



# **Future on-demand services**

*Requirements for multicast / broadcast*

*Multimedia content delivery, mobile content distribution,  
standardisation, management, on-demand routing, QoS,  
security, ....*

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# Topics



- ▶ **Challenges for on-demand multicast**
  - ▶ **Transmission of multicast data to multiple recipients at distinct time in order to reduce the cost**
    - ▶ On-demand multicast streaming protocols
    - ▶ On-demand multicast routing - optimised routing based on temporary caching of the data at the routers, later forwarding and cooperation of routers for tree construction
- ▶ **On-demand applications and services**
  - Multimedia content delivery
  - Mobile on-demand
  - Intelligent control and multiple access network interfaces
  - Security issues
- ▶ **Standardisation issues**





# Scalable on-demand streaming

- ▶ **Requirements for scalable on-demand streaming**
  - ▶ Allow each client to begin playout with minimum delay
  - ▶ Support interactive requests (skip ahead/back and fast forward)
  - ▶ Scalable service – bandwidth required to deliver the media grows slowly with the file request rate
- ▶ **Scalable on-demand streaming protocols**
  - Use multicast and broadcast to reduce required server bandwidth from linear in requested rate to logarithmic in requested rate by aggregation of clients making closely requests in time
  - Caching of multicast streams at routers
  - Batching – to delay the service until the next multicast stream starts
  - Periodic broadcast protocols
  - Patching – merge services from distinct multicast streams
  - Split and merge
  - Bandwidth skimming
    - Hierarchical multicast stream merging
    - eTeach





## On-demand multicast routing for mobile ad hoc networks (MANET)

- ▶ **Goal**
  - ▶ Reducing the number of multicast streams and network bandwidth based on caching of multicast data at routers and later forwarding
- ▶ **Reservation-based Multicast Routing**
  - ▶ User specify requirements for resources and constraints
  - ▶ Builds a core based tree for each multicast group
- ▶ **On-Demand Multicast Routing Protocol (ODMRP) based on mesh forwarding for mobile ad hoc wireless networks**
  - On-demand multicast route construction and membership maintenance
- ▶ **Content based routing with on-demand multicast**
  - ▶ Integrates an extended ODMRP and content based subscription
  - ▶ Builds routing tables on demand
  - ▶ Optimised data dissemination with context awareness including location, network topology, availability and mobility
  - ▶ Event based middleware – events are routed based on content and consumer interest





# Multimedia content delivery (1)

Increasing demand for content delivery applications,  
Different approaches for application design and requirements for  
multicast

- ▶ **Scenarios (entertainment, training, software, etc)**
  - Content produced for later distribution to multiple users
  - Content Distribution Networks (CDN)
- ▶ **Content delivery networks (CDN) standardisation**
  - Moving Picture Expert Group MPEG-21 framework for management and delivery of content
  - IETF CDI WG (content distribution internetworking)
- ▶ **Applications**
  - Video On-demand (layered video coding, multiple sending peers)
  - Peer-to-peer (P2P) streaming multimedia and delay-sensitive
  - Streaming of content to large population of clients
  - Large scale content delivery (reliable file distribution)
  - P2P file sharing systems and file replications to a large set of peers (Napster, Gnutella, Supernodes)
    - Approaches:
      - **centralised and decentralised,**
      - **structured and unstructured,**
      - **streaming and delay-sensitive**





## Multimedia content delivery (2)

### General requirements for multicast transport services for content delivery

- ▶ Asymmetric multicast/broadcast transfer
- ▶ Interaction channel
- ▶ Multimedia streaming video, audio and data content for multiple receivers including notebooks, cell phones, and PDAs
- ▶ Scalable on-demand delivery
- ▶ Multiple channel communication with QoS levels
- ▶ Multicast transport classified into:
  - Streaming (stream of continuous media – audio, video, text – with time synchronisation and display, such as mobile television)
  - Reliable binary file download
  - Carousel (synchronised media and file delivery with target static media for later display)





## Multimedia content delivery (3)

### Delay sensitive p2p streaming

- ▶ **Application scenarios:**
  - Television broadcast
  - Mobile TV
- ▶ **Delay-sensitive streaming multimedia multicast**
  - **Single trees**
    - Reproduces the native IP multicast structure across tunnelled unicast connections between peers
    - Reliable and unreliable multicast
    - Application driven tree creation / maintenance algorithms,
    - Management of peer arrivals and departures
    - Used in SpreadiT, PeerCast, ESM, NICE, Zigzag
  - **Multiple applicative multicast trees**
    - Load balancing and better resiliency to node failure
    - Reducing the packet loss by appropriate encoding strategies
    - Integrated in Splitstream, Coopnet, P2PCast
  - **Hybrid schemes**
    - Combining a standard single tree structure and a mesh made of random connections used to send a bulk of data among peers which are far away in the tree hierarchy





## Multimedia content delivery (4)

### Multimedia P2P Replication of files to a large set of peers

- ▶ **Distributed algorithms**
  - Enforcement of cooperation among selfish hosts
  - Robust to early departure of peers and to flash crowd arrivals of new peers
  - Large scale replication strategies
    - Chains
    - Trees
    - Parallel trees
- ▶ **Applications**
  - FastReplica: Replication of context, where all peers are controlled by the single entity
  - BitTorrent: efficient for replications of files to large sessions (thousands of peers) with flash crowds





# Mobile multimedia on-demand (1)

Multimedia content delivery to mobile receivers, mobile television, mobile streaming, reliable mobile downloads ....

EU IST Projects including mobile DVB-T scenarios: DAIDALOS, ATHENA

- DAIDALOS user-centric mobile scenarios
  - Mobile TV
  - Streaming
  - Content delivery
  - Reliable File download
- Multiple mobile access networks
- Seamless Vertical / Horizontal Handover
- Mobility requirements
  - Receiver mobility
  - Source mobility
- QoS selection
- Heterogeneous Mobile environment
  - Vertical
  - Horizontal
- Efficient DVB-T integration in mobile IPv6
- Intelligent management and context-aware control of multiple access network interfaces

1<sup>st</sup>. picture/Airport Car parking scene



2<sup>nd</sup>. Picture/ Accident Broadcast scene



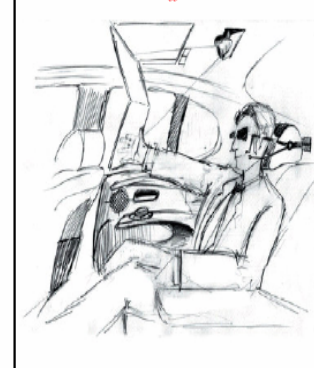
3<sup>rd</sup>. picture/ Car "powerupgrate" scene



4<sup>th</sup>. Picture/ Car Gaming scene



5<sup>th</sup>. Picture /Car Office Scene



6<sup>th</sup>.picture/ Car - Rest Area Scene



6<sup>th</sup> Scene

7<sup>th</sup> Scene

8<sup>th</sup> Scene



## Mobile multimedia on-demand (2)

Context-aware technologies for efficient mobile multicast in heterogeneous mobile networking environment (DAIDALOS approach)

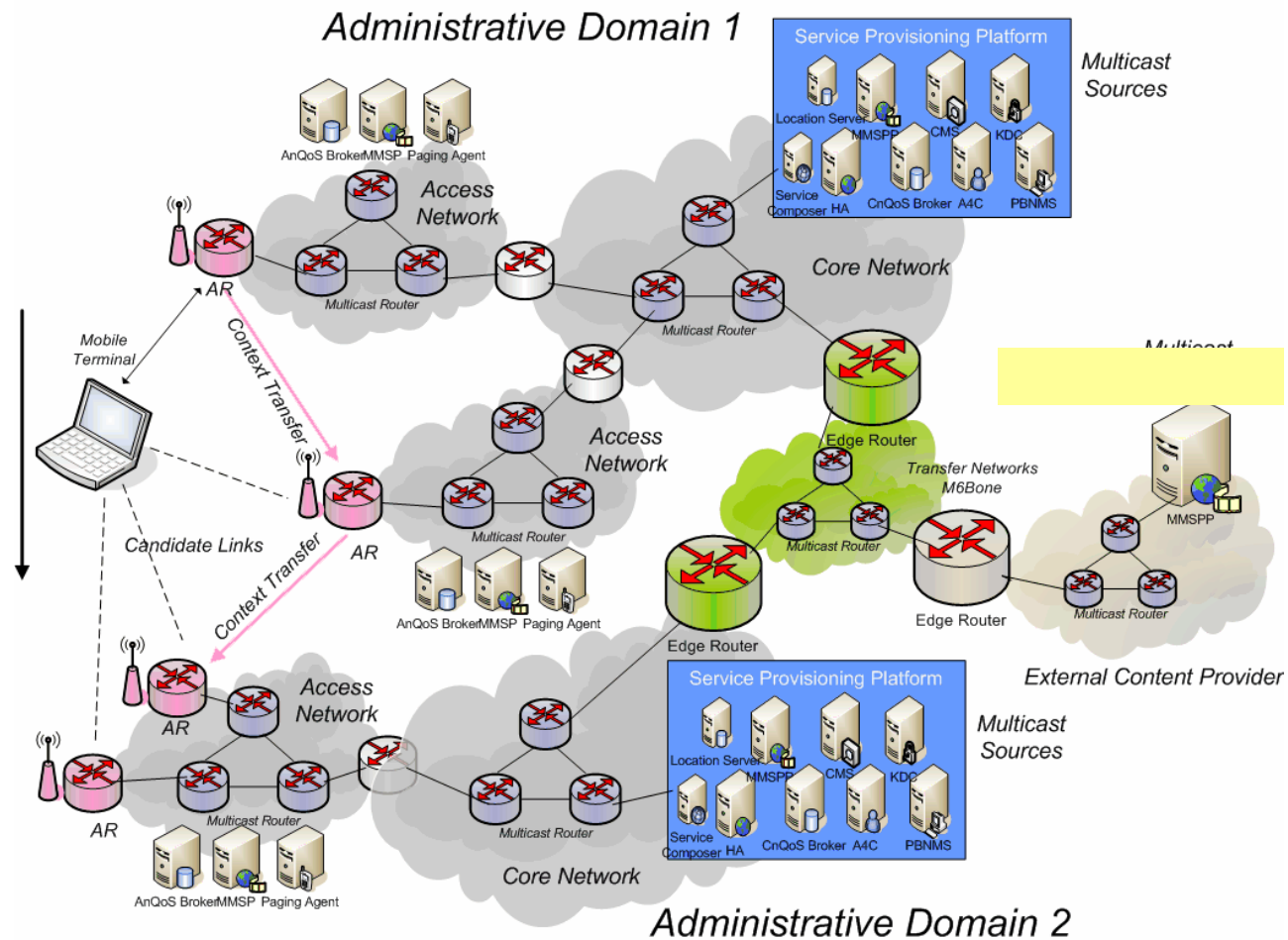
Challenge for	Context management	Expected effect
Efficient Handover	Context transfer of <b>protocol states</b> (security, multicast protocols such as MLDv2, PIM-SM, ....)	Speed-up the service reestablishment after handover (reducing packet loss and delay)
Interoperability in Heterogeneous Access Networks	Context dependent <b>QoS support and mapping</b>	Enhanced QoS support of mobile services
Application, QoS and User Environment support	Management of <b>different kinds of context data</b> structures	Efficient information exchange
Intelligent Service Management	Context aware <b>User Interfaces</b>	Adaptation and user driven QoS selection





# Mobile multimedia on-demand (3)

## Issues of context management of mobile multicast services



**Context transfer during handover**

→ multicast protocol states (MLDv2, PIM-SM)

**Intelligent user interfaces (context awareness)**

→ Flexible management of multiple access network interfaces

**Access router assisted scalable reliable multicast**

-> multicast retransmission and flow control supported at access router





## Mobile multimedia on-demand (4)

### Integrated context transfer and network delivery technologies

- ▶ Goal to re-establish the multicast services in case of handovers efficiently without requiring the mobile host to explicitly perform all protocol flows for those services from scratch [RFC3374]
- ▶ Context Transfer Protocol
  - Context Transfer protocol standardised by Seamoby IETF WG → Messages to initiate and authorise context transfer as well as messages transferring contexts prior to, during and after handovers.
  - Supports integration of heterogeneous wireless networks in Internet infrastructure based on **interoperable services**
- ▶ Multicast Listening Context Transfer
  - Multicast Listener Discovery (MLDv2) [RFC3810]...
  - MLDv2 supports the join or leave a multicast group at any time and offers the SSM opportunity for receivers to filter specific multicast sources.
- ▶ Multicast Routing Context Transfer
  - PIM Sparse-Mode (PIM-SM) version 2 [RFC2117], [RFC2362]...
  - Protocol independent multicast routing
- ▶ Security context transfer
- ▶ QoS based resource reservations of mobile multicast connections
  - DiffServ [RFC3745]
  - IntServ/RSVP [RFC2490]

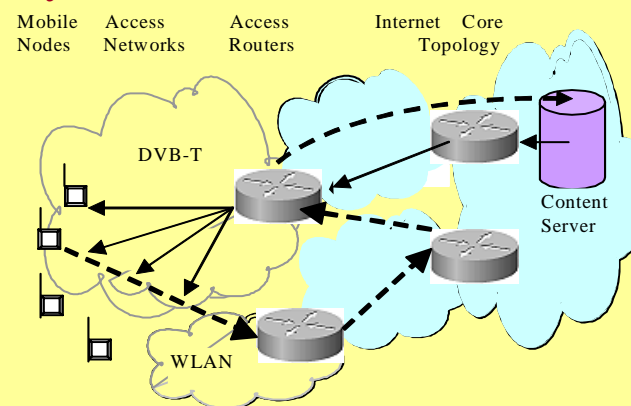




## Mobile multimedia on-demand (5)

### Reliable mobile multicast transport in DAIDALOS

- **Different mechanisms for reliable transmission selectable dependent on the network and application context**
  - Resilient transmission in case of streaming services
  - Strict reliability for file downloads
- **Access router assistance to support reliable multicast based on context transfer**
  - NACK processing not only at mobile nodes and multicast source, but also at the access routers
  - Optional access router reliability control selection when moving to new access networks

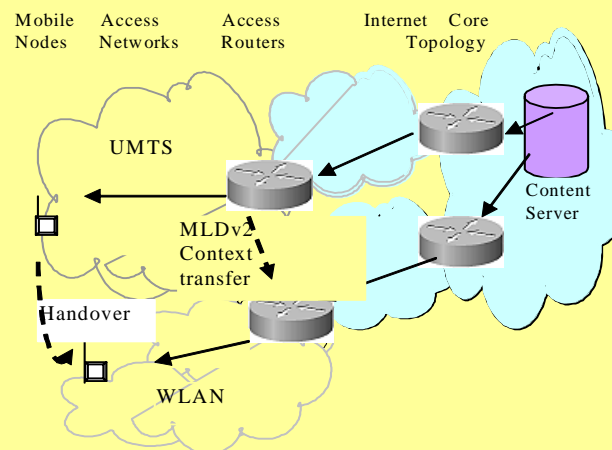




## Mobile multimedia on-demand (6)

### Context dependent reliable mobile multicast in DAIDALOS

- **Context management during handover to ensure reliable transport**
  - Proactive reliable multicast
  - Transfer of reliable multicast control states (NACK states)
  - Transfer of unacknowledged multicast data between sources and next access router
- **Context dependent selection of reliable transfer schemes at access network**



# Standardisation issues



- ▶ **Multimedia broadcast / Multicast services (MBMS) in the 3rd Generation Partnership Project (3GPP) - user services are defined in 3GPPTS 22.246**
  - Streaming
    - Continuous media (audio, video)
    - Synchronised transmission of media streams, as for instance based on digital video broadcasting with supplementary information of text (URLs) and/or still images (static media as banner image)
  - File Download
    - Reliably multicast binary data (file) delivery
  - Carousel combining streaming and file download
    - Time synchronisation is used for static media including its continuous updates and reliably file transmission.
- ▶ **3GPP2 Broadcast and Multicast Service (BCMCS) standardisation**
- ▶ **Open Mobile Alliance (OMA) - “Browser and Content” (BCAST) WG**
  - broadcast / multicast related service layer functionalities that are applied to mobile and non-mobile digital broadcast networks
- ▶ **Digital Video Broadcasting (DVB)**
  - DVB-T (Digital Video Broadcast—Terrestrial), DVB-H (Digital Video Broadcast—Hand-held Terminals), DVB-S (Digital Video Broadcast—Satellite), DVB-C (Digital Video Broadcast—Cable)
- ▶ **Convergence of broadcast and telecommunication platforms: DVB-UMTS standards**
- ▶ **IP Datacasting Forum is aimed at integration of DVB-T standards for delivery of multimedia content using IETF Internet Protocol standards.**





# Intelligent context aware user interfaces

- ▶ **Facilities of intelligent context aware user interface**
  - Multiple access network interfaces
  - Access of context information
  - Usage of Context data for change of environment parameters and mobile behaviour
  - Seamless handover based on context access
  - Adaptation to changing environment
  - Selection of optimal candidate access network considering QoS parameters

- ▶ **Platforms**
  - Open IP Multimedia Services (IMS)
  - Mobile all-IP environment (UMTS)
  - User-centric broadband networking





# Security

- ▶ Key distribution schemes
  - IP Multicast
  - Application Layer Multicast (ALM)
  - Multicast overlay protocols
- ▶ Confidentiality
  - Data security achieved by encryption in ALM
- ▶ Anonymity
- ▶ Availability
- ▶ Authentication





## Further topics

- ▶ Optimisation of resources for scalable on-demand services (video, streaming, carousel)
- ▶ Multicast tree topology discovery and congestion control
- ▶ Distributed groups and multiple sources
- ▶ User-centric versus data resource reservation
- ▶ Proactive mobility and resource reservation in advance for on-demand services

