Evaluating and Improving Alternative Multicast Solutions: CastGate and CastGate with PIM-SM

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Agenda

I. Introduction

II. CastGate

III. Improving CastGate

IV. Evaluating CastGate

V. Conclusion

I. Introduction

Introduction

- Multimedia content streaming – **MULTICAST**
- Native multicast creates distribution trees:
  - PIM (Protocol Independent Multicast)
  - DVMRP, MOSPF, CBT
- Lack of multicast deployment:
  - technical reasons (high complexity)
  - marketing reasons (no customers)
- AGCS – Alternative Group Communication Service
  - tunneling (CastGate)
  - overlay multicasting (Narada)
  - group specific routing services (Xcast)

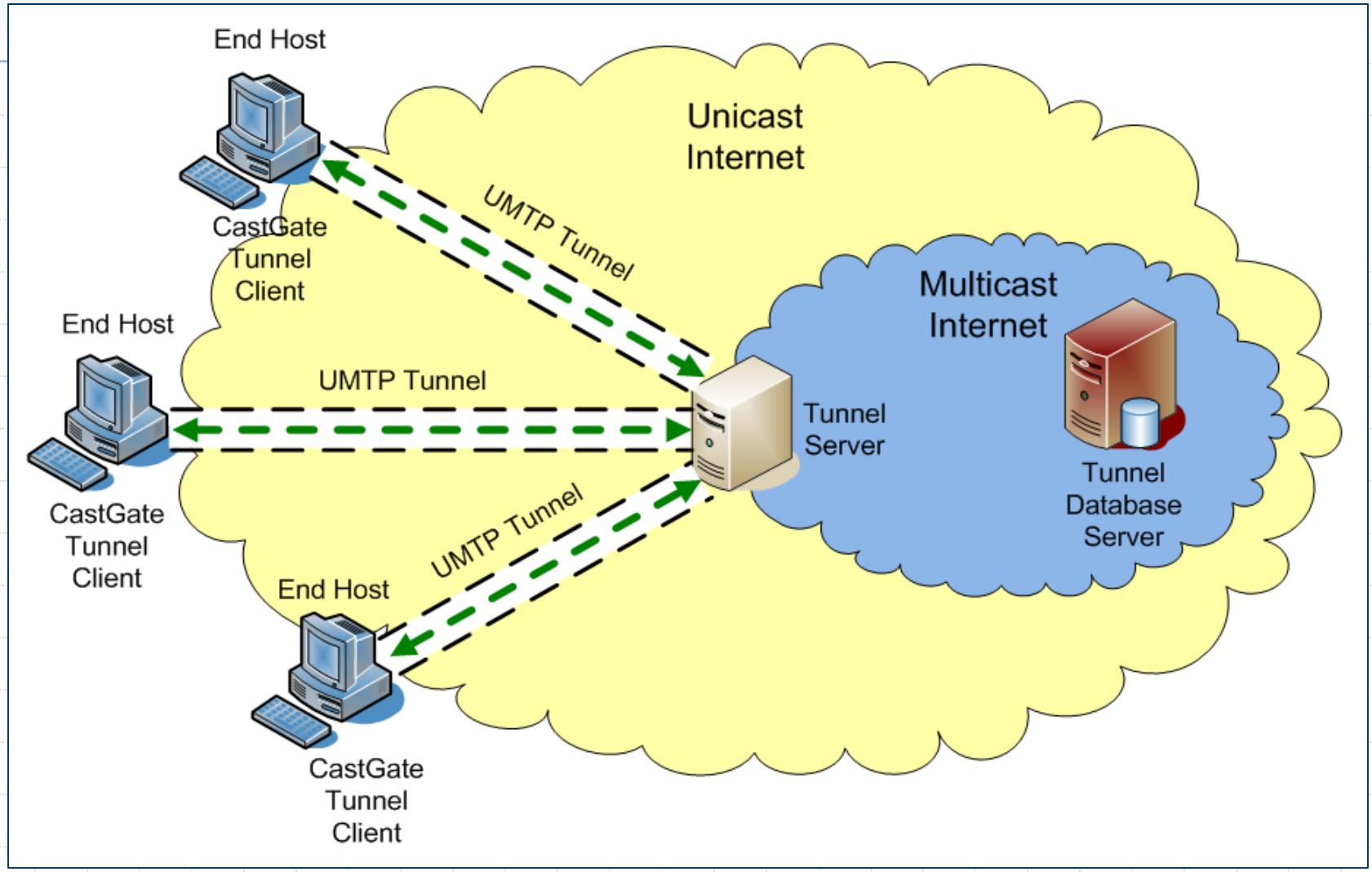
II. CastGate

- CastGate Client
- CastGate Router
- CastGuide and CastContent

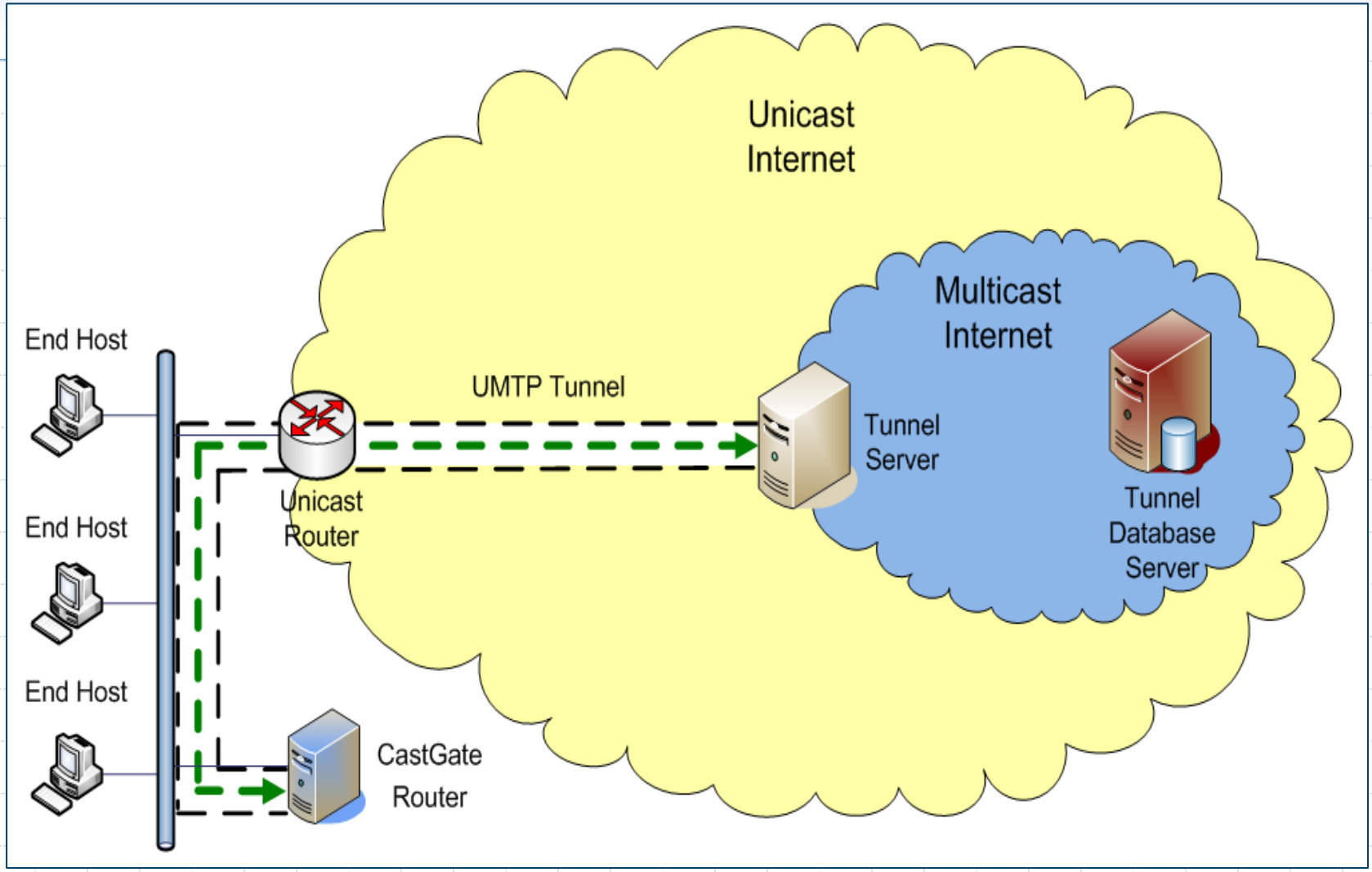
CastGate

- Developed by ETRO department from VUB
- Provides access to multicast through auto-tunneling
- Transition technology – increase the number of multicast users
- Enhanced UMTP (UDP Multicast Tunneling Protocol)
- Supports HTTP tunneling
- Basic architecture:
  - CastGate Tunnel Client
  - CastGate Tunnel Server
  - CastGate Tunnel Database Server

CastGate Client



CastGate Router



CastGate

- Support for AAA
  - Tunnel Server + RADIUS
- CastGuide session directory tool
- CastContent
  - CastLive
  - CastCOD for Content-On-Demand

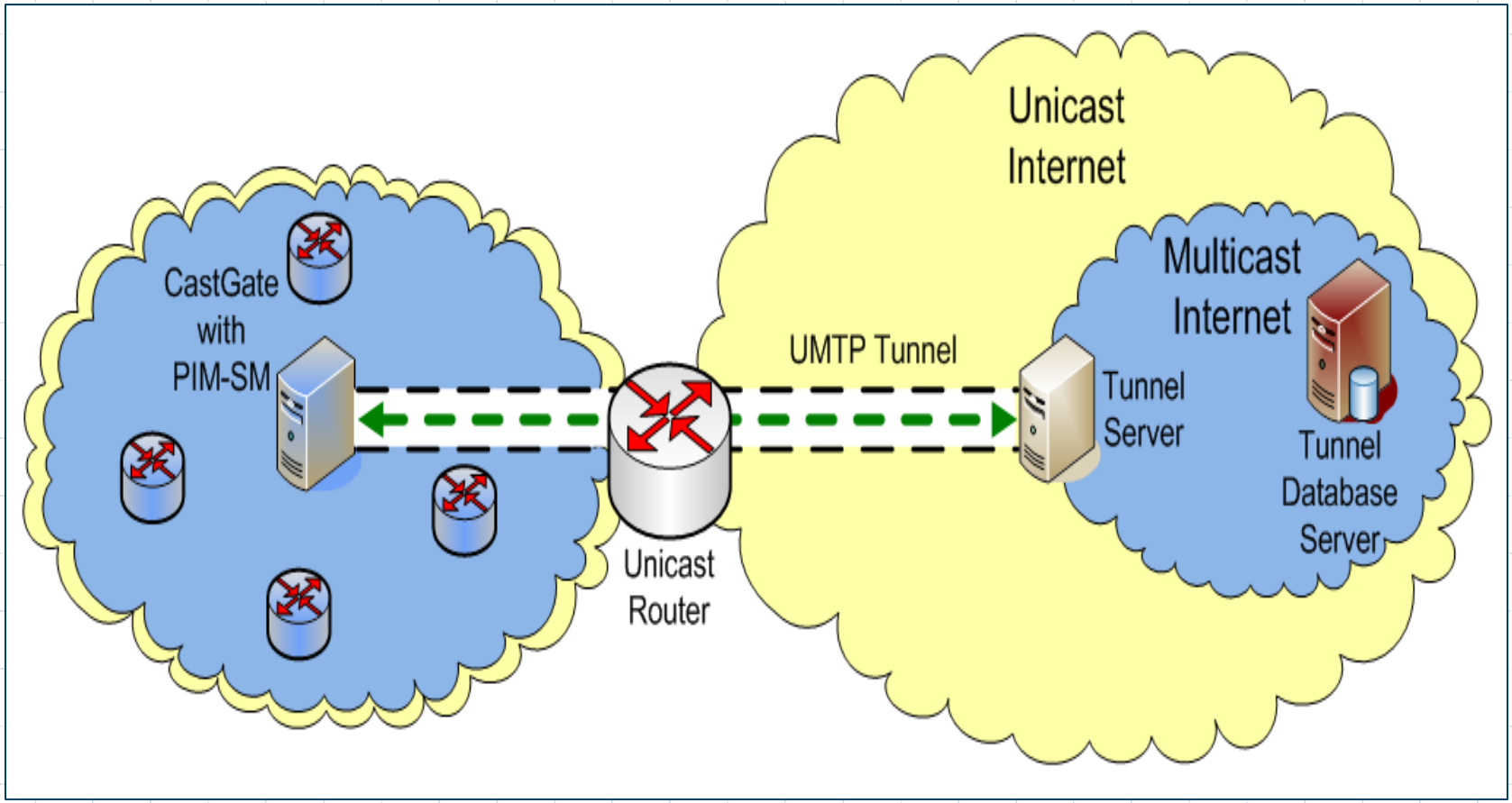
III. Improving CastGate

- CastGate with PIM-SM

CastGate with PIM-SM

- Provide multicast access – **entire local domain**
- Local domain = group of networks with multicast capabilities (multicast routing protocol), no global multicast access
- PIM-SM (Sparse Mode)
  - shared root RP (Rendezvous Point)
- RP-on-a-stick a single PIM-SM interface
  - incoming interface of (S, G) entry
  - outgoing interface on the shared tree for group G
- CastGate Router + partial PIM-SM functionality

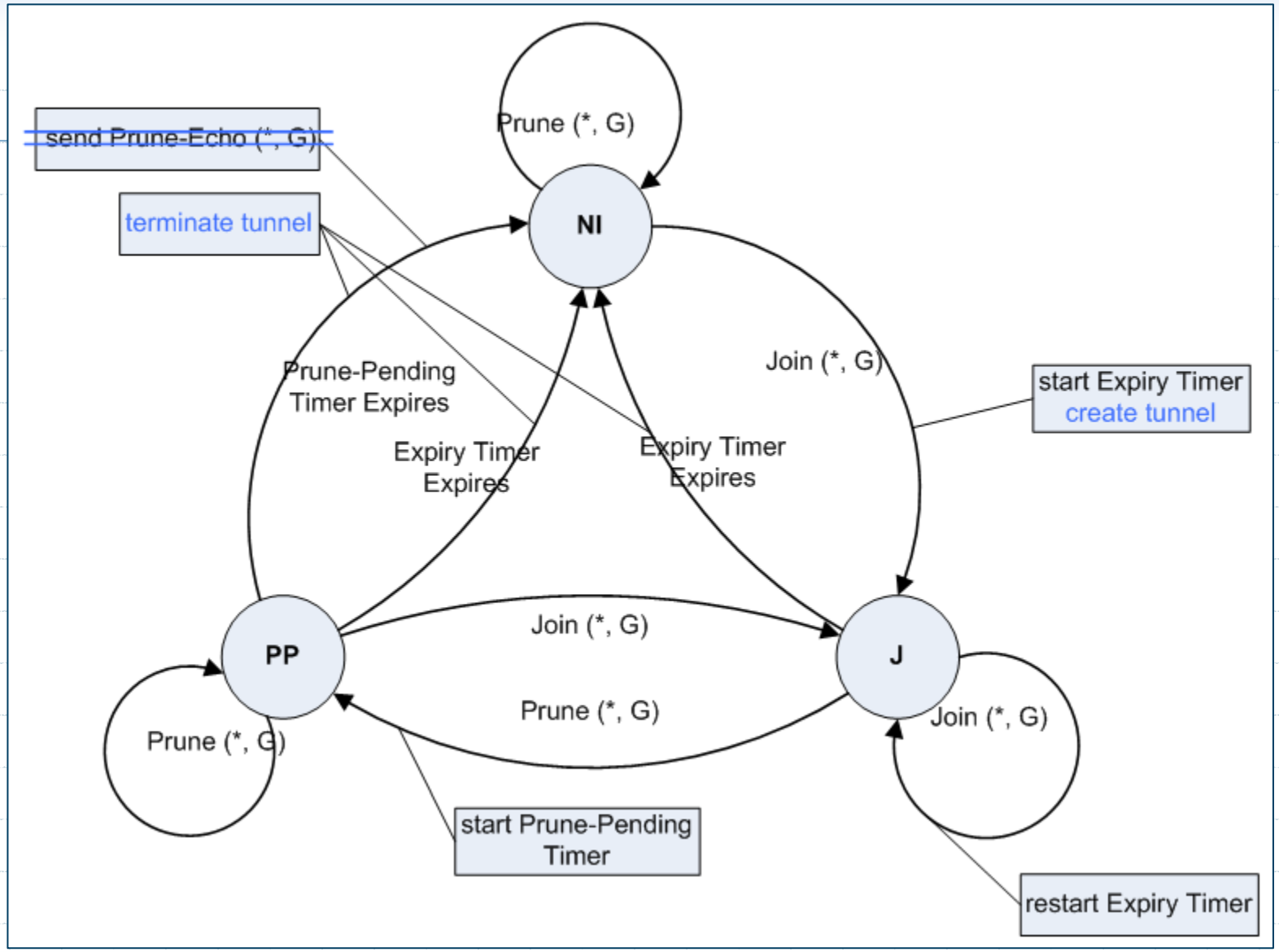
CastGate with PIM-SM



Receiving multicast

- PIM-SM module:
  - capture messages destined to RP
  - Join/Prune (*, G) messages
  - “join” group G through the tunnel
  - modified version of downstream per-interface (*, G) state machine from PIM-SM protocol specification
- Machine states:
  - NoInfo (NI)
  - Join (J)
  - Prune-Pending (PP)

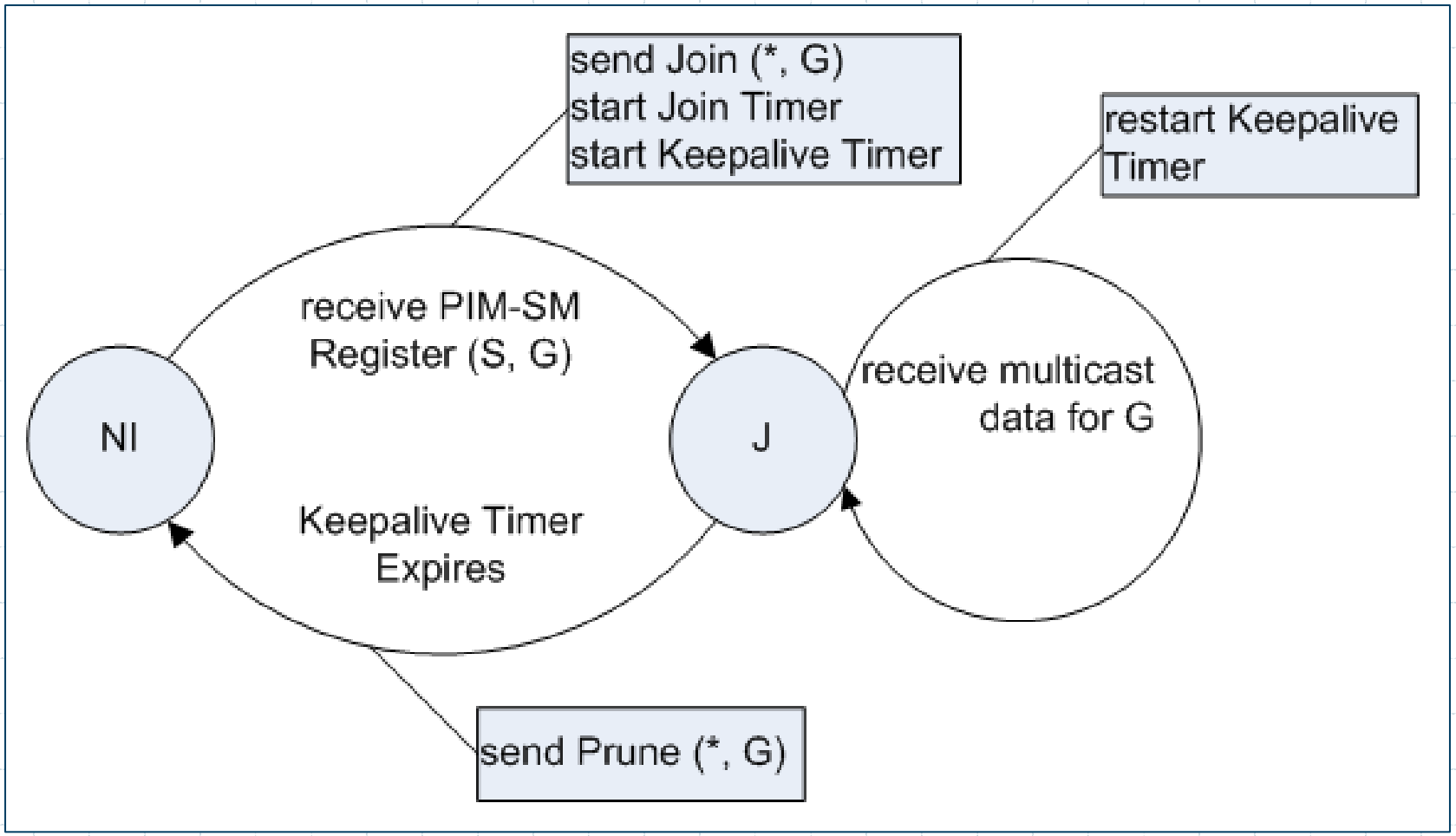
Receiving multicast



Sending multicast

- PIM-SM module:
  - capture PIM Register messages, (S, G) information
  - discard Null-Register messages
  - send Hello messages **!! DR election !!**
  - send Join (*, G) messages
  - state machine for forwarding multicast traffic through tunnel
- Machine states:
  - NoInfo (NI)
  - Join (J)

Sending multicast



IV. Evaluating CastGate

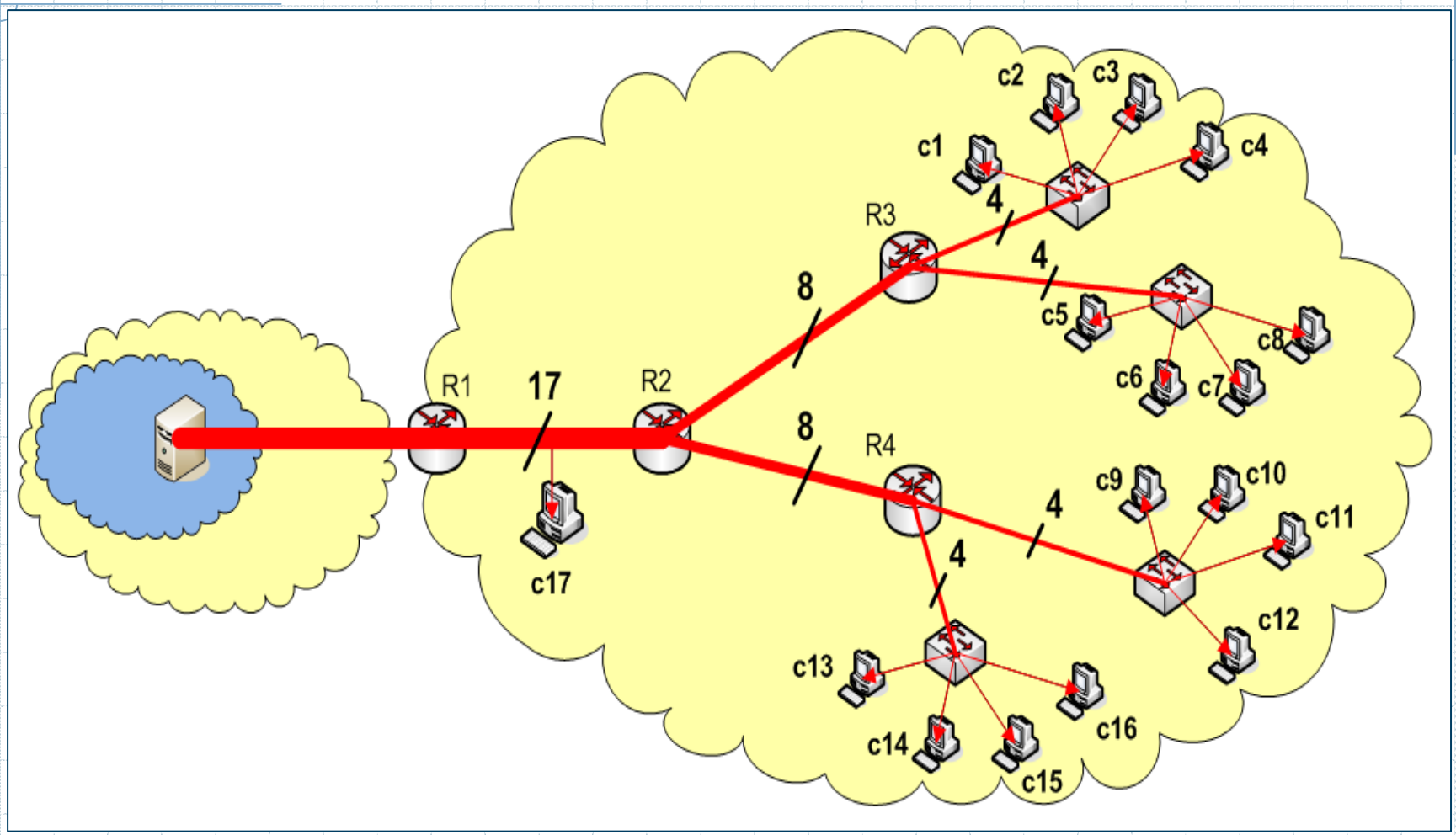
- CastGate Client
- CastGate Router
- CastGate with PIM-SM
- Native multicast

Evaluating CastGate

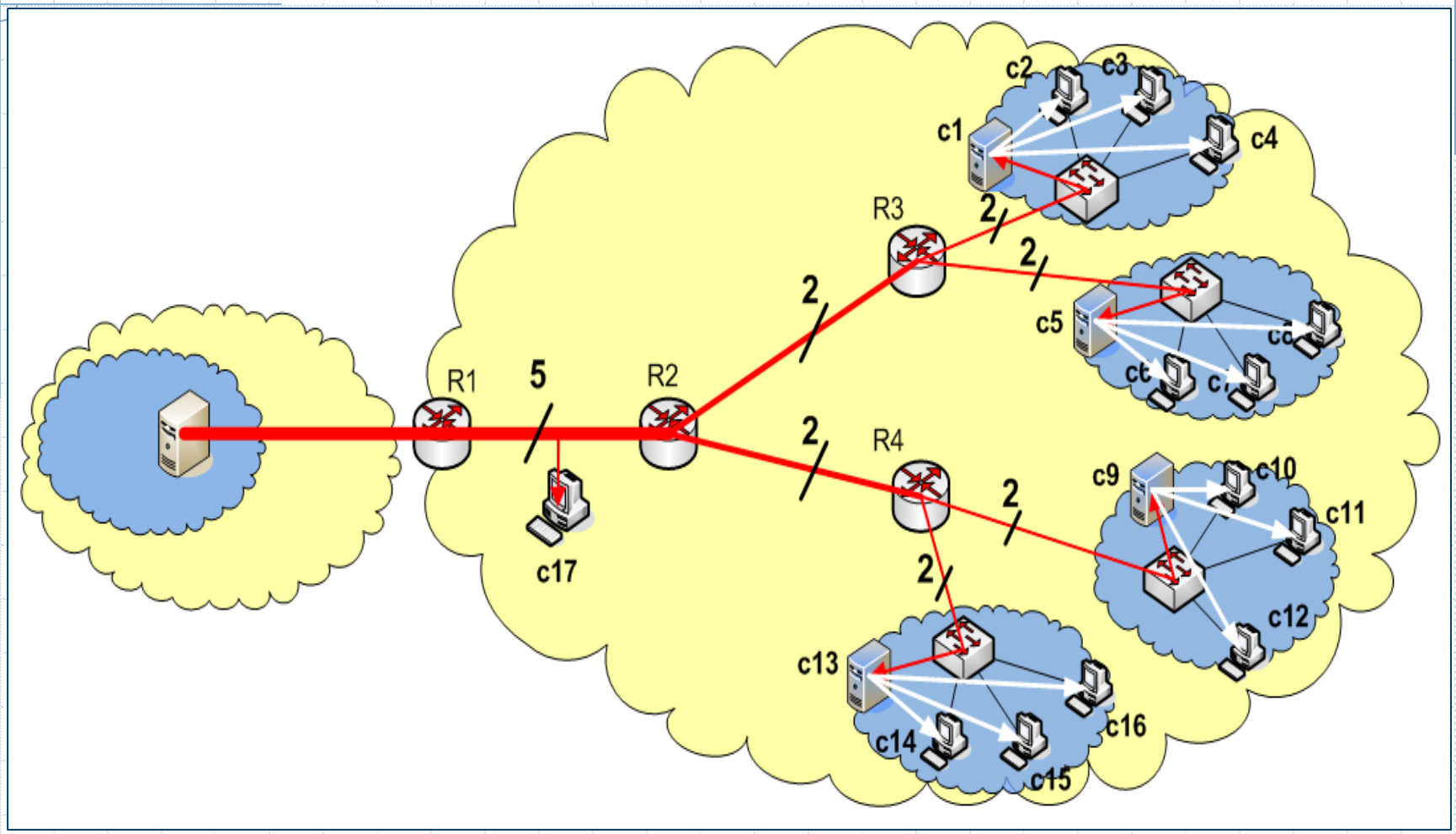
- Metrics:
  - **stress** – for multicast value is 1
  - **resource usage:** $$R = \sum_{i=1}^{L} d_i * s_i$$

    $\mathbf{d_i}$ delay of link i, $\mathbf{s_i}$ stress of link i, **L** number of links
  - **stretch** or relative delay penalty
  - control overhead
  - join latency or time to first packet
- Delay on all links has relative value of 1
- Each LAN segment is considered one link

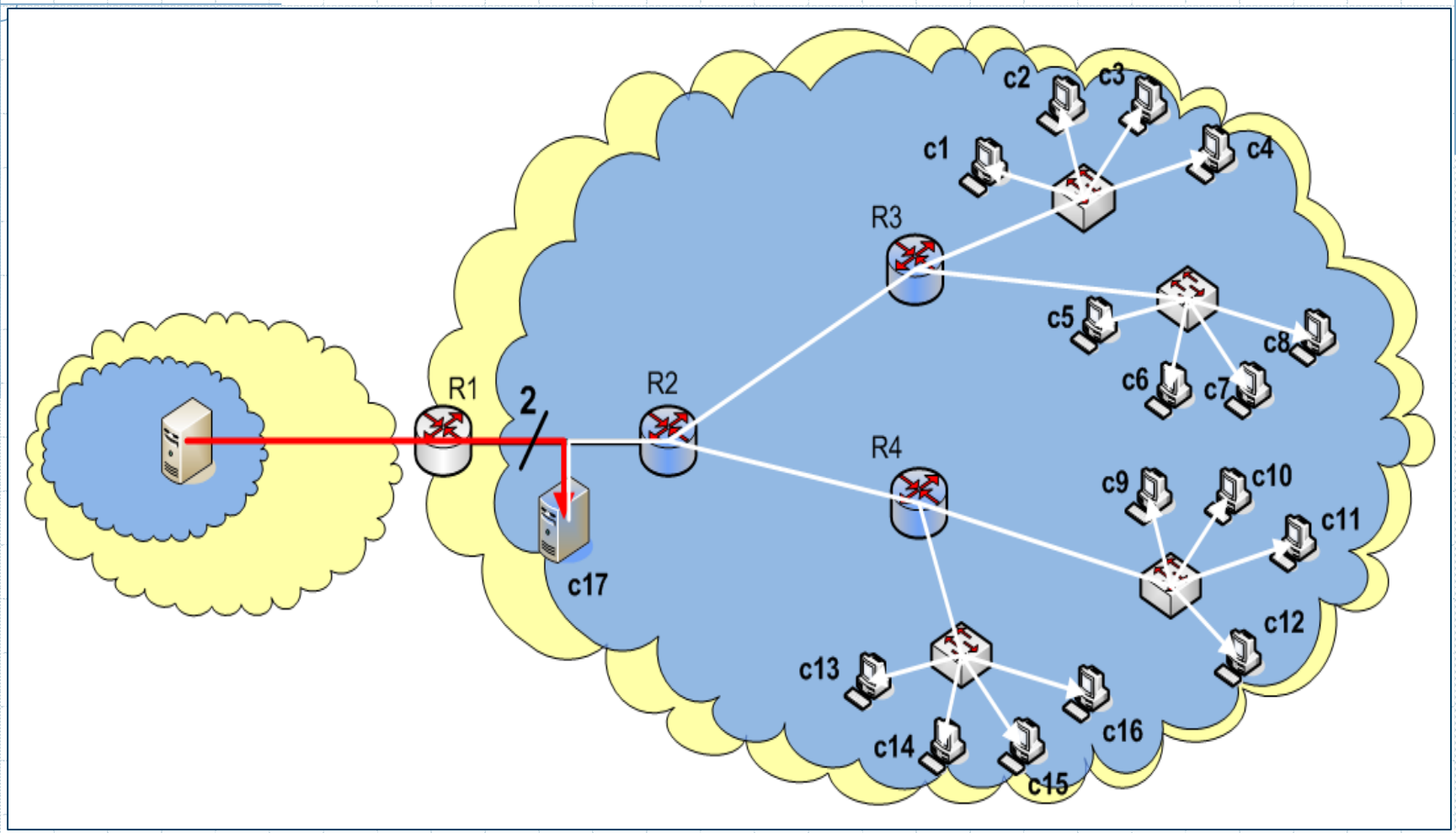
CastGate Client



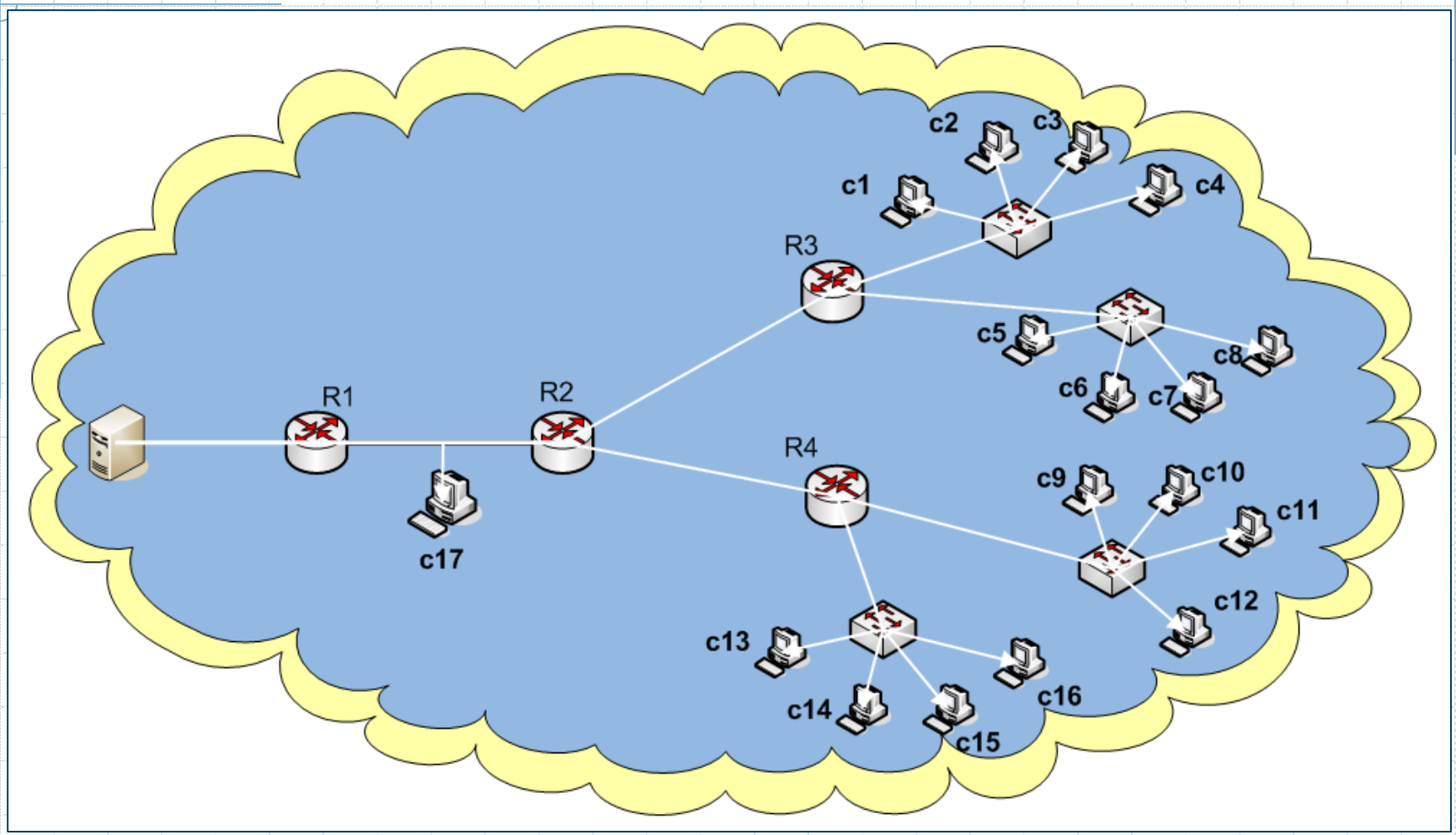
CastGate Router



CastGate with PIM-SM



Native multicast



Evaluation Results

- Stress evaluated on each link
  - R1-R2 – s1
  - R2-R3 / R2-R4 – s2/s3
  - R3-c1...c4/R3-c5...c7/R4-c8...c11/R4-c12-c16 – s4/s5/s6/s7
- Values for s1 the highest
- CastGate with PIM-SM
  - 2-8 times more efficient
  - comparable with native multicast

	STRESS			RESOURCE USAGE	STRETCH for c7
	s1	s2 / s3	s4 / s5 / s6 / s7		
CastGate Client	17	8 / 8	4 / 4 / 4 / 4	49	1
CastGate Router	5	2 / 2	2 / 2 / 2 / 2	17	1.33
CastGate with PIM-SM	2	1 / 1	1 / 1 / 1 / 1	8	1.33
Native Multicast	1	1 / 1	1 / 1 / 1 / 1	7	1

Evaluation Results

- Resource usage if $d_i = 1$: $R = \sum_{i=1}^{7} s_i$
- CastGate Client R = 17 + 8 + 8 + 4 + 4 + 4 + 4 = 49
- CastGate with PIM-SM resource usage
  - 5 times less than CastGate Client, 2 times less than CastGate Router
  - 15% more than native multicast
- Stretch determined from R1
- Higher for CastGate Router and CastGate with PIM-SM

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V. Conclusion

Conclusion

- Evaluated metrics: stress, resource usage and stretch
- CastGate with PIM-SM is more efficient
  - stress 4-8 times less
  - resource usage
    - 2-5 times less
    - more by 15% than native multicast
- Stretch higher for CastGate Router and CastGate with PIM-SM because data crosses the same link twice
- Result must be confirmed by practical experiments
  - control overhead
  - join latency
- CastGate transition solution