SCALABLE VIDEO CODING IN CONTENT-AWARE NETWORKS

Michael Grafl
Institute of Information Technology
Alpen-Adria Universität Klagenfurt, Austria

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INTRODUCTION

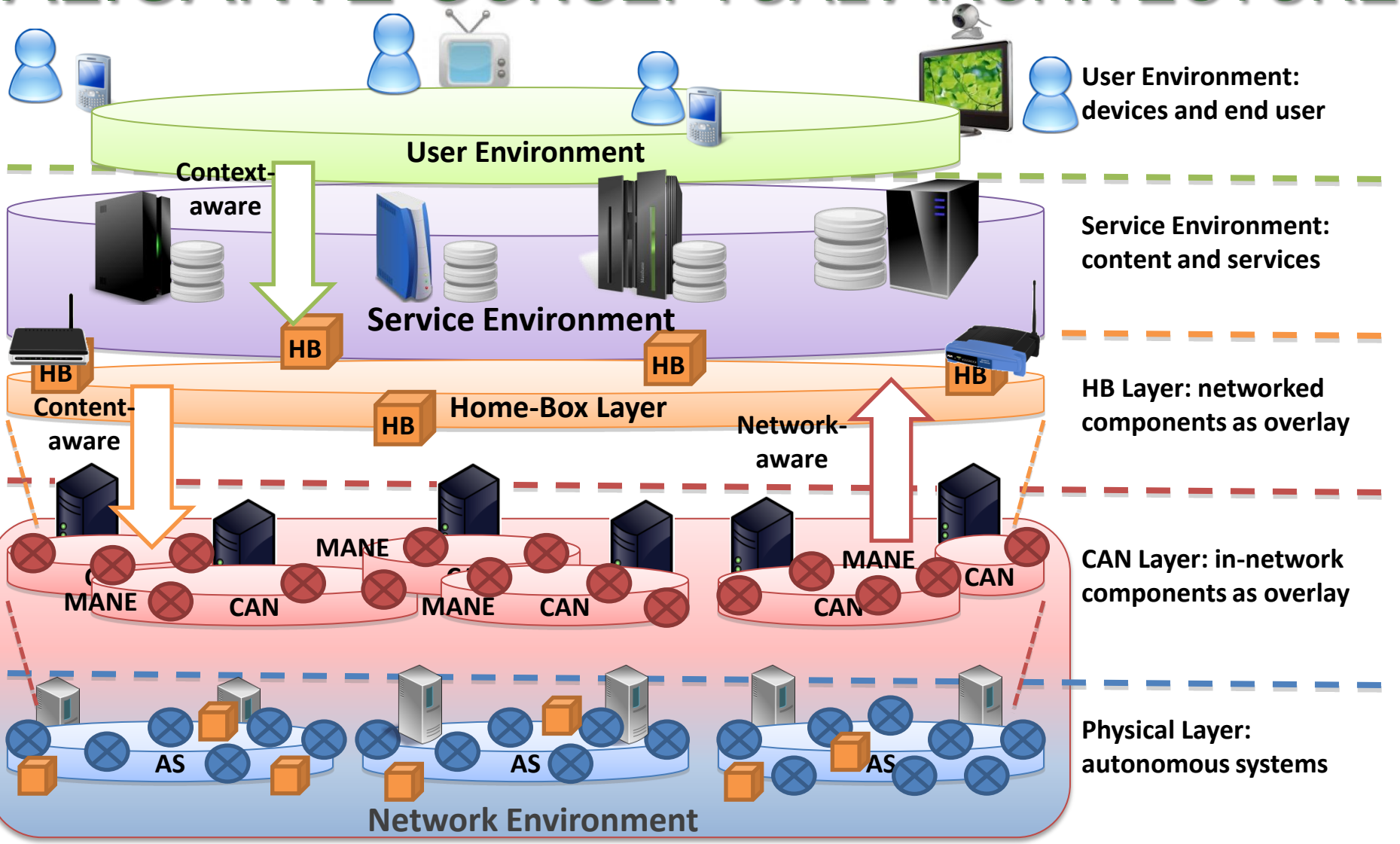
- Information-Centric Networking (ICN)
  - Revolutionary approach
- Content-Aware Networking (CAN)
  - Evolutionary approach
  - ALICANTE project
- Scalable Video Coding (SVC)
  - Extension of H.264/MPEG-4 AVC
  - Spatial, temporal and quality (SNR) scalability
  - Base layer + multiple enhancement layers
  - Coding overhead: ~ 10% wrt. H.264

ALICANTE

- Project Info:
  - EU FP7-ICT project
  - Duration: March 2010 – Aug 2013
  - 20 partners
- "Media Ecosystem Deployment through Ubiquitous Content-Aware Network Environments"
- Goal: New Home-Box layer and CAN layer with distributed cross-layer adaptation and universal multimedia access enabling cooperation between providers, operators, and end-users

http://ict-alicante.eu

ALICANTE CONCEPTUAL ARCHITECTURE



ALICANTE vs. Full ICN Approach

Approaches:

- Best effort
- QoS-based virtual splitting
- Content-aware networks
  - Content-type awareness
- Service-aware networking
- Full ICN
  - Content/object awareness
  - Name/location resolution, routing of requests, caching at network nodes

Degree of awareness on upper layer information at network level

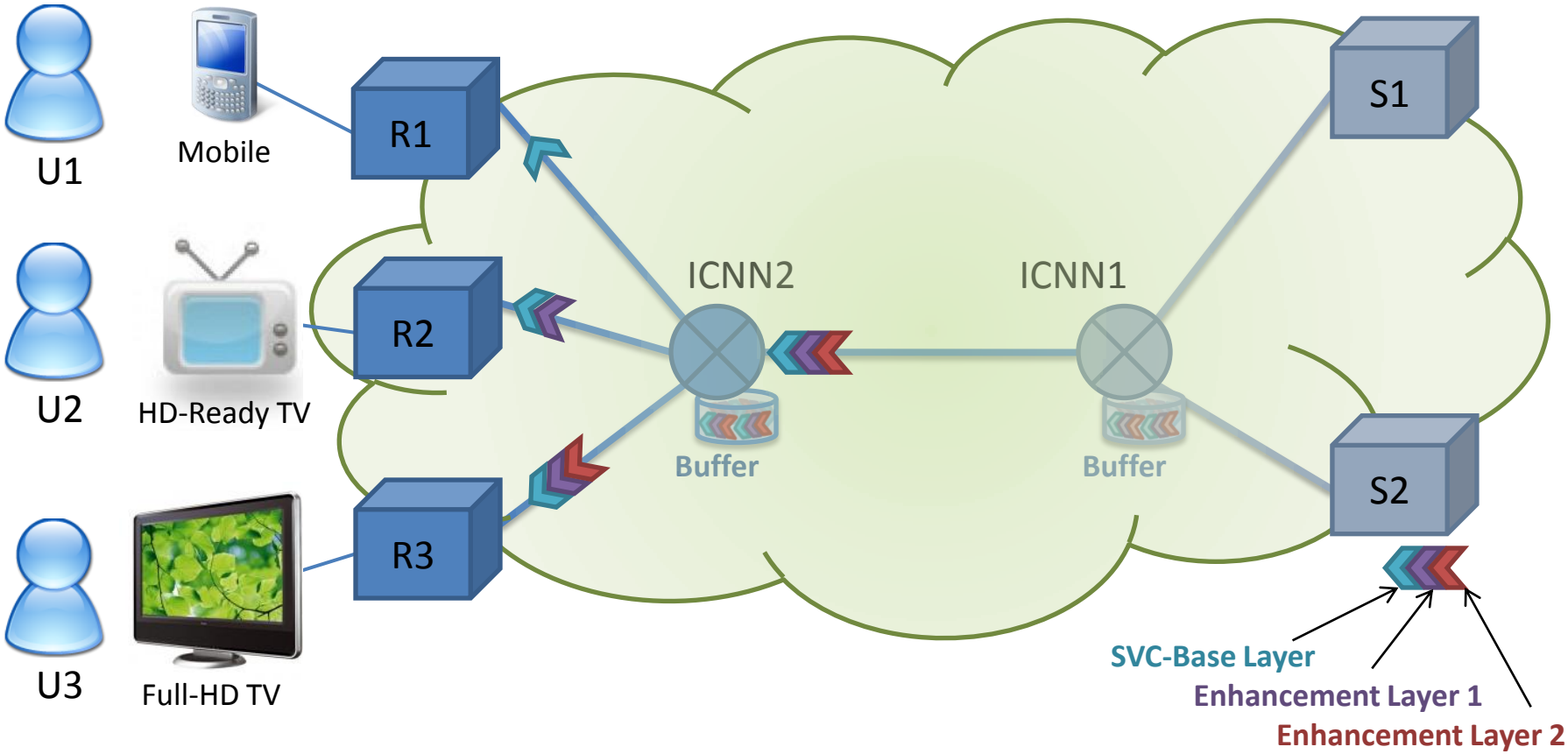
- Evolutionary approach for FI (Mid-way to full ICN)
- Caching and storage
  - In Home-Boxes (network edge) and Content Servers
- Scalable and Cost-Efficient Content Distribution
  - Name/location resolution – at Service level (not in routers)
- Content-awareness
  - aggregated CA and associated processing at network level
- Deployment
  - Seamless/incremental deployment

USE CASES FOR SVC IN CAN

- Role of scalable media formats for enabling content-aware networking

- Unicast, Multicast, Peer-to-Peer Streaming, Web/HTTP Streaming
- Analysis wrt. ICN research challenges:
  - Routing & Forwarding
  - Caching & Buffering
  - Quality of Service/Experience (QoS/QoE)

System Overview for Use Cases



USE CASES: UNICAST

- Example: Video on Demand (VoD)
- RTP (with SST of SVC) and RTSP
- Routing & Forwarding:
  - ICN node can react to network fluctuations
    - In-network adaptation of SVC at ICN node (for short-term fluctuations)
    - Signal to sender for dropping SVC layers (for long-term fluctuations)
- Caching & Buffering:
  - ICN node can perform prefix caching
    - Reduce start-up delay
    - Selective caching of SVC layers
- QoS/QoE: (applies to all use cases)
  - Consider terminal capabilities when requesting SVC layers
  - Monitor network conditions at ICN nodes (cf. ALICANTE)
  - Smooth, undistorted playout

USE CASES: MULTICAST

- Receiver-Driven Layered Multicast (RDLM) of SVC
- RTP in MST mode (each SVC layer in own session)
- Routing & Forwarding:
  - ICN nodes adapt to network conditions through subscription to SVC layers
  - ICN nodes as bridges between native and overlay multicast (ALICANTE: virtual content-aware network of ICN nodes)
  - Selective treatment of SVC layers (MPLS, DiffServ)
- Caching & Buffering:
  - Prefix caching to reduce start-up delay in non-live scenarios

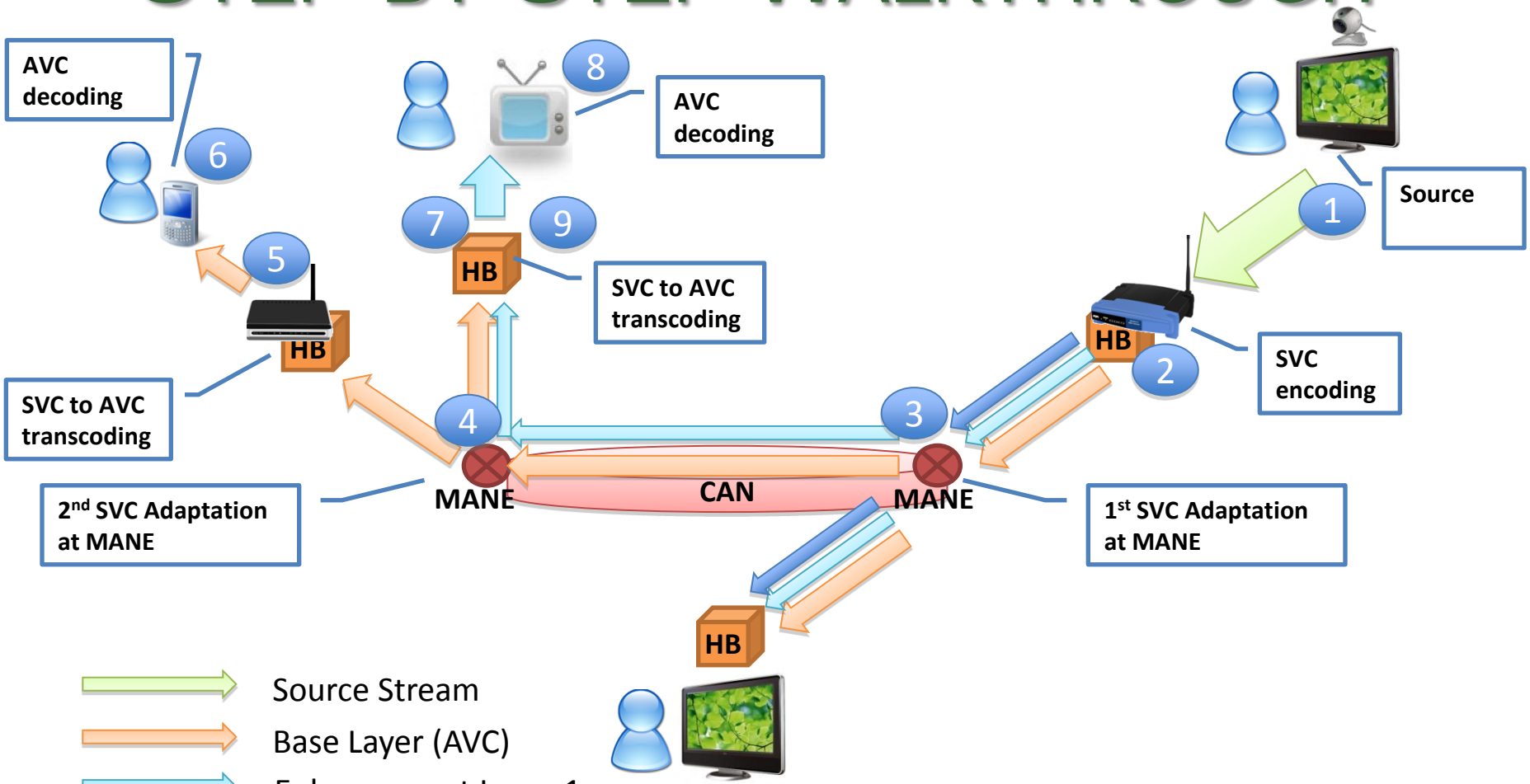
USE CASES: P2P STREAMING

- Receivers request *pieces* from multiple senders
- P2P network as overlay
- Receiver only requests SVC layers supported by end-user terminal
- Routing & Forwarding:
  - ICN nodes can act as peers, forming an in-network overlay
- Caching & Buffering:
  - Aggregate requests and perform *information-centric buffering (during sliding window)* at ICN nodes

USE CASES: WEB/HTTP STREAMING

- Download via HTTP (partial) GET requests
  - Content fragmented into *segments* (e.g., per SVC layer and GOP)
  - Manifest file describes structure of segments and available representations
  - Standard: *Dynamic Adaptive Streaming over HTTP (DASH)*
- Overcome NAT traversal & firewall issues
- Stateless sender
- Unicast, multicast, and multisource (P2P-like) scenarios
- Routing & Forwarding:
  - ICN node signals network condition to receiver (→implicit adaptation)
- Caching & Buffering:
  - SVC-based prefix caching using HTTP-based CDN infrastructure
  - Buffering during sliding window creates multicast tree
  - Information-centric buffering in multisource scenario

STEP-BY-STEP WALKTHROUGH



CONCLUSIONS

- Towards ICN: Scalable media coding formats (e.g., SVC) in combination with in-network adaptation
  - Routing & Forwarding
  - Caching & Buffering
  - QoS/QoE
- Enabling content-awareness within the (core) network
- Context-awareness at receiver & sender (& ICN node)
- ALICANTE
  - Towards deployment of a networked "Media Ecosystem"
  - Collaboration of CAN layer and Home-Box layer

LITERATURE

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THANK YOU FOR YOUR ATTENTION!

Questions?