Quality of Service Provisioning in Source Specific Multicast

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Outline

1. Introduction

2. Review on DiffServ aware multicast schemes

3. Proposed Scheme

    - QoS aware SSM (QSSM)

4. Experiment results

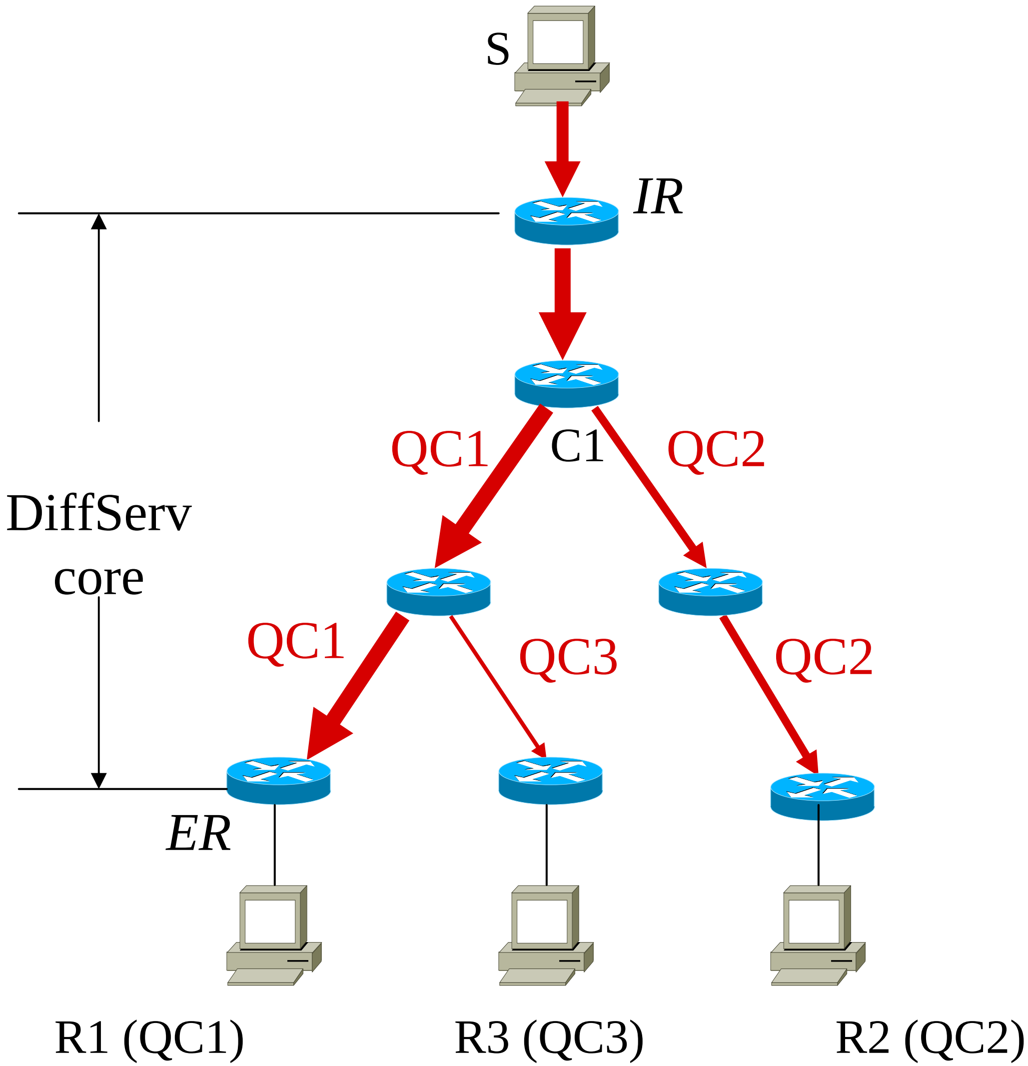
5. Multicast Traffic Engineering

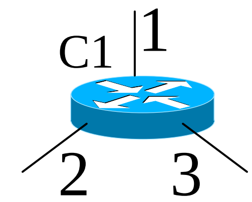
6. Summary

Introduction

1. DiffServ aware multicast services
   a. Class of service heterogeneity for different group members
   b. Handling QoS states at core routers
2. Tree construction strategy
   a. Hybrid tree: One tree per group for all QoS classes
   b. Separate trees: One tree per *QoS* class
3. An example — The *QUASIMODO* scheme

QUASIMODO





S	G	*iif*	*oif*	*DSCP*
S	G	1	2	QC1
			3	QC2

Multicast forwarding table structure

What are the issues?

1. QoS states need to be maintained at core routers for splitting traffic to heterogeneous end users

2. Current structure of forwarding table must be extended for embedding DSCPs at core routers

3. Both multicast routing protocol (PIM-SM) and IGMP need to be modified for carrying QoS requirements from individual group members

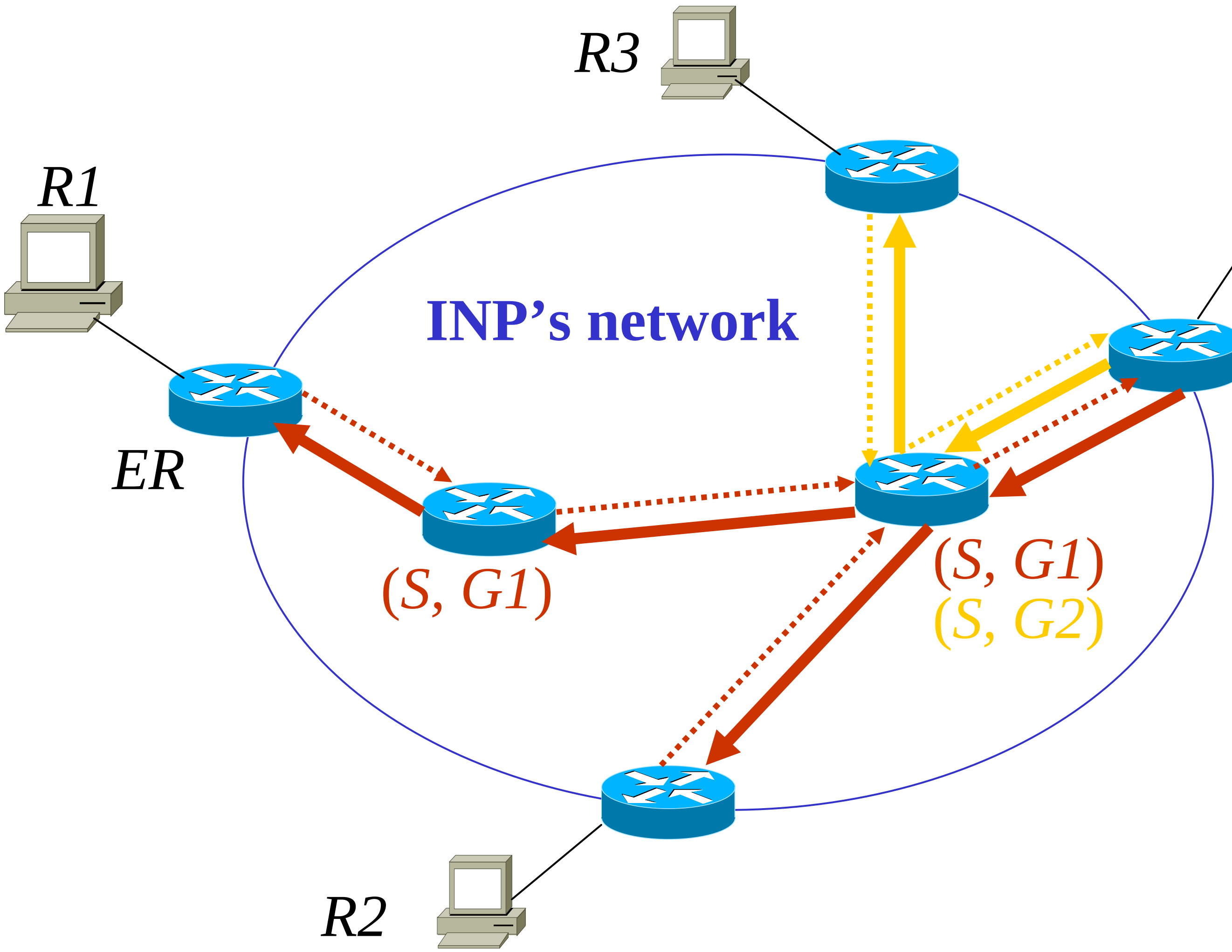
SSM Review

1. Each multicast group is associated with a single source
2. Group addresses in range of 232.0.0.0/8
3. Designated Routers (DRs) send direct group join requests towards the specific source without passing the RP
4. Advantages:
    - Scalability in inter-domain multicast address allocation
    - No need for inter-domain source discovery using MSDP
    - Efficient group management compared to IP multicast

QSSM Overview

1. Based on Source Specific Multicast (SSM) Model
2. Group addresses (in range of 232.0.0.0/8) is used to encode a set of unified QoS class by the INP
3. Heterogeneous group members express their desired QoS class by selecting different SSM addresses
4. Multicast delivery tree is both source specific and QoS class specific, decided by source and group address respectively
5. Need a mapping table at ingress routers for translation between an SSM group address and DSCP value

QSSM Example



G	DSCP
G1	QC1
G2	QC2
…	…

Tackling Scalability

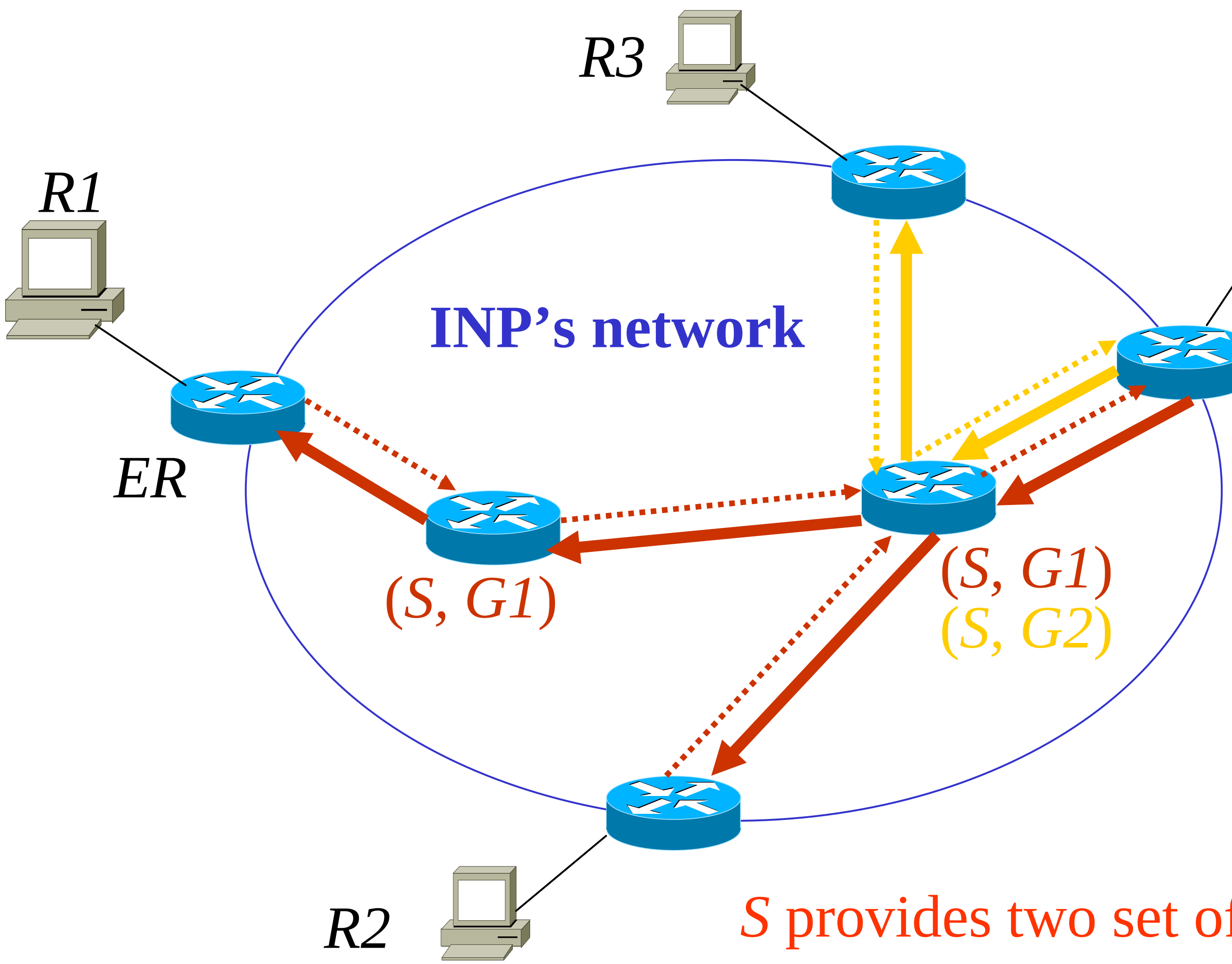
Scalability problem: One multicast source can only send a single set of content, which is in contrast to SSM!

S	IP address of the multicast source
G	Group address mapped to a *specific* QC

Proposal: To "reserve" multiple group addresses to be mapped to a single QC

Group Address	***QoS Class***
G1 – G5	*QC1*
G6 –G10	*QC2*
…	…

QSSM Example



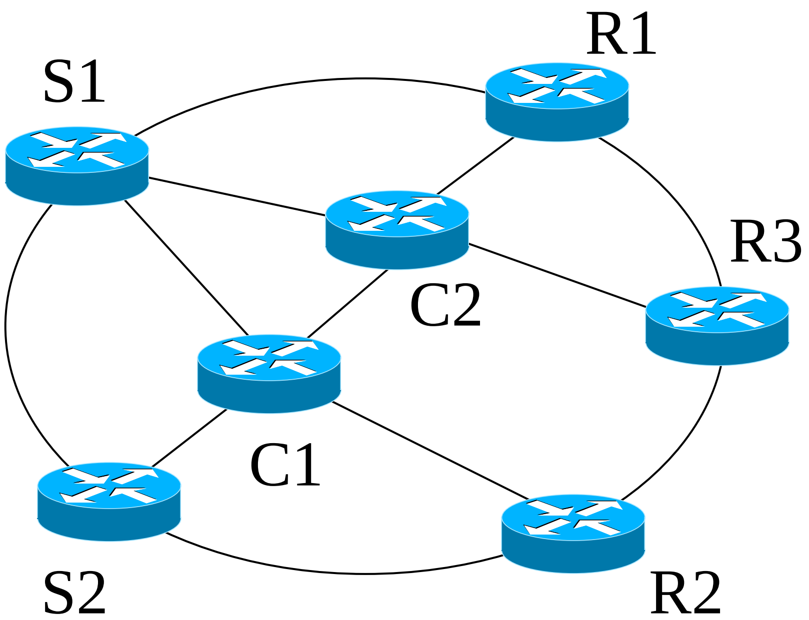
G	*DSCP*
G1 – G5	*QC1*
G2 – G10	*QC2*
…	…

S provides two set of contents now!

All receivers using the same QC (QC1)

Experiment Results

Topology



Ns-2 Simulator

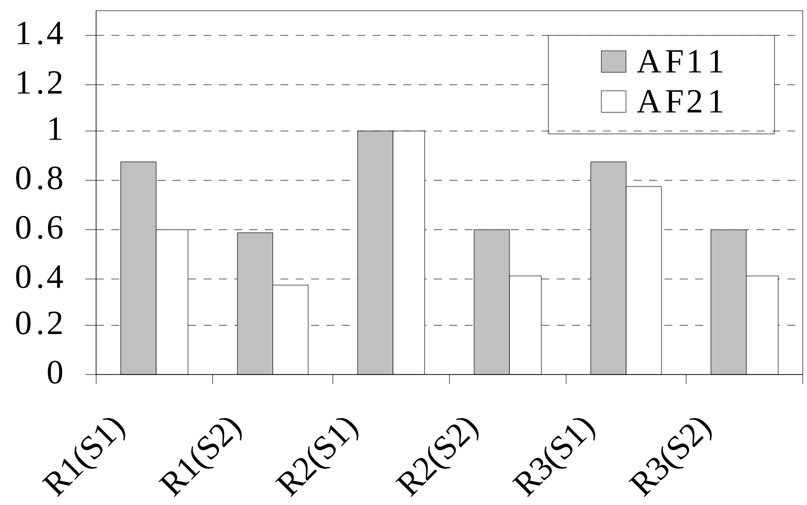
Link capacity: 10Mbps

3Mbps background traffic from S*m* to R*n*

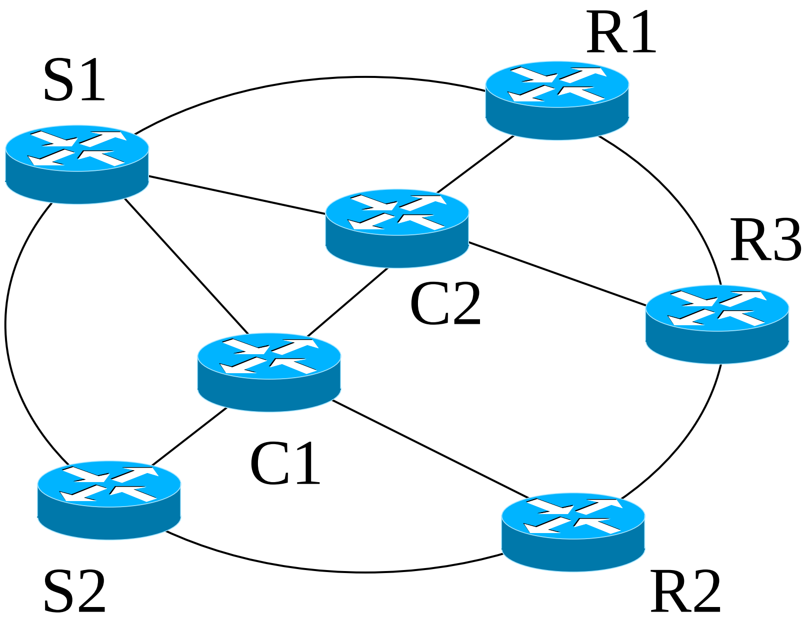
Source rate: S1→2Mbps (AF11,AF21),

S2→1Mbps (AF11, AF21)

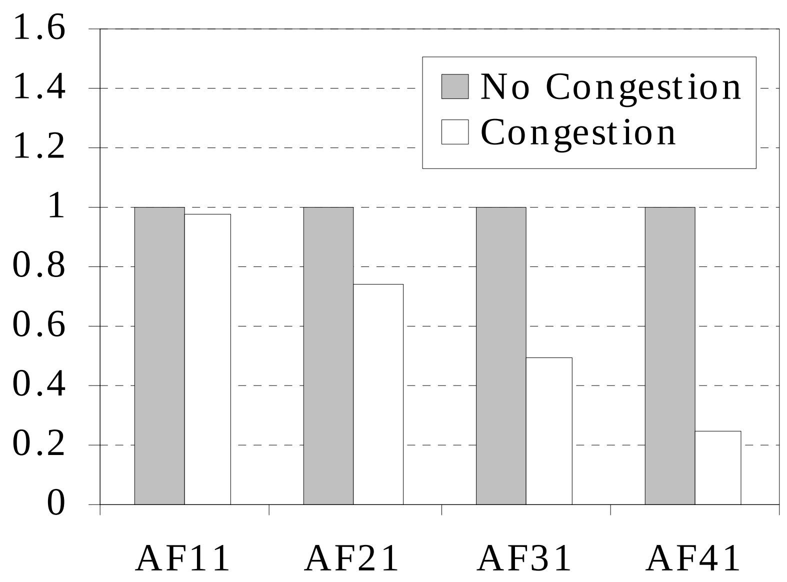
R1, R2, R3 join S1, S2 for AF11, AF21



Topology



Source rate: S2→1Mbps (4 AF traffics),
4 members attached to R1 join S2
for AF11, AF21, AF31, AF41
To introduce congestion:
3Mbps background traffic from S*m* to R*n*



Pros and Cons

Pros:

- Scalable, achieve QoS statelessness at core networks
- No traffic conditioning and DSCP remarking at cores
- No fairness problems in QoS delivery to heterogeneous receivers by using separate trees

Cons:

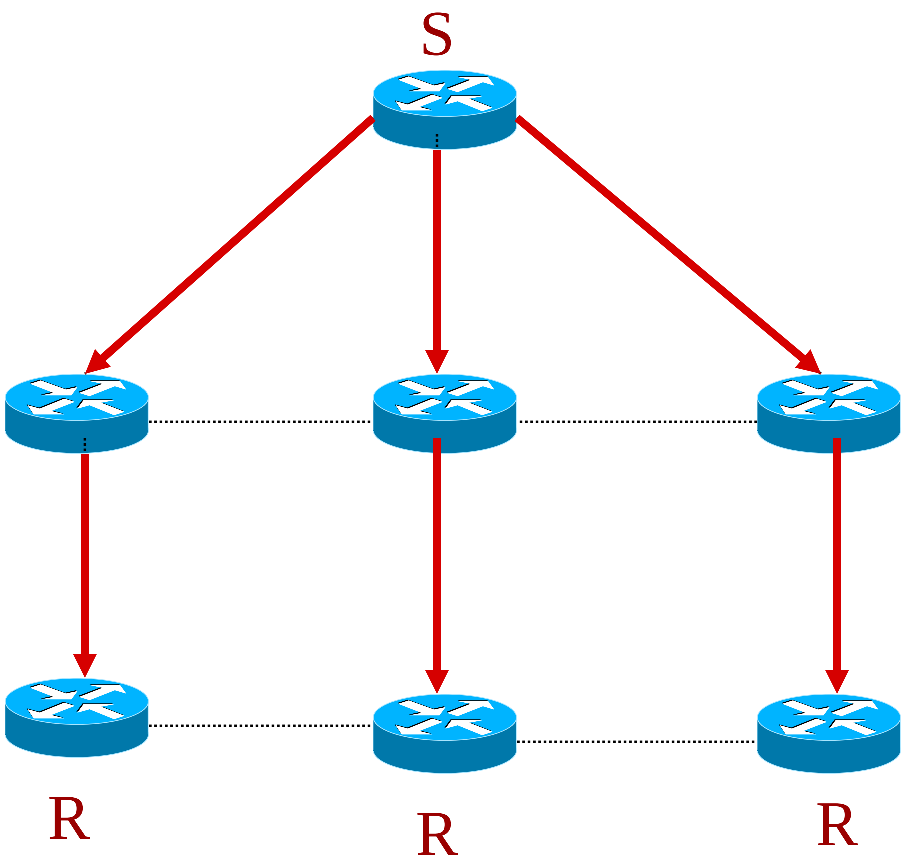
- One source cannot be involved in multiple sessions
- Need higher bandwidth consumption and group state overhead for independent tree maintenance.

MPLS-free Multicast Traffic Engineering

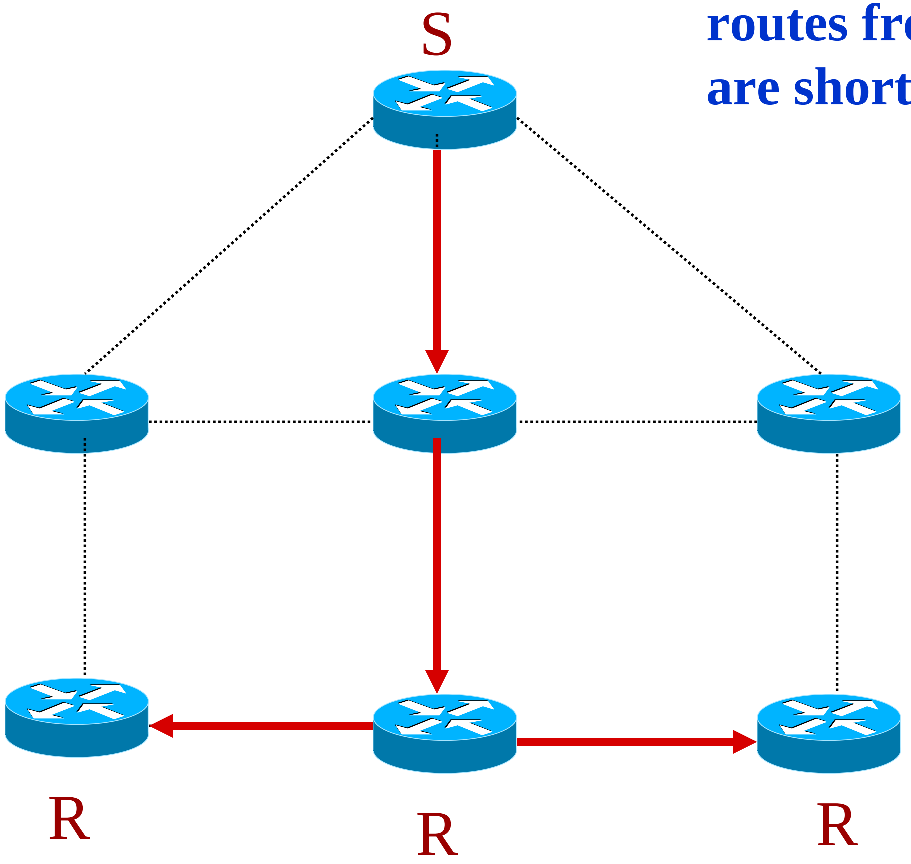
- **Objectives**
  - **To enhance the network service availability to-external multicast groups while optimizing bandwidth consumption within the network**
- **Current common practice**
  - **Apply Steiner tree based schemes to MPLS explicit routing**
- **Shortcomings**
  1. **Overhead in maintaining (point-to-multipoint) LSP states within the network**
  2. **Difficult to aggregate multicast traffic from different groups**

MPLS-free Multicast Traffic Engineering

- Conventional shortest path routing with hop-counts: 6 units of bandwidth consumed



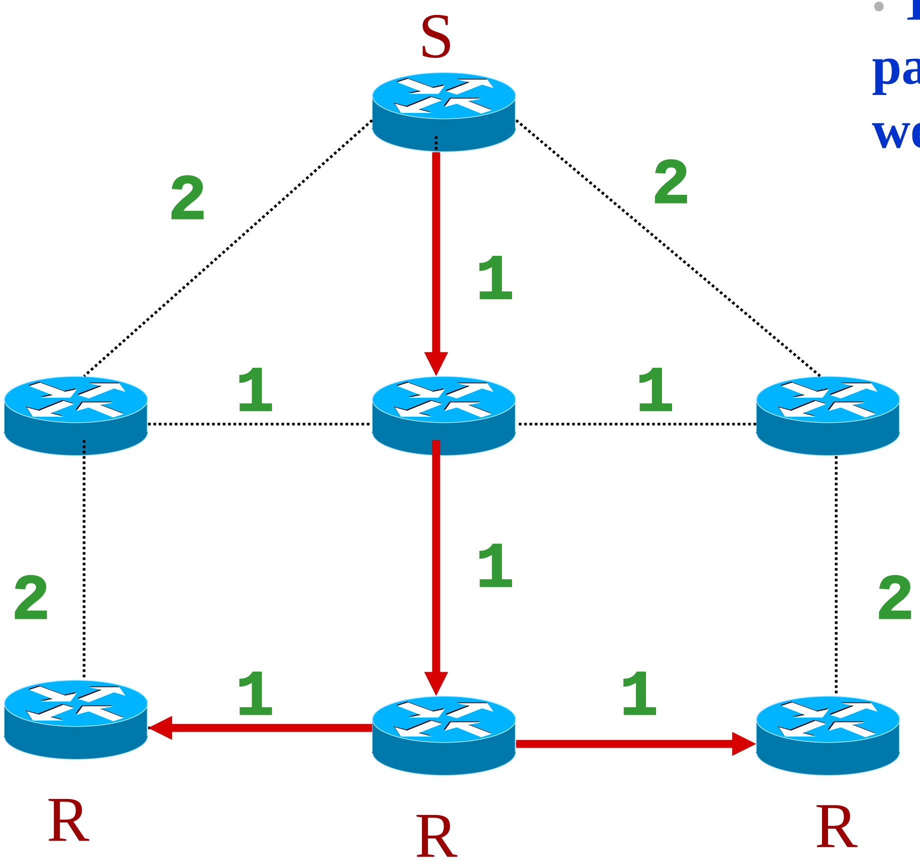
MPLS-free Multicast Traffic Engineering



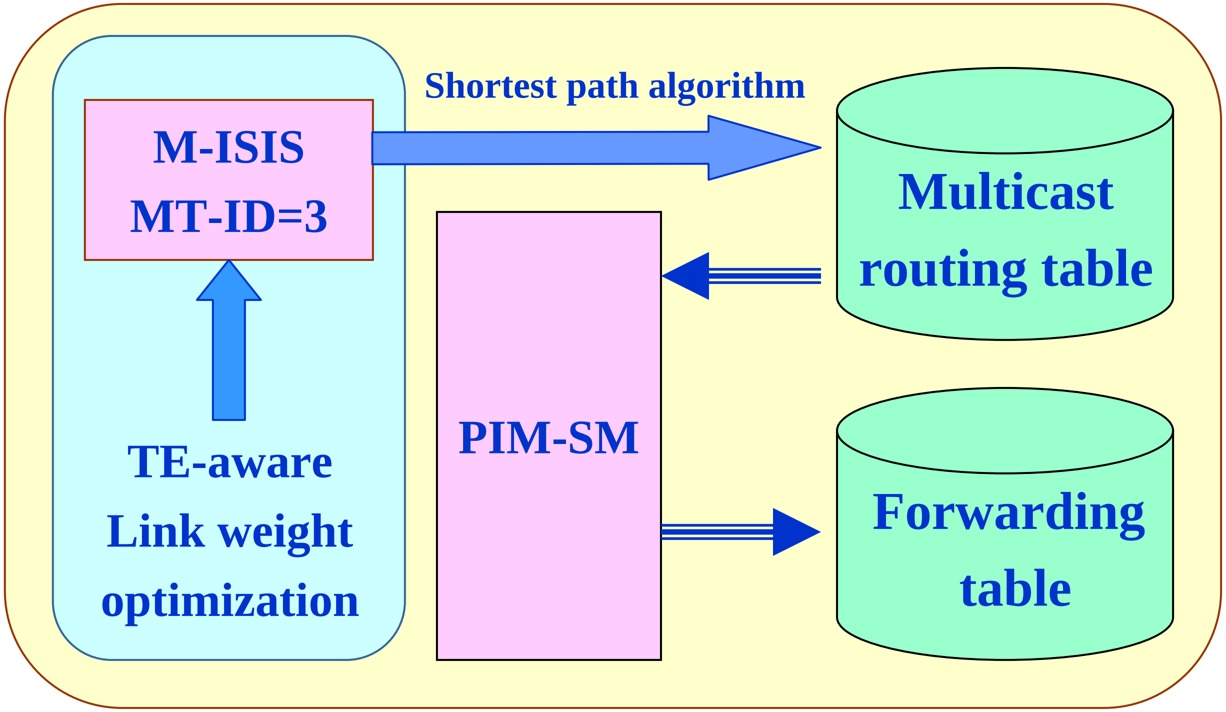
- **Optimal Steiner tree routing: 4 units of bandwidth consumed**
- **Need MPLS support as not all the routes from the source to the receivers are shortest paths!**

MPLS-free Multicast Traffic Engineering

- Same TE effects can be achieved by setting proper link weights
- The on-tree paths are all shortest paths with respect to this set of link weights



MPLS-free Multicast Traffic Engineering



1. Offline configuration of TE-aware link weight
2. IP router computes multicast RIB based on the configured link weights
3. PIM-SM uses the populated M-RIB for deciding the NEXT-HOP of a join request
4. Update *iif* and *oif* list

Multi-topology IGP (e.g., M-ISIS) is used for avoiding routing dependency on unicast traffic, as MT-ID of 3 is dedicated for routing multicast flows

Q&As

Thank you!