# Wireless World Research Forum (WWRF)

## (a) Title of the research item: Ambient Media Delivery

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## (b) Subject Area: New Communication Environment and Heterogeneous Networks

## (c) Objectives of the required research (Why has the topic been chosen? Where will the results be applied?)

**Description:**

Distribution of multimedia content is expected to take a leading role in the service portfolio of future communication networks. People are assumed to require access to multimedia content of various nature and format through different end devices and access networks. Especially within the context of co-operative networks, multimedia content distribution will face a number of challenges, as content should reach the consumers regardless of the available networks to deliver the content data and devices to display.

Heterogeneity is though not only a matter of the content delivery paths and display devices, also the user himself will have different preferences concerning the content quality and media selection.

It is commonly accepted that due to the above-mentioned circumstances content will need to be available in various formats or allow for adaptation. Still, the solutions available today or currently under investigation follow a vertical approach and are limited in scope as either the list of supported networks, devices or media types is limited.

Aiming at a non-restrictive solution to content delivery in heterogeneous environments, the overview given in Figure 1 structures the problem area in a generic fashion. Considering the multimedia service provider two decisions need to be taken when selecting the most appropriate content distribution scheme and content type. First, the distribution service type has to be selected. Content might either be made available for non-real-time distribution, e.g. for messaging of download services, or the content might be delivered in an real-time fashion, e.g. by using streaming services or establishing a conversational service between content provider and content consumer. Secondly, the content provider needs to be aware of the number of interested consumers, as this will influence the choice of the communication topology, which might be either unicast or multicast/broadcast.

The consumer on the other hand is more concerned with the available access networks and the devices he can access to view the content. The number of available networks and devices is supposed to further increase making the decision process too complex to be left for the end-user. The objective of the required research is thus to develop a solution which abstracts network and device heterogeneity as well as content characteristics in order to create a future proof media distribution architecture, which allows to easily include new types of content, devices and networks.

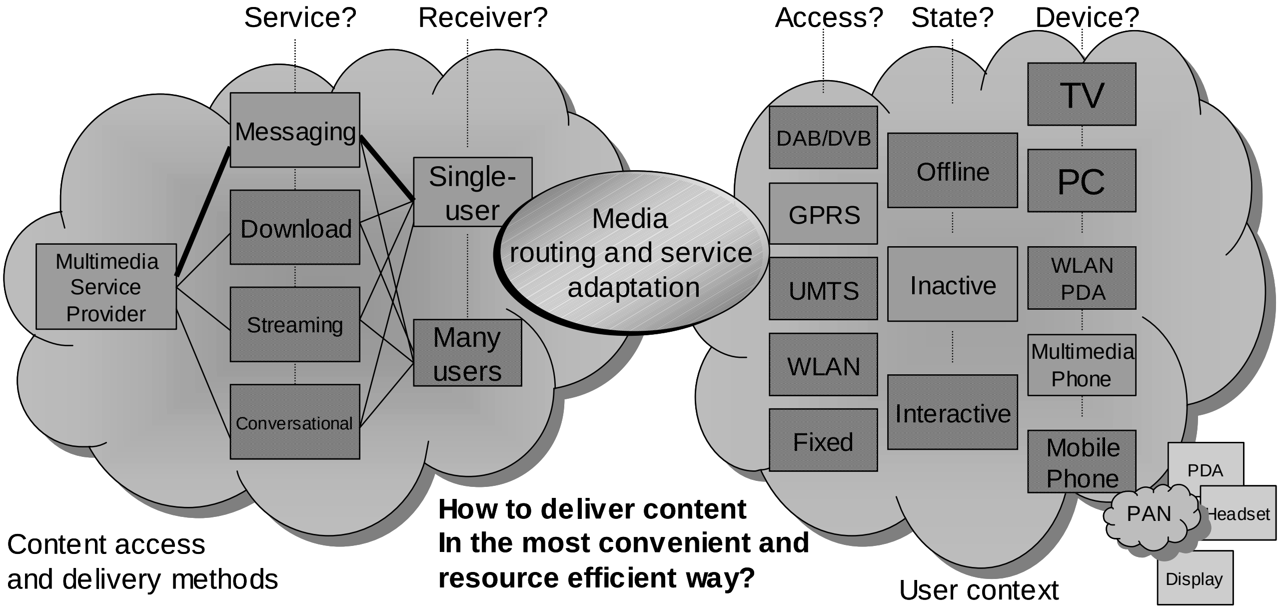


**Figure 1: The challenge of media distribution in heterogeneous environments**

By changing today's vertical content distribution architectures into horizontal multimedia services, the number of reachable users can easily be increased. In addition, a horizontally layered structured makes it easier to combine multimedia services with other services (e.g. user-context awareness, personalization, location-awareness) to further add value to multimedia content. A more flexible multimedia delivery architecture also makes it easier to utilize network resources in the most optimal way and to integrate the kind of service adaptation, which is required for *mobile* multimedia services.

## (d) Possible approach

The approach proposed to establish a generic solution for media distribution in heterogeneous environments is to establish an abstraction layer referred to as the Ambient Media Overlay Network. The Media-delivery overlay network is supposed to distribute content, once injected, economically and efficiently to millions of mobile users within a matter of seconds.
The Ambient Media Overlay Network (see Figure 2) establishes a virtual network plane comprising logical nodes implementing certain functions, which are important for addressing all media delivery challenges in mobile networks. The nodes constituting the Ambient Media Delivery Overlay are further referred to as MediaPorts. MediaPorts will implement one or all of the following functions:

- Smart Media Routing
  Smart media routing refers to the ability to take into account characteristics of the media content, link characteristics and user preferences to deliver media content in the best way. Smart media routing also refers to the capability to manage and maintain disjoint paths between content sources and sinks, which could be used simultaneously. This is useful for increased service robustness but might also be necessary for supporting scenarios where consumer like to interact with a multimedia application via various devices using different access technologies. A consumer with a mobile terminal and a WLAN PDA might want to view the video part of a session on her PDA (delivered via WLAN access), while listening to the audio part with the Bluetooth headset.

- Media Adaptation
  Media adaptation refers to the capability to adapt media content to different quality levels and data rates as well as transformation functions to convert between different media formats. The MediaPort can provide the required adaptation function by itself or it manages and controls resources, to carry out those functions. The needs of commercial content providers need to be considered carefully, since they often would like to avoid uncontrolled transformation of their content.

- Media Caching
  Media caching refers to the capability to store media or certain fractions of media in order to avoid long haul communication paths between media source and media clients (sink). Media caches will primarily be used for content for which a high demand is expected or has already been monitored.

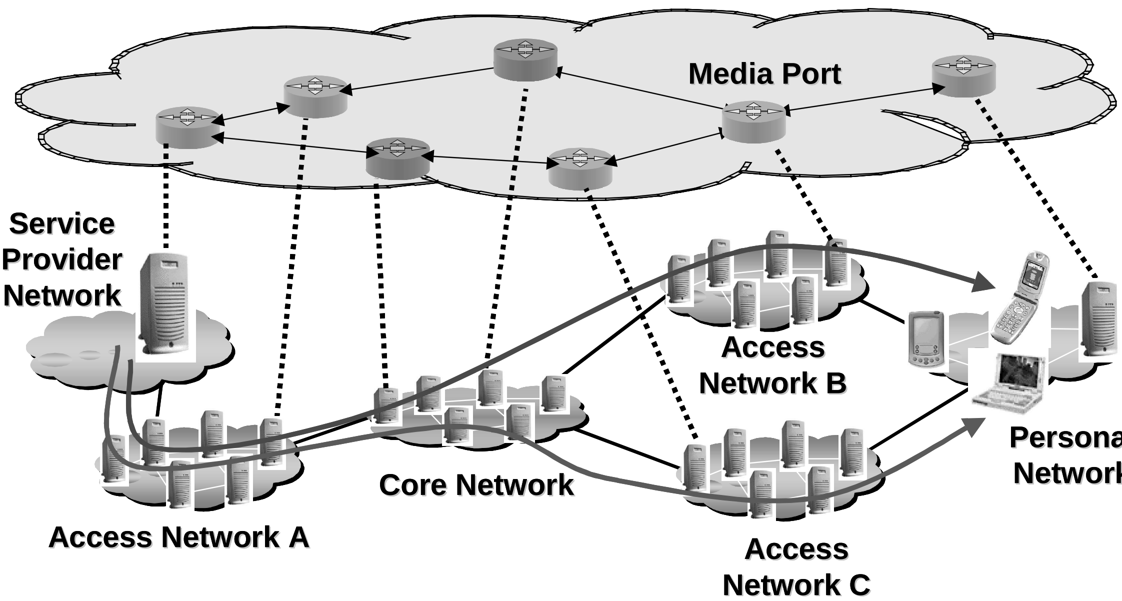


**Figure 2 – Ambient Media Delivery Network Architecture**

Physical nodes of the interconnectivity layer can be turned into MediaPorts by implementing the smart media router, media adaptation and/or media cache functionality (see Figure 2). At least nodes located at the edges of a domain - technology domain or operator domain - should provide MediaPort functionalities to make the transmission characteristics known to the media delivery overlay network.

Different access networks, core networks, and service provider networks will typically belong to different commercial entities (companies). The Ambient Media Delivery Network Architecture must be able to handle such a multi-operator environment. The Ambient Media Delivery overlay itself can also be sub-divided over multiple operator companies. It is important to find business models where each of the involved operators profits from media delivery and has the right incentive to make the required investments in media delivery technology.

## (e) State of the art in the area (including important references)

[1] proposes to split media streams into subflows and to transport the subflows over disjoint paths. The following advantages are mentioned: reduced link congestion probability, independent packet loss over the disjoint path, increased robustness against link failures since it is unlikely that all of the disjoint paths are affected by link failures at the same time, increases security, since for an eavesdropper it's difficult to collect and put together data sent over disjoint paths. Ideas for a multi-flow realtime transport protocol (MFRTP) sitting above RTP and TCP are outlined. The usefulness of the approach is verified by simulation results.
[2] mentions the drawbacks of traditional routing protocols like BGP (border gateway protocol): sub-optimal routing decisions, does not consider path performance, and the long time it takes (up to several minutes) until stabilization in case of link failure. As a solution it is proposed to introduce Resilient Overlay Networks (RONs) on top of the underlying Internet routing substrate. Advantages of the approach: efficient end-system detection and correction of faults, better reliability, and better performance. Mentioned application: content Delivery Networks.

Media Point systems

[10] presents the Media Point concept as a means to provide managed high-rate services in areas with fragmented radio coverage. It is shown that 'islands' of Media Points can be integrated into the public cellular infrastructure, benefiting from the signalization when high-rate access is temporarily unavailable. It is shown that the Session Initiation Protocol (SIP) can serve as an enabling technology for session management and data delivery. The Media Point system provides a managed push-service, which gives users access to high rate personalized data/content via a cost-efficient infrastructure.
In [11] a new service concept for a mobile broadband system called the Wireless Media System (WMS) is introduced. The WMS will provide broadband access to terminals with medium velocity of movement and is embedded into a cellular radio network to support a high velocity of terminals with medium transmission rate. An Intelligent Service Control will provide virtual continuous radio connectivity to the WMS although the physical radio connectivity might be discontinuous. Broadcast, multicast and single-cast services will be combined to minimize the number of

transmissions needed to provide the contents requested by the users. The concept of the Intelligent Service Control as well as basic service concepts and multimedia applications and usage scenarios are presented.

Media Adaptation

In the last decade, media adaptation research has been performed very actively. Several hundred papers have been published in conferences and journals. In most cases, the publications focused on a specific adaptation means (like FEC, re-transmission, etc.) but also integrated research projects have been performed. It is totally out of scope to present a comprehensive overview. Here, we just want to mention some examples of ongoing research activities in the area of transcoding and adaptive codecs.
In general, we can differentiate between sender- and receiver driven adaptation. Many proposals are variants of the receiver-driven layered multicast (RLM) approach [8], which have problems with scalability and efficiency. For sender rate adaptation, various adaptive codecs have been used for adaptation purposes (e.g. layered DCT [4], H.261 [5], MPEG-4 [7]) etc. While these approaches are useful in a point-to-point scenario, they often suffer from the flexibility for the support of different receiver requirements. For this case, wavelet based coding mechanisms have recently proven to offer a good compromise between compression ratio, error tolerance and the ability to support various filter operations within network nodes to adapt to the respective requirements even in group scenarios ([3],[6]). But all methods have in common, that for large heterogeneous requirements, it is sometimes impossible to agree on a common set of codecs for all involved partners. In this case, transcoding is necessary. Some work has been done for specific media conversions (e.g. for MPEG-2 to H.263 transcoding [9]).

### (f) Expected results

The proposed research activity is expected to result in a specification of the ambient media delivery overlay network, which includes:

- the overlay network architecture,
- the design and functional structure of media ports,
- the specification of protocols and APIs connecting media ports as well as offering information exchange with the network and application/service layer and
- the description and evaluation of routing strategies as well as adaptation strategies.

### (g) Time frame to get the expected results

It is expected to provide the expected results within a research activity lasting 2 years.

### List of References

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