*R*oute-*O*ptimized NAT *T*raversal Approach for LISP *M*obile Node (ROTAM)

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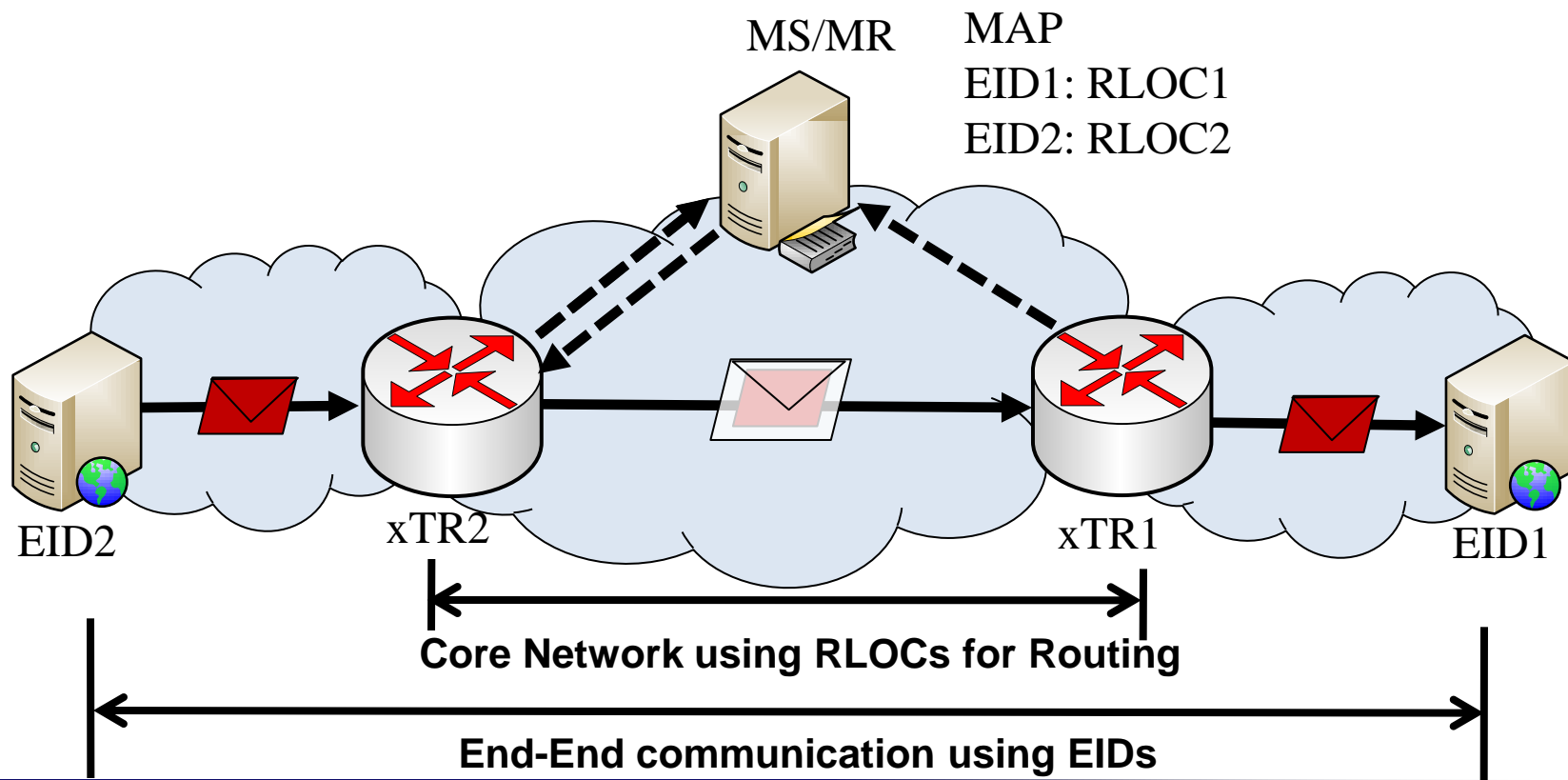
2012/3/6

World Telecommunications Congress 2012

Overview

- Introduction
    - LISP
    - LISP Mobile Node
- The NAT Traversal Issue of LISP
- Related Research
- Proposed Approach
    - ROTAM
    - Modification Points
    - The Main Difference between NTR and ROTAM
- Discussion
    - Delay Comparison with NTR
   - Overall Comparison with NTR
- Summary

- LISP(Locator/ID Separation Protocol)

  - Separate IP addresses into Endpoint Identifiers (EID) and Routing Locators (RLOC)

  - Originally proposed to solve routing table explosion problem

  - IETF standardization in progress

MS/MR

MAP
EID1: RLOC1
EID2: RLOC2

EID2   xTR2   xTR1   EID1

Core Network using RLOCs for Routing

End-End communication using EIDs

LISP Mobile Node

- MN(Mobile Node) architecture is proposed to allow roaming while keeping TCP connections alive

- MN is a lightweight xTR for itself
    - A MN has both RLOC and EID address
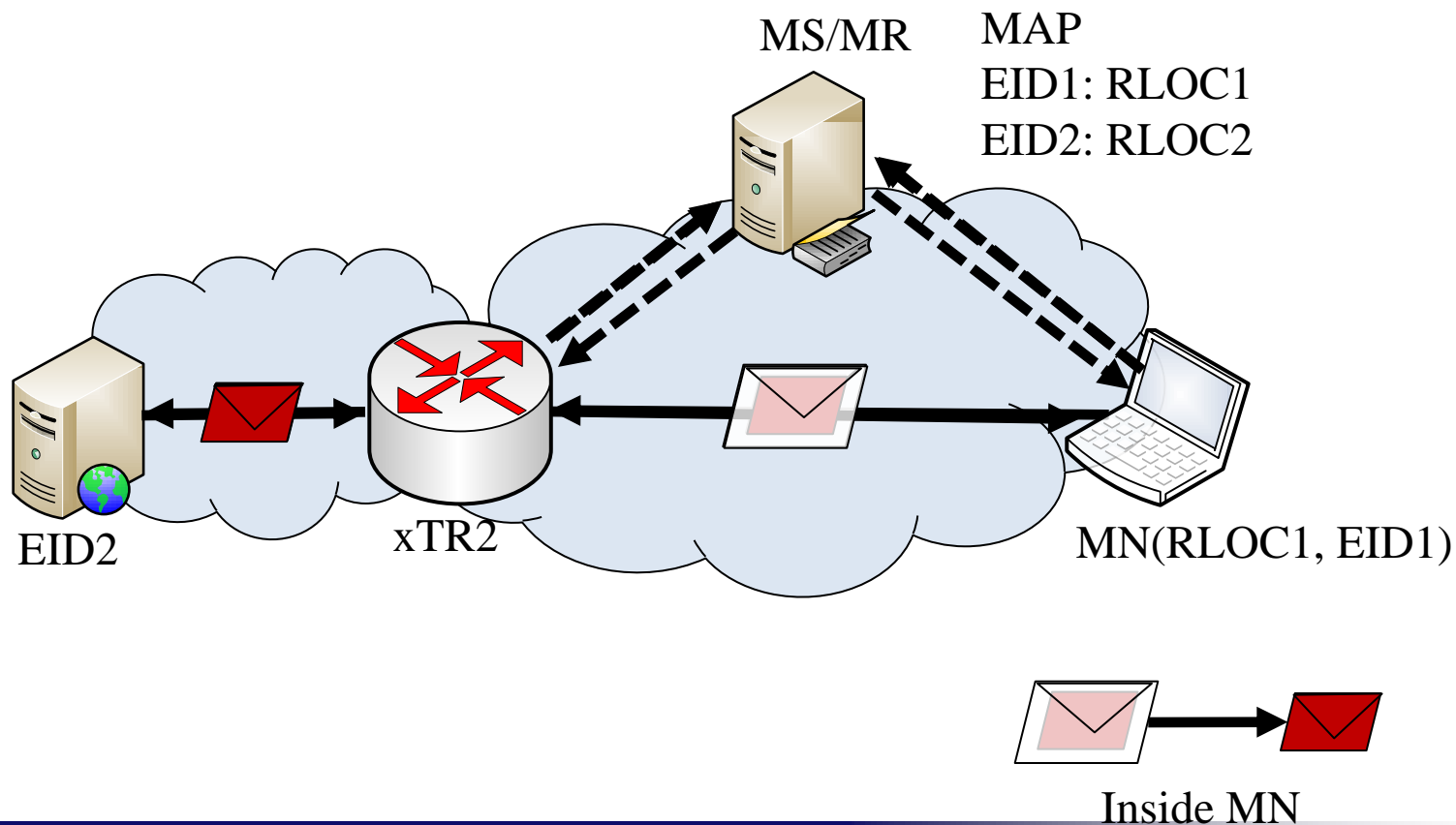
The NAT Traversal Issue of LISP

- Mobile Node(MN) has a private IP(RLOC) address
- The destination address of LISP Data Packets is always 4341

MS/MR   MAP
EID2: RLOC2

?

EID2   xTR2   NAT   MN(RLOC1, EID1)
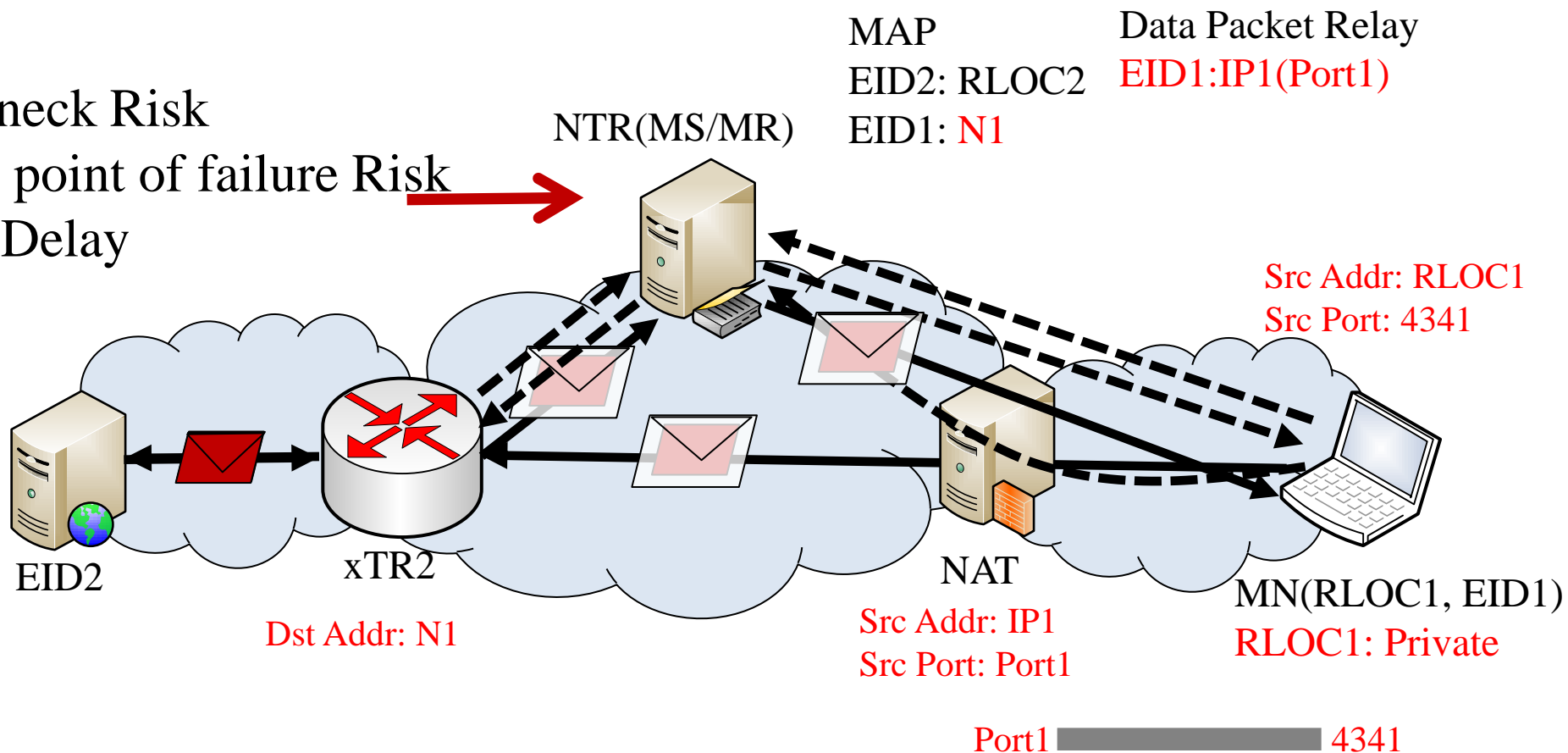RLOC1: Private
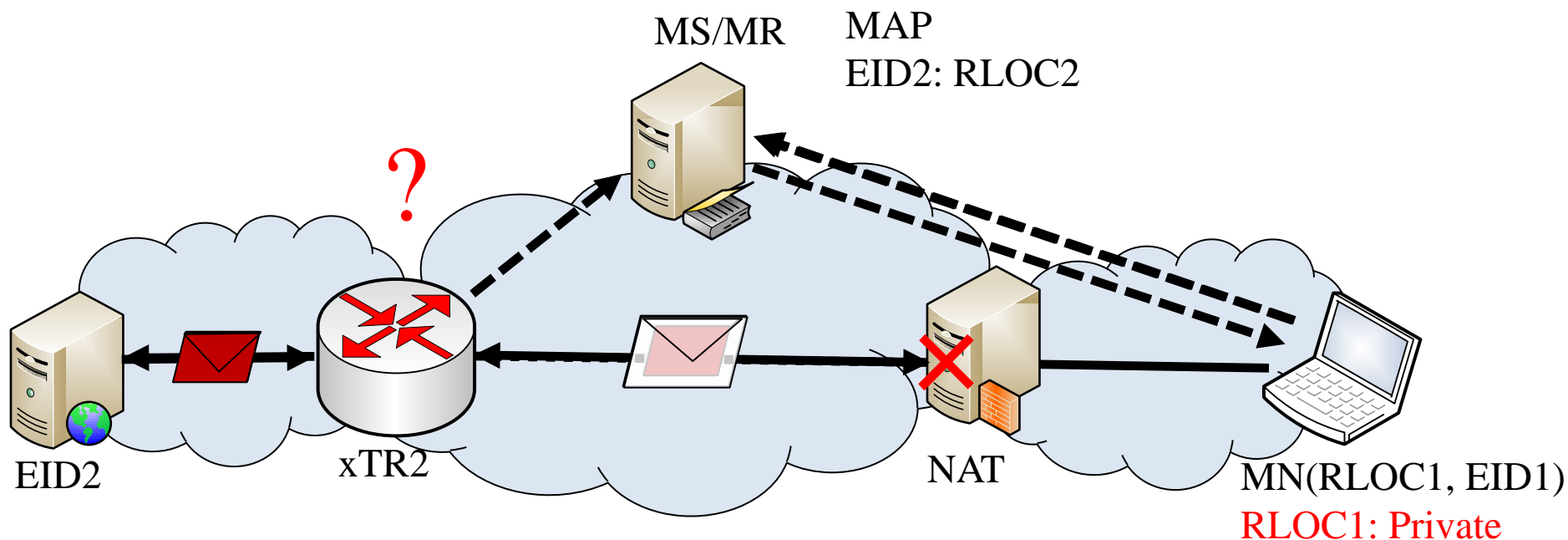
Centralized Solution

- Open a port at the NAT device that corresponds to 4341 of the inside MN
- NTR acts as a proxy and relays data traffic

Bottleneck Risk
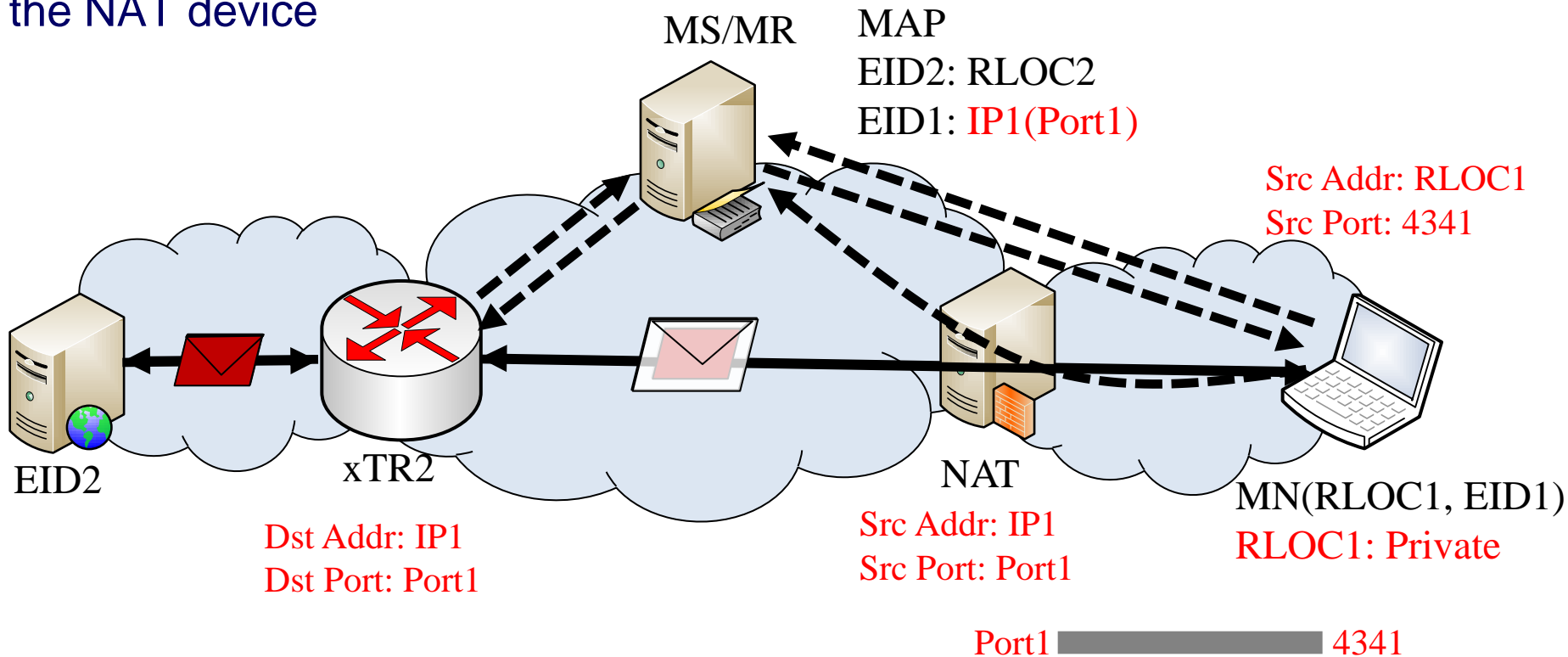Single point of failure Risk
Large Delay

MAP
EID2: RLOC2
EID1: N1

Data Packet Relay
EID1:IP1(Port1)

NTR(MS/MR)

Src Addr: RLOC1
Src Port: 4341

EID2

xTR2

NAT

MN(RLOC1, EID1)
RLOC1: Private

Dst Addr: N1

Src Addr: IP1
Src Port: Port1

Port1 ▬▬▬▬▬ 4341

Proposed Solution (ROTAM)

- ## Decentralized Proposal

  - Open a port at the NAT device that correspond to 4341 of the MN

  - MS/MR Informs(e.g., xTR2) the IP address and the opened port of the NAT device

  - Leveraging xTR capabilities. xTRs send data packets to the opened port of the NAT device

MS/MR

MAP
EID2: RLOC2
EID1: IP1(Port1)

Src Addr: RLOC1
Src Port: 4341

EID2

xTR2

NAT

MN(RLOC1, EID1)
RLOC1: Private

Dst Addr: IP1
Dst Port: Port1

Src Addr: IP1
Src Port: Port1

Port1 � 4341

- **MN**
  - Open a port at the NAT device that corresponds to 4341 of the inside MN
    - Use source port of 4341 to send Map-Register message

- **MS/MR**
  - Detect the opened port and the IP address of the NAT device
    - In case the source port of the received Map-Register message is not 4341(Changed by the NAT device)
  - Reply with the detected IP address as RLOC in case of Map-Request regarding the inside MN
    - Store the detected port to unused fileds of the Map-Reply message

- **xTR**
  - A xTR that receives a RLOC together with a port number must send LISP data packets not to 4341 but to the designated port
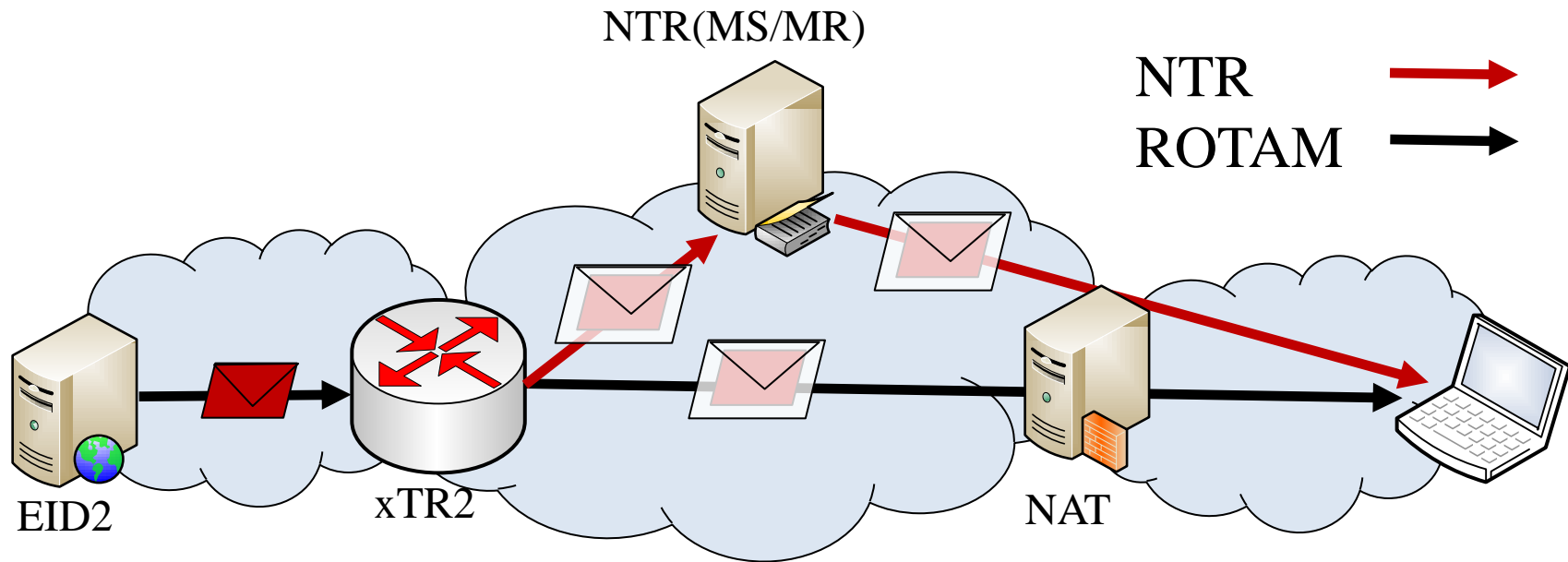
The Main Difference between NTR and ROTAM

- NTR
 - NTR relays data packets
- ROTAM
  - The xTR sends data packets directly

NTR(MS/MR)

NTR →
ROTAM →

EID2   xTR2   NAT

- ## ROTAM: Full-cone NAT only
  - ### Server 1: MS/MR
  - ### Server 2: xTR2
- ## NTR: All kinds of NAT types
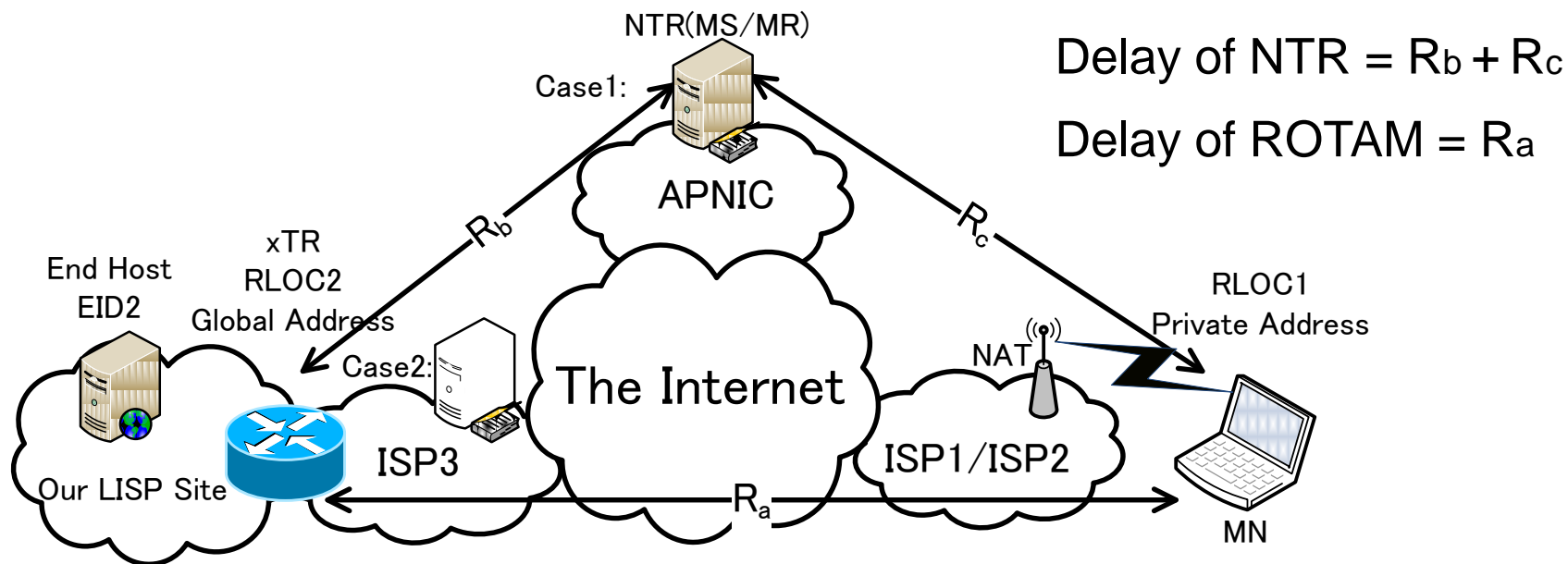 - ### Server 1: MS/MR
  - ### Server 2: NTR(MS/MR)

NAT Types
Full-cone NAT
Address-restricted cone NAT
Port-restricted cone NAT
Symmetric NAT

Address-restricted cone NAT
Port-restricted cone NAT
Symmetric NAT
Full-cone NAT

NAT

Client

Server 1

Sever 2
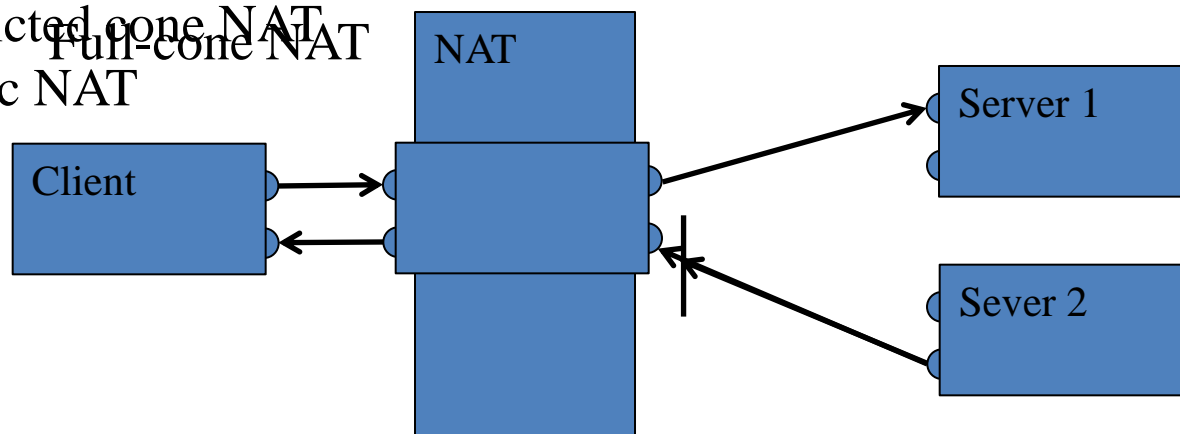
- ROTAM avoids triangle data packets delivery, thus reduces delay

$$\text{Delay of NTR} = R_b + R_c$$

$$\text{Delay of ROTAM} = R_a$$

		NTR	ROTAM	Diff
Case 1 (APNIC NTR)	ISP1	176.7 ms	7.0 ms	169.7 ms
	ISP2	176.9 ms	5.4 ms	171.5 ms
Case 2 (ISP3 NTR)	ISP1	7.9 ms	6.1 ms	1.8 ms
	ISP2	6.3 ms	4.8 ms	1.5 ms

Overall Comparison with NTR

NAT Traverse Solutions	NTR	ROTAM
Bottleneck Risk	×	○
Single Point of Failure Risk	×	○
Delay	×	○
Effective NAT Types	○	△

○ Advantage
△ Minor Disadvantage
× Disadvantage

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Summary
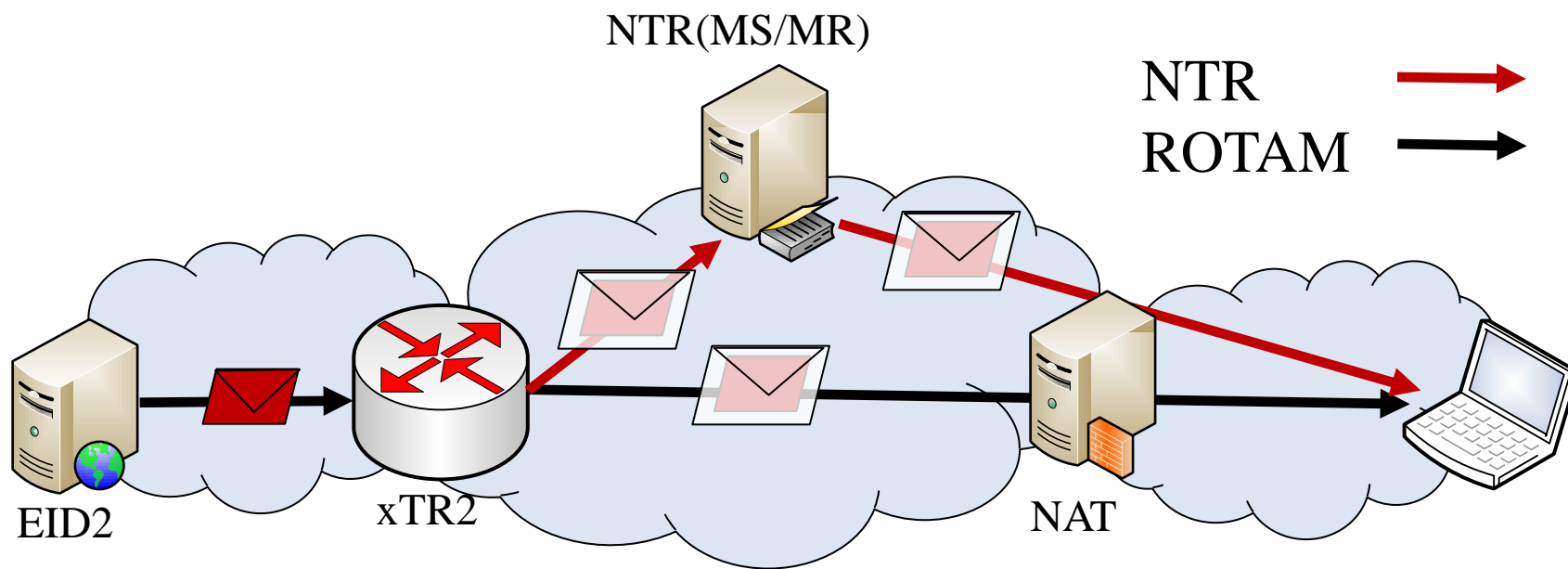
- *Route-Optimized NAT Traversal Approach* for LISP *Mobile* Node (ROTAM) proposed
  - Decentralized approach which leverages xTR capability
  - Pros: No bottleneck rick, no single point of failure risk and less delay
  - Cons: Only effective to Full-cone NAT
- Future work
  - A hybrid approach of ROTAM and NTR that has both advantages