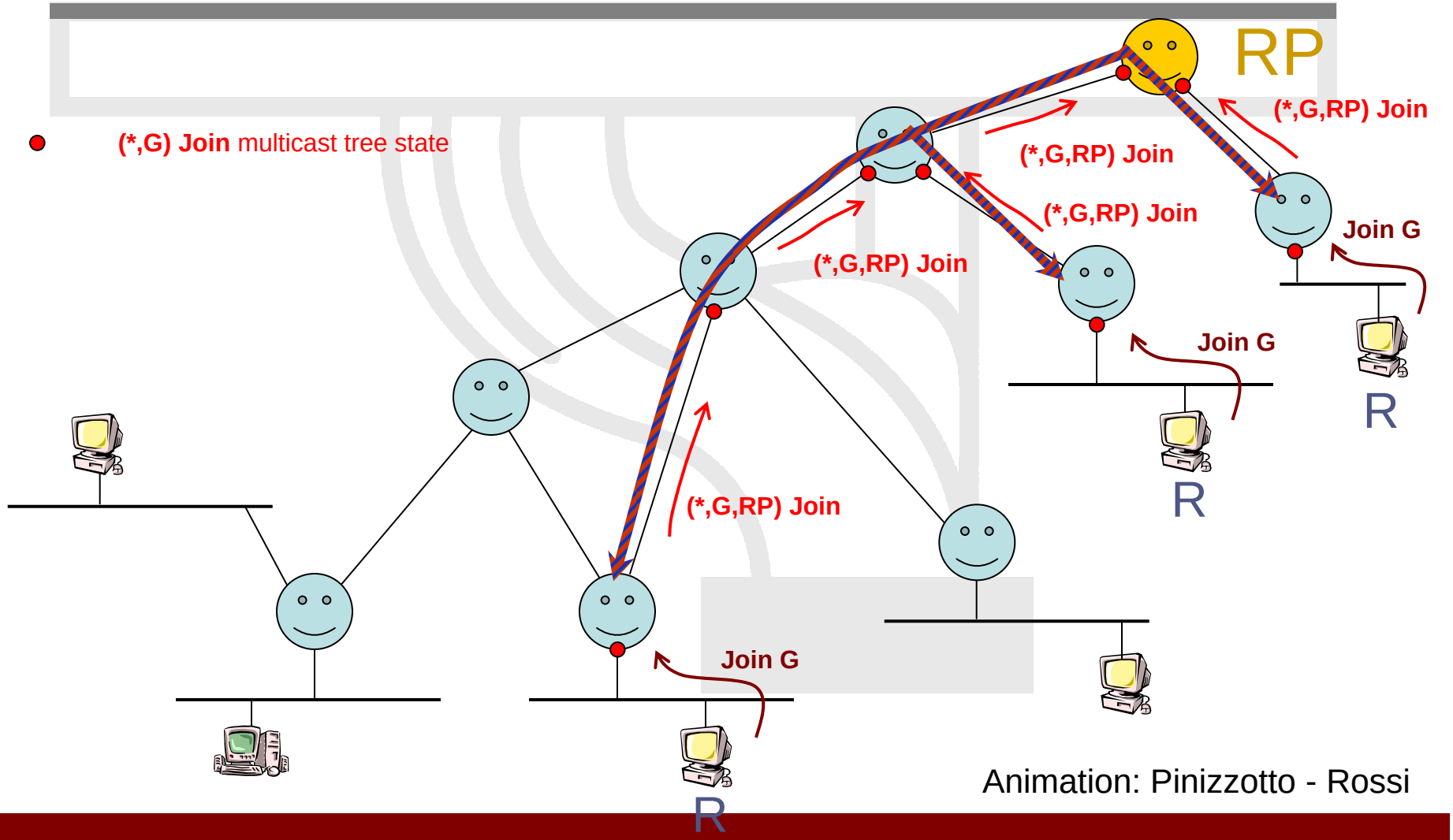
Protocol Independent Multicast (PIM)

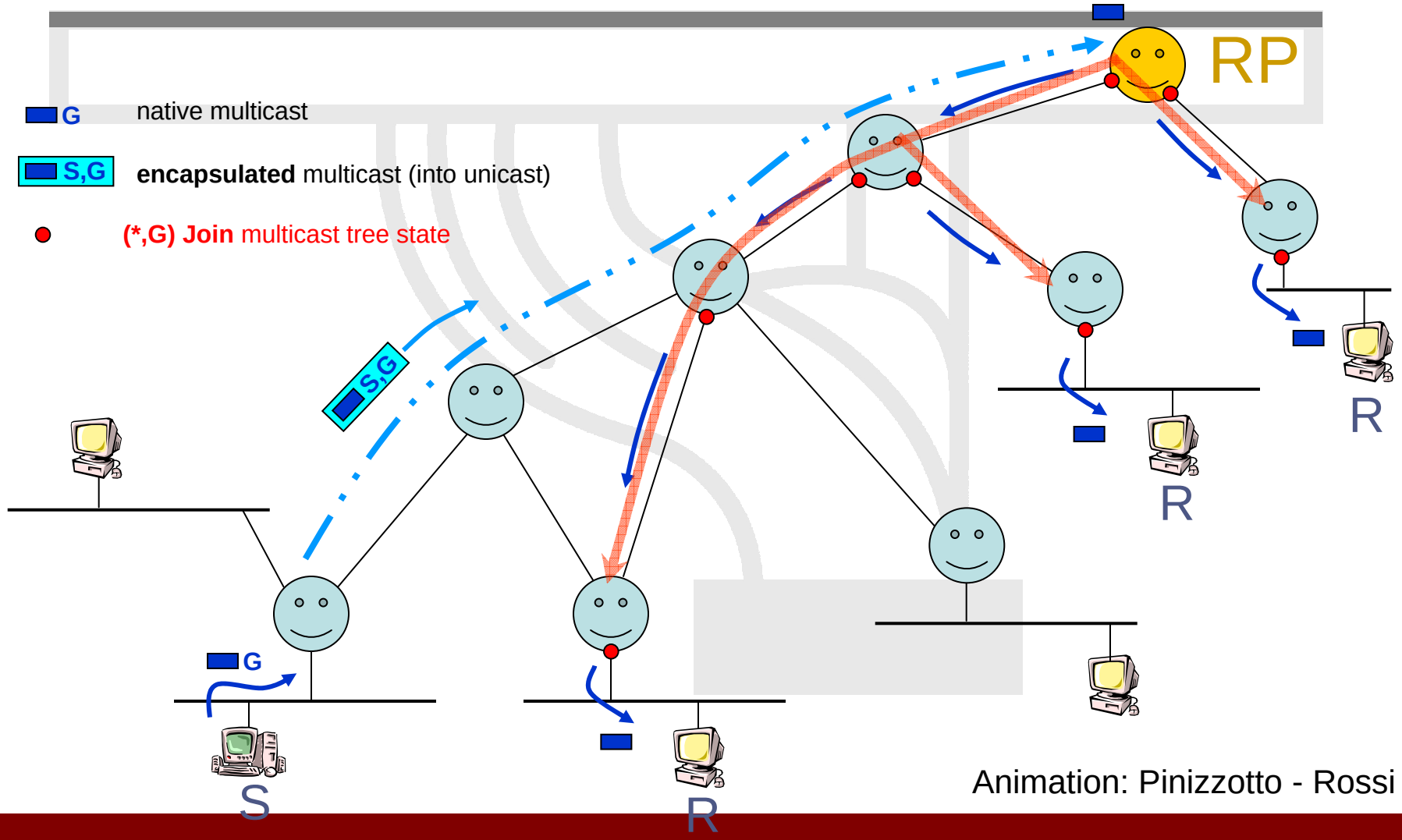
- PIM is *not* a routing protocol
  - Relies on other routing protocols, such as MP-BGP
- PIM allows to create multicast trees between senders and receivers
- In IPv6, only PIM-SM (sparse mode) is supported.
- No difference with PIM for IPv4 …
  - … but PIM messages are sent with link-local IPv6 address

PIM-SM Example



Animation: Pinizzotto - Rossi

PIM-SM Example



Animation: Pinizzotto - Rossi

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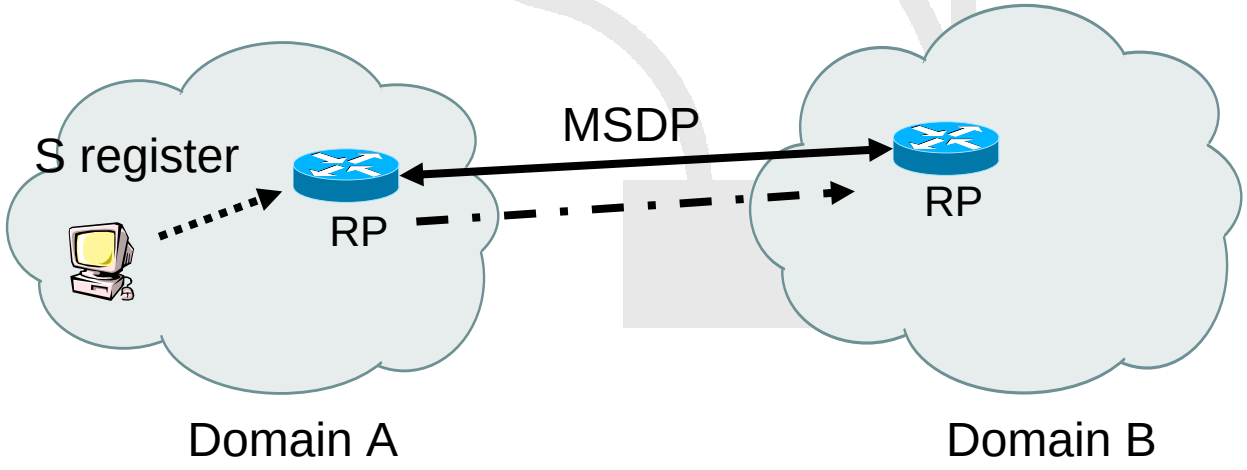
- **Inter-domain Multicast**

Inter-domain Multicast

- MSDP is not supported in IPv6 networks
  - In IPv4, each site has typically one or more RPs for all global groups. RPs in different domains use MSDP to learn of remote sources
  - Not manageable / scalable solution



Inter-domain Multicast

- In IPv6, for a given global group there can be only one single RP on the Internet
  - Not scalable solution by itself.
- Embedded-RP (RFC 3956) allows each domain to distribute multicast sessions using their own RPs
- Embedded-RP solution characteristics
  - Backbone networks do not need any RP configuration
  - E-PRs should (ideally) be located near the sources
  - Prerequisites support of E-RP in all PIM routers
- How to solve ASM?
  - Application / Middleware ?
  - Not there yet (work ongoing)

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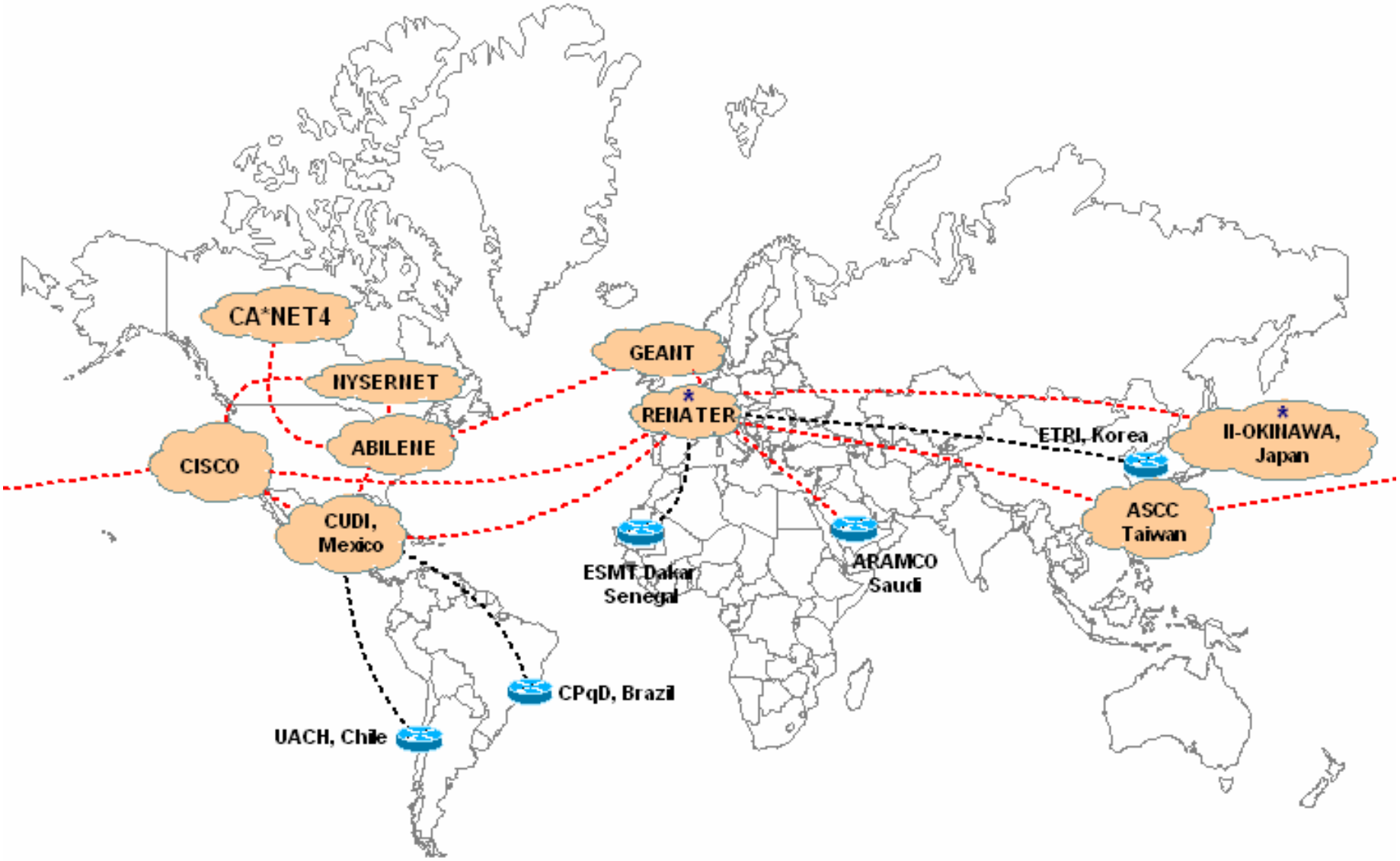
- **Current IPv6 Multicast Deployment**

Current IPv6 Multicast Deployment

- M6bone
  - An IPv6 Multicast test network with more than 30 networks & 60 sites connected
  - Started in July 2001 in France
- Aims to
  - offer IPv6 multicast connectivity,
  - test and develop soft and equipments related to IPv6 multicast technologies,
  - be active in IPv6 multicast standardization and provide deployment recommendations

M6Bone


CA*NET4
NYSERNET
ABILENE
CISCO
CUDI, Mexico
GEANT
RENATER
ESMT Dakar Senegal
ARAMCO Saudi
ETRI, Korea
II-OKINAWA, Japan
ASCC Taiwan
CPqD, Brazil
UACH, Chile

M6Bone In Europe

Current IPv6 Multicast Deployment

- Many networks provide native IPv6 multicast services in their service prortfolio
  - Abilene, GÉANT, NORDUnet, SEEREN (?) etc.
  - RENATER, UKERNA, GRNET, etc
- Prominent router vendors already support IPv6 Multicast-enabled routers.

Questions?

Thanks for your attention!

Contact

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