UNIVERSITEIT GENT

FACULTEIT INGENIEURSWETENSCHAPPEN

Management of time-shifted IPTV services through transparent proxy deployment

T. Wauters, W. Van de Meerssche, F. De Turck, B. Dhoedt, P. Demeester
T. Van Caenegem, E. Six

Outline

- **Introduction**
  - IPTV
  - access network architecture
- **Time-shifted television**
  - concept
  - caching algorithms
  - deployment options
- **Proxy implementation**
  - RTSP proxy
  - streaming session setup
  - performance measurements
- **Conclusions**

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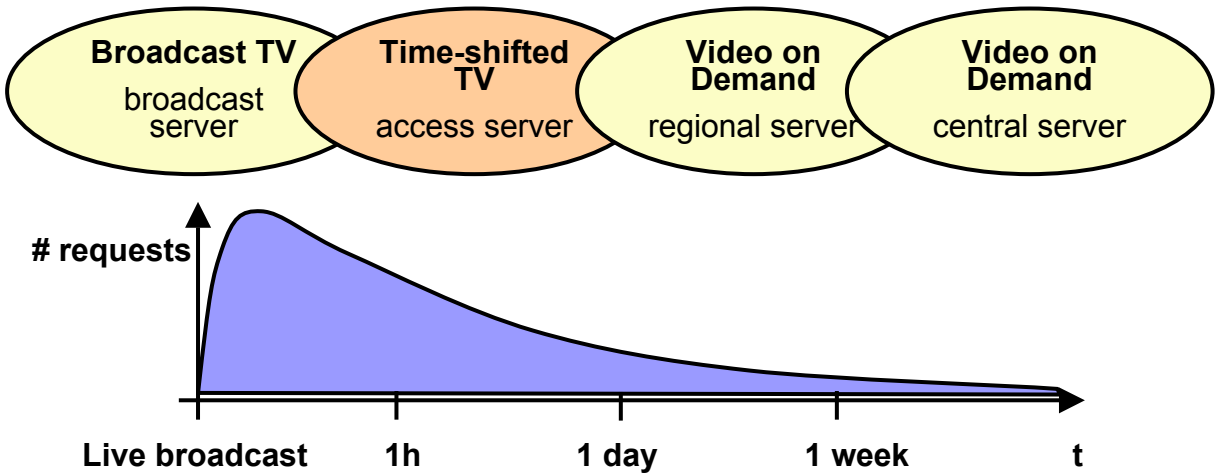
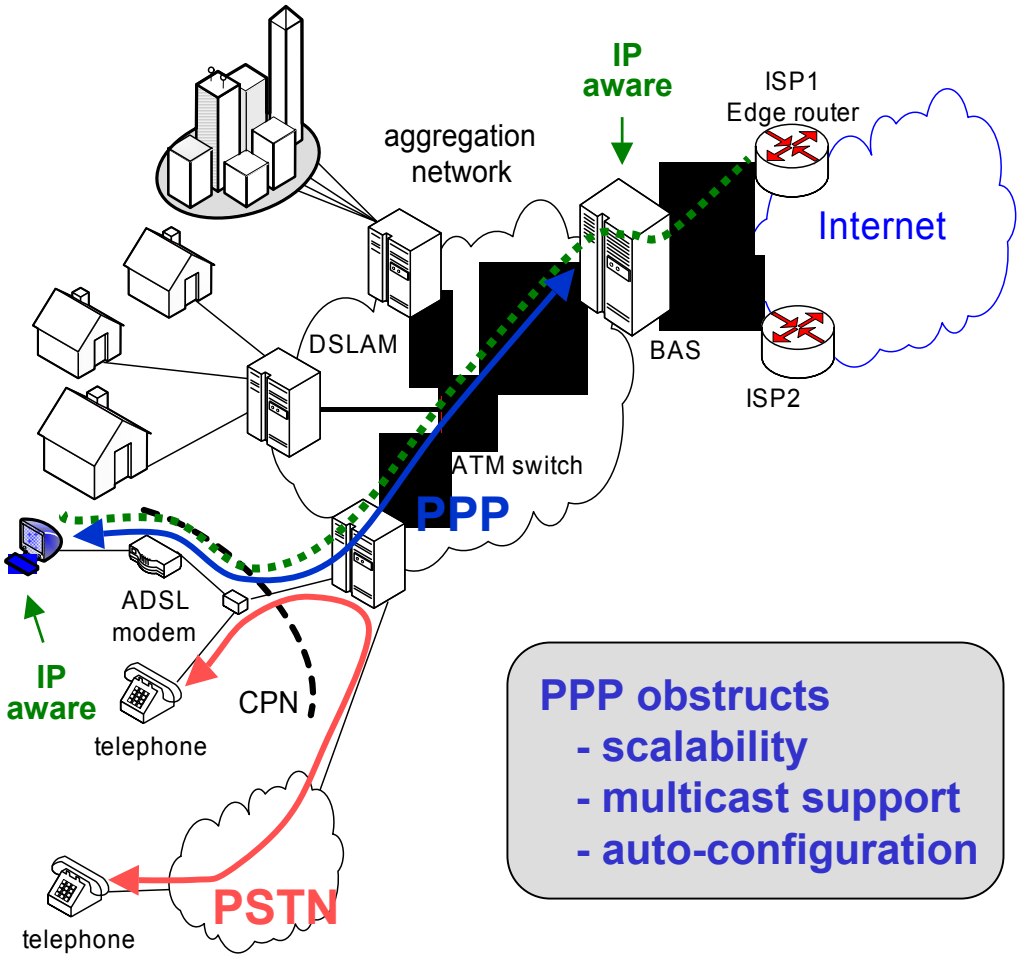
Introduction

- **High priority: IPTV services**
  - requirements: high bandwidth, low delay and jitter
  - today: broadcast TV (live) or VoD (older content)
    - **highly loaded VoD servers at the network edge**
    - **complete files are stored**
  - solution: time-shifted TV for (very) recent content
    - **distributed servers in the access network**
    - **fragments are stored**



Introduction



PPP obstructs
- **scalability**
- **multicast support**
- **auto-configuration**

Current ATM-based broadband aggregation

ATM DSLAMs

- Unintelligent Layer 1 aggregation
- Low-speed ATM uplinks
- Mostly Central Office - based

Complex, fixed connections

- PPP-based
- Bound to DSL CPE in the home
- Provisioning cost high

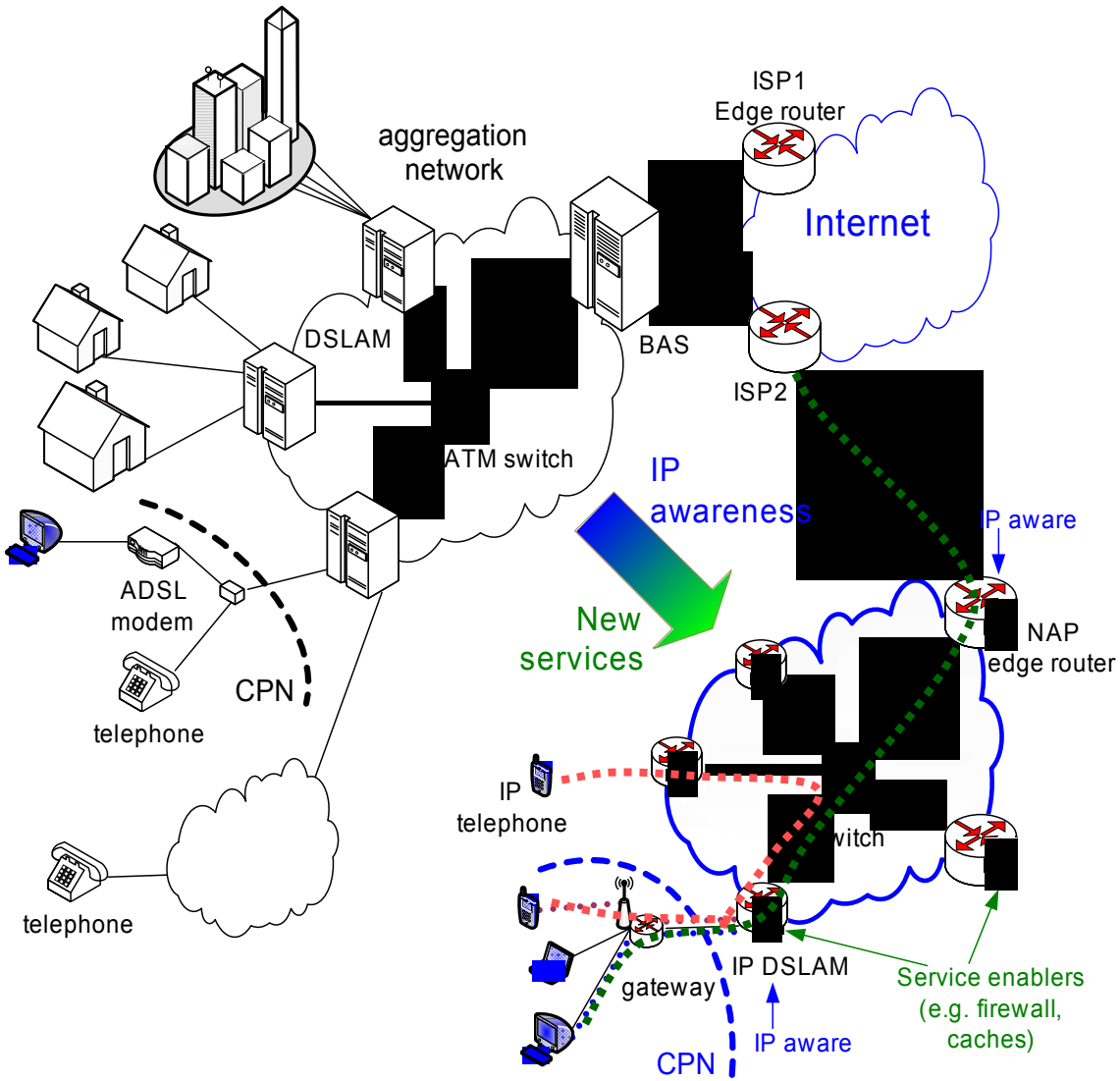
Centralized B-RAS

- Optimized for best-effort internet
- Lack of scalable routing and QoS
- Typical OC-12 handoff to IP core

Lack of network resiliency

- Outages tolerated
- Minimal financial repercussions

Introduction



Next-generation Ethernet/IP-based broadband aggregation

IP DSLAMs

- Intelligent aggregation with multicast support
- Gigabit Ethernet Uplinks
- Increasingly RT-based

Simple, flexible connections

- DHCP-based
- Independent of device
- User-based
- Provisioning cost low

Distributed routers

- Optimized for QoS-sensitive services
- Highly scalable
- 10 GbE handoff to IP/MPLS core

Highly available network

- Little to no tolerance of service interruptions
- Risk of churn if reliability metrics aren't met

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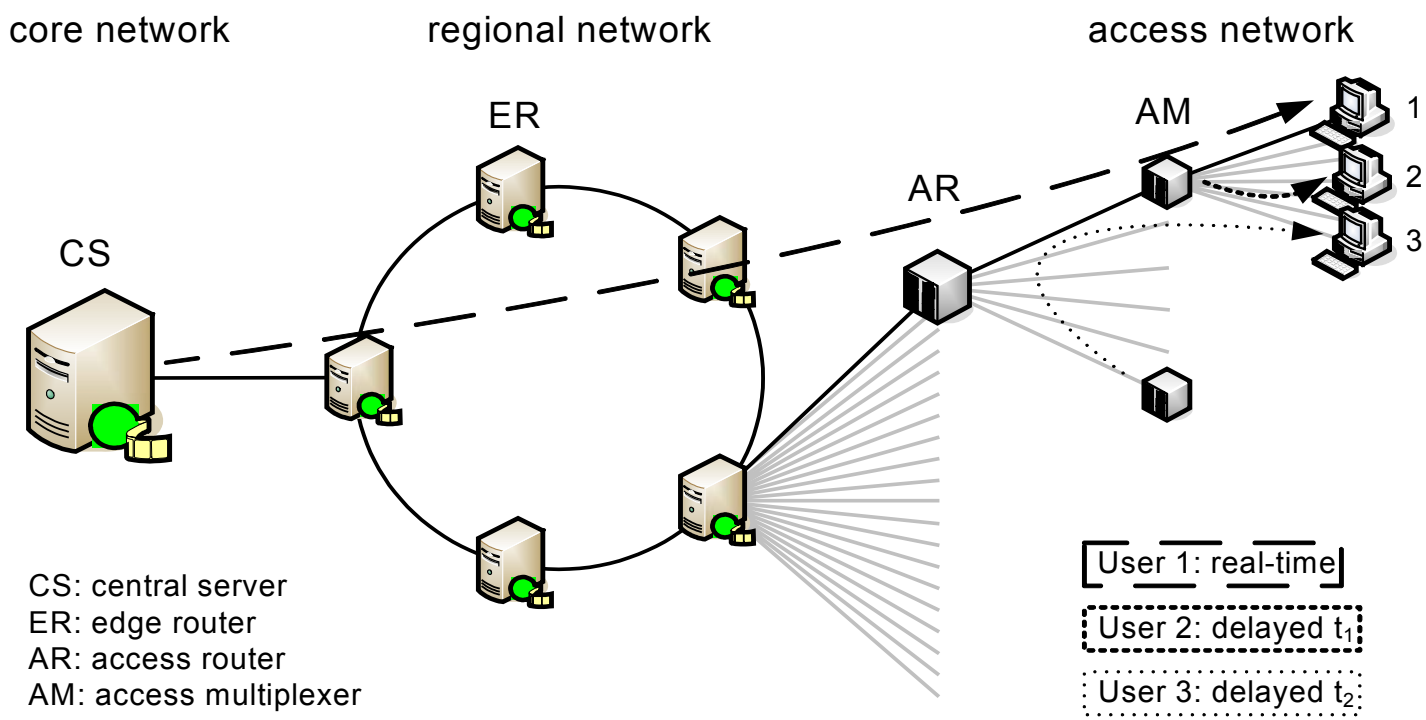
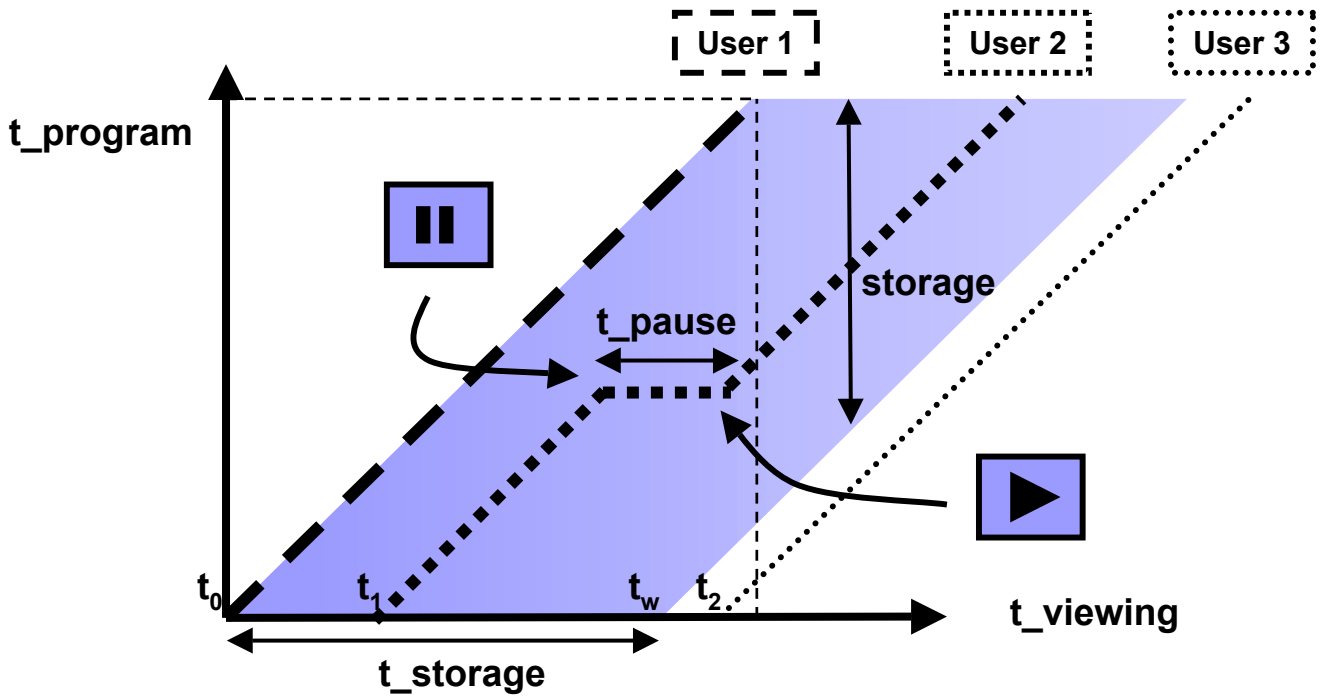
Time-shifted TV

- **Network view**
  - caching of fragments
  - p2p caches

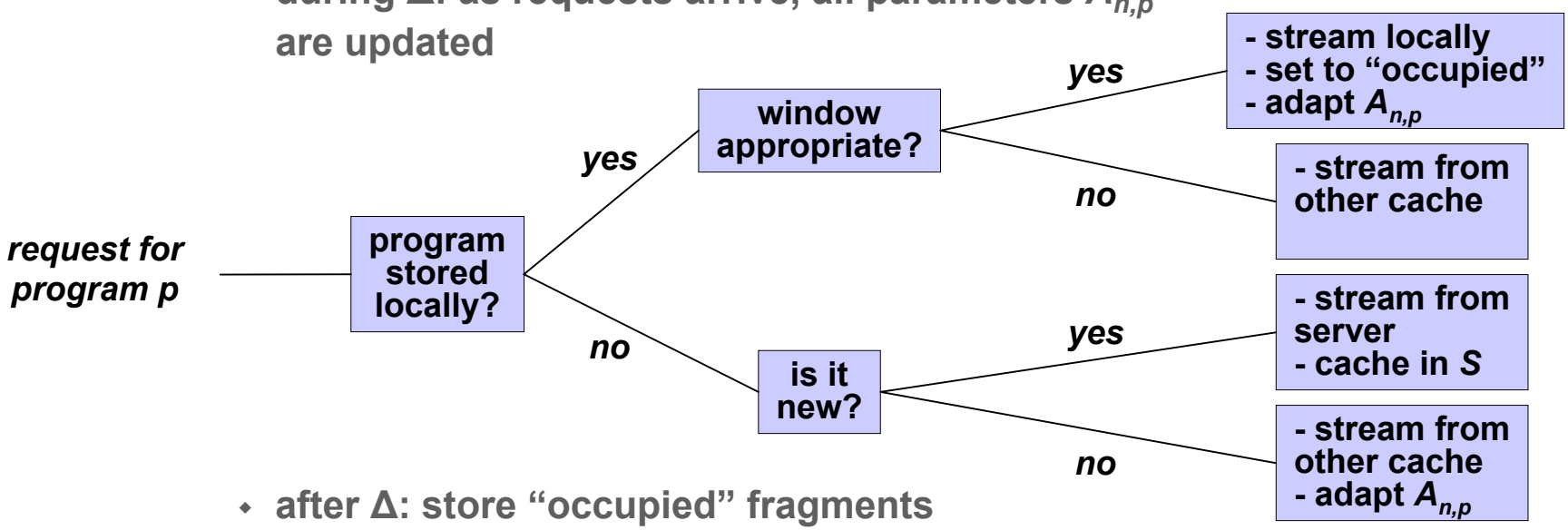


- **Streaming diagram**
  - supports user interactivity



Caching algorithm

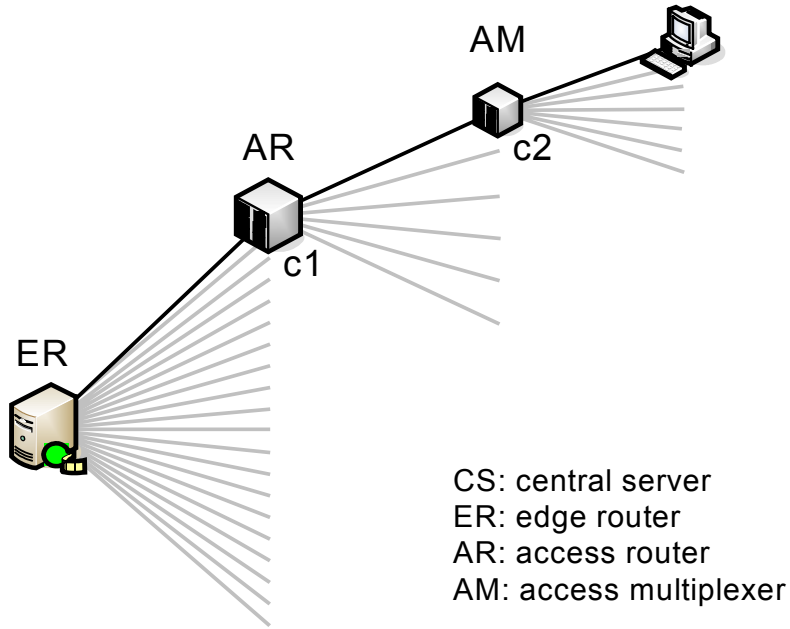
- storage space
  - small part *S* for learning (< 1 GB)
  - large part *L* for storage of popular/distant fragments, determined by the parameters $A_{n,p}$
- time intervals Δ
  - during Δ: as requests arrive, all parameters $A_{n,p}$ are updated



  - after Δ: store "occupied" fragments and fragments with highest value for $A_{n,p}$

Time-shifted TV

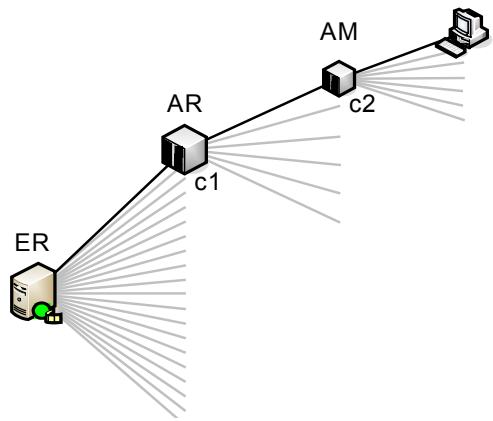
- **Input parameters**
  - 5 tsTV channels
  - 6 programs per channel
  - 45 minutes per program
  - exponentially decreasing popularity
  - Δ = 5 minutes



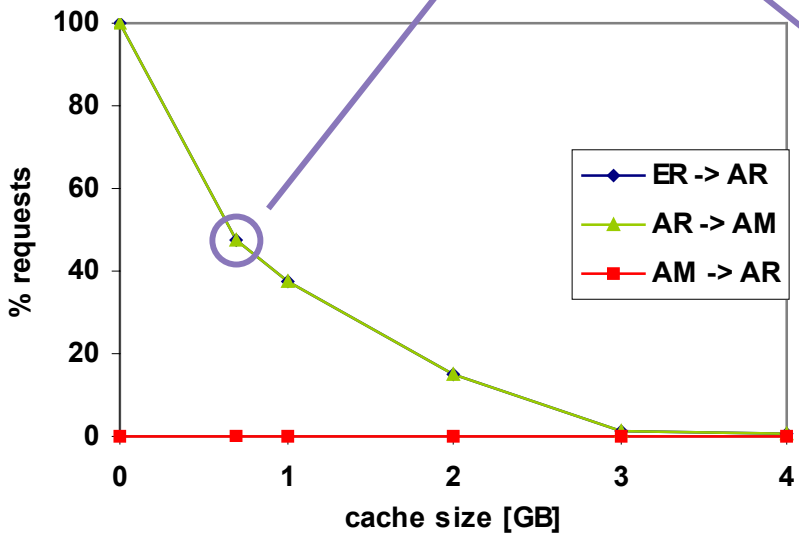
- **Deployment options**
  - hierarchical caching
    - **caches at AR and AM level**
  - co-operative caching
    - **co-operating caches at AM level**

Time-shifted TV

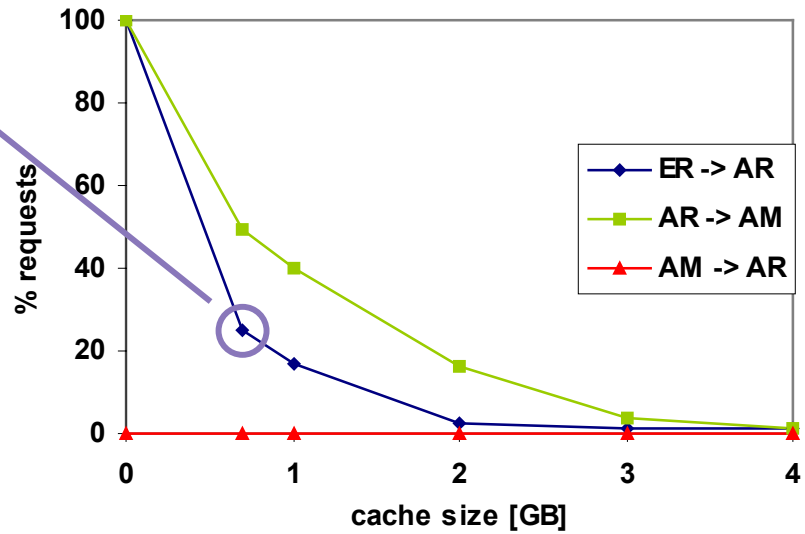
- **Hierarchical caching**



Server load reduced by 50% to 70% with 0.5GB caches

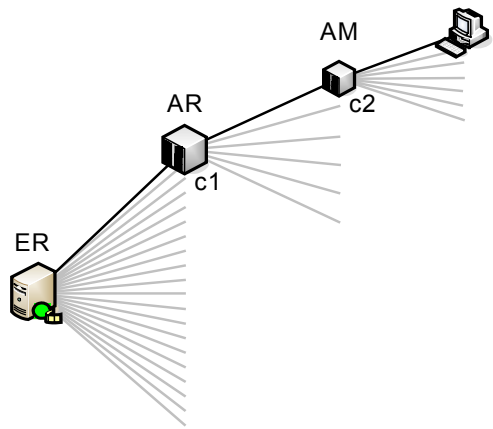


AM caches only

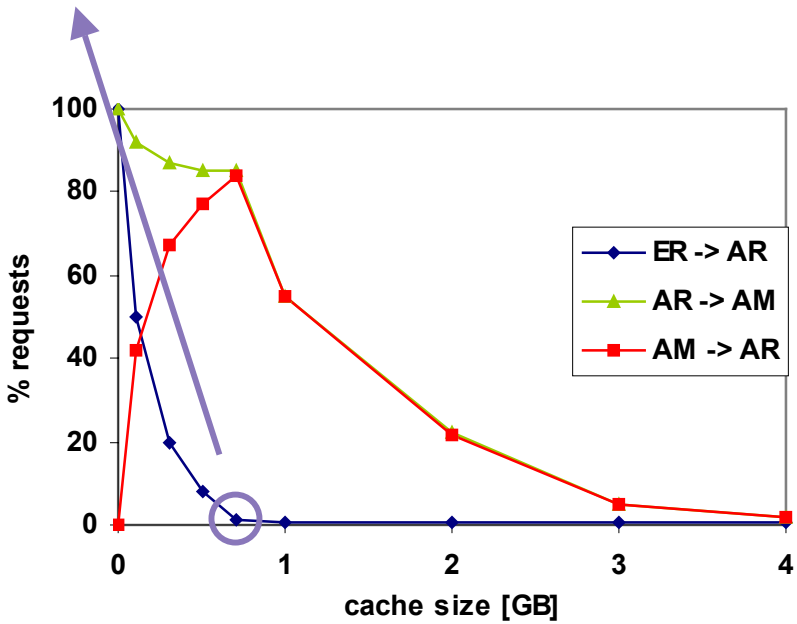


AR and AM caches

- **Co-operative caching**



Server load reduced by 95% with 6 co-operating 0.5GB caches



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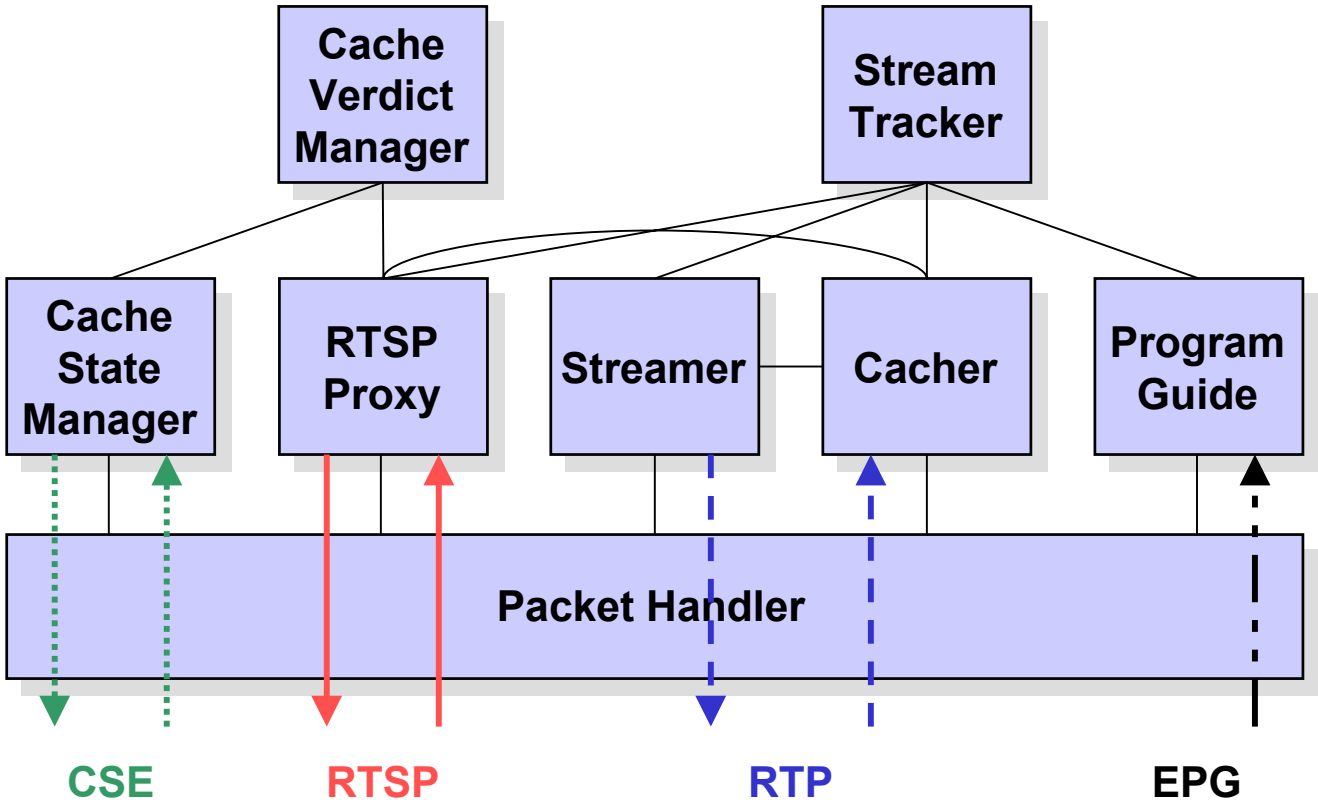
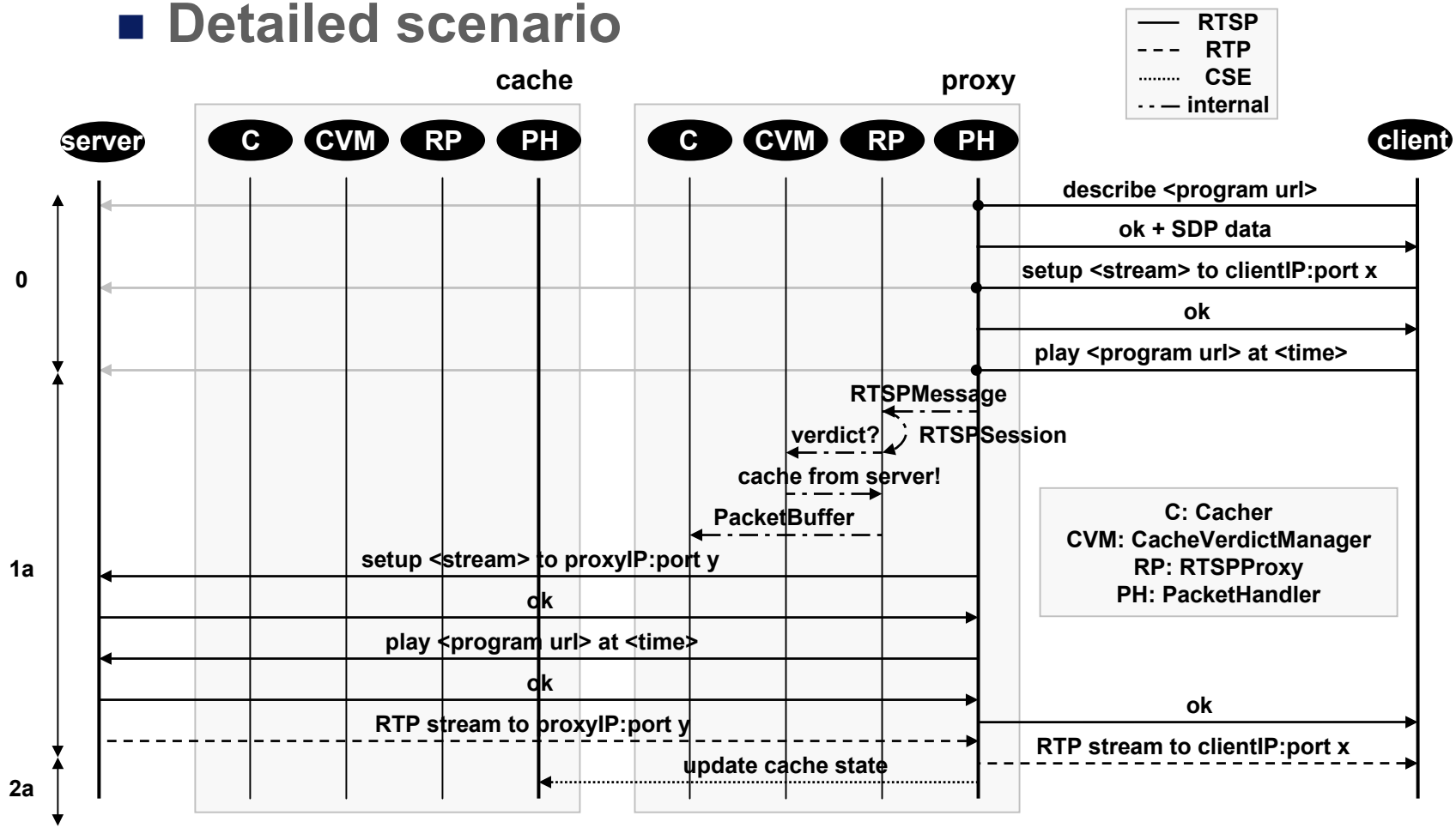
- **RTSP proxy**
  - implementation using RTP / RTCP / RTSP



Detailed scenario



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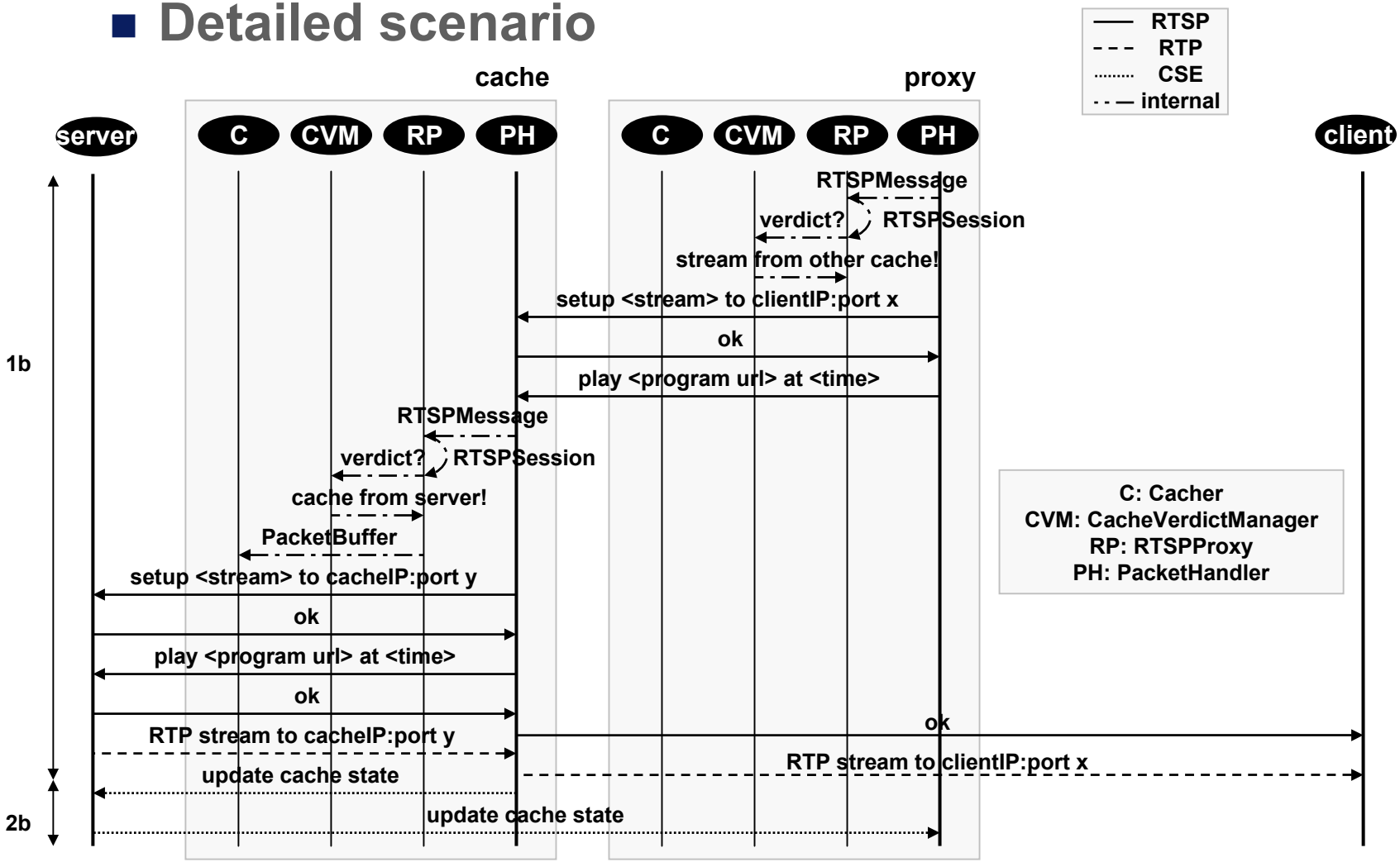
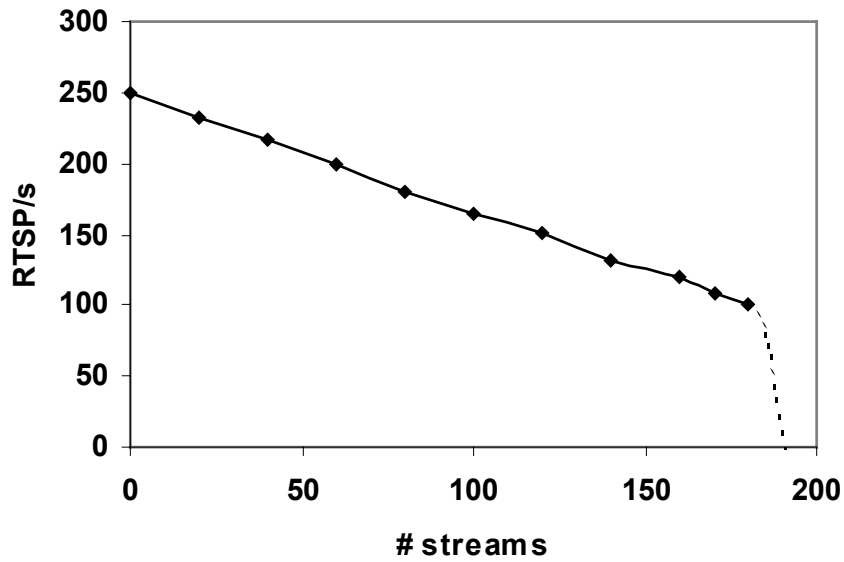


- **RTSP proxy**
  - measurements
    - **AMD Athlon™ 64 (512MB RAM), 1GB links**
    - **handling of simultaneous client RTSP requests (low priority), while serving RTP streams (high priority)**



- **RTSP proxy**
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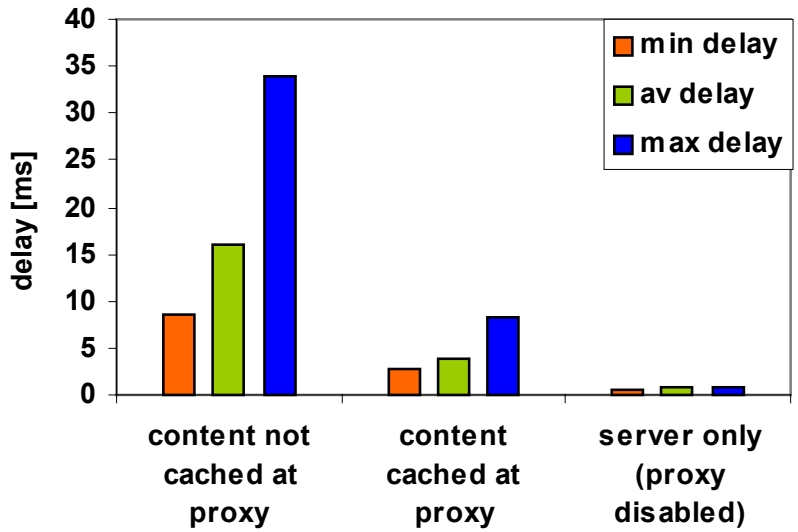
    - **AMD Athlon™ 64 (512MB RAM)**
    - **delay between PLAY request and first RTP packet in a server - proxy - client configuration**



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Conclusions

- **Access network transformation**
  - from ATM based broadband aggregation to multi-service IP-aware access networks
  - increased flexibility, scalability and availability

- **IPTV**
  - identified as highest-priority, bandwidth intensive residential telecom service
  - server load and access network load reduced effectively through time-shifted TV using distributed and transparent proxy streamers, especially for co-operative caching
  - proxy implementation using RTP / RTCP / RTSP protocol suite