Wireless World Research Forum (WWRF)

(a) Title of the research item: Large User Group Support in Mobile Networks

Experts:

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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?)

With the introduction of Multimedia content into the network, we see also an increasing number of personalized and non-personalized information distribution services. In particular news and entertainment services are becoming more and more popular. Besides being always connected, users are interested to be always informed on various subjects, depending on personal interest. Examples of time-bounded information are information and news on ongoing political, cultural, social and sport events, and of course also news on and from friends and relatives ("buddies"). The commonness behind many of those services is, that the same multimedia information needs to be time-bounded distributed to groups of interested users, and that personalization of the information can be performed on the client side and not in the network. In contrast to traditional web content (Pull service), the user is informed about updates, changes and news information (push service). An important aspect for this kind of services is, that many interested users would like to get it as soon as it becomes available, but definitely not later than their neighbor.

Mobile operator today offers a large number of information distribution services. Main examples are sport information like results from football matches or highlights from a Grand-Prix track (see Figure 1). One group comprises the terminals of all users, who are interested in the same information. All members of such a group receive exactly the same information *preferably* at the same time. A number of different groups may exist and one user may belong to different groups at the same time.

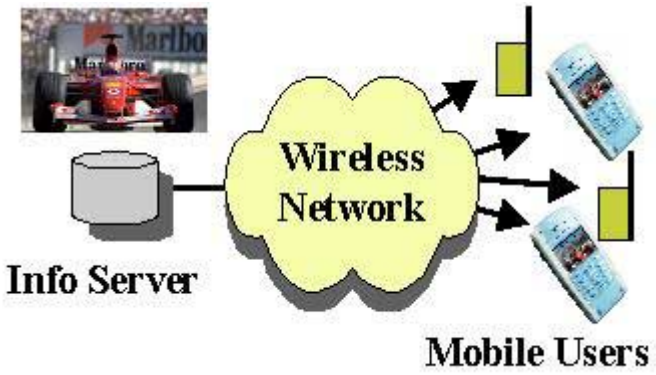

Figure 1: Information Distribution Service

This service is considered as base for the OverDRiVE work [1][2][5]. The network perspective for such services is depicted in Figure 2. The network provides the same information for medium to large-sized groups of mobile users. Depending on the group size and the concentration or distribution, respectively, of the group members, different solutions might be appropriate to enable the time-bounded delivery.

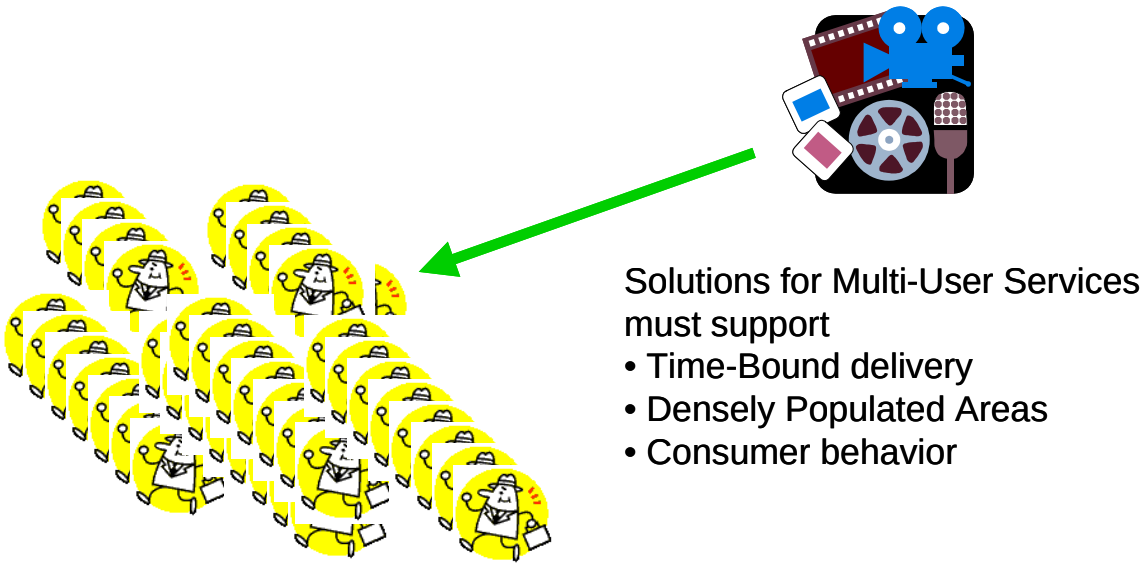

Figure 2: Network view on Multi-User Services

Services such as sports information distribution services have high requirements on delivery time bounds. This is not an issue today, but this may become an issue when services become attractive and the group sizes very large. From the Internet, the type of consumer behavior is also referred as "SlashDot –Effect".

"The Slashdot Effect is the sudden, relatively temporary surge in traffic to a Web site that occurs when a high-traffic Web site or other source posts a story that refers visitors to another Web site. The effect gets its name from the Slashdot Web site, which provides content about Linux and related software, and sometimes features news about other related but less-traveled sites. However, the effect can be perceived when any large Web site posts a high-interest, widely-publicized story, about another site. The effect is obviously much more noticeable on smaller sites and the surge in traffic sometimes will slow a site down or make it impossible to reach." [9][10]

In case of a highlight such as a goal during a match, the delivery time should be predictable and not exceed certain delivery duration.. Note that the total time between the event and the content reception is also composed of the content creation, adaptation, delivery etc. This additionally becomes a challenging requirement in densely populated areas, where traditional point-to-point delivery mechanism provide insufficient support for time-bounded delivery to a large number of group members in the same area.

(d) Possible approach

Multicast technology provides a number of beneficial features for information distribution services. The overall idea of multicast is to save resources by replicating data packets as close as possible to their final destinations. The main benefits for mobile operators, service providers and mobile users are

- Saving capacity and resources on the radio interface and in the network
- Saving processing and line capacity on content servers, intermediate nodes like SGSNs and GGSNs and terminals because of sending packets only once
- Simultaneous and on-time delivery for large user groups
- Enabling technology for all kind of “Push-Services”

IP Multicast is a topic of investigations for a long time now. It provides the ability to send efficiently information to one or more receivers at the same time. The multicast sender sends the information package only once. The group management just handles membership information like providing join and leave-messages. The package is addressed with a group address.
Multicast Listener Discovery (MLD) [7] for IPv6 provides multicast group management functions between the hosts and the local multicast routers. However, when applying the group management function to multi-access systems, new tasks and functions become necessary. This contribution discusses a certain set of new functions and optimization approaches.

In the context of this contribution, a multiple access system is considered. Multi-Access (see also Figure 3) is the system capability of combining and using a number of radio and fixed accesses. It is assumed, that at least one access system provides continuous connectivity to services in the infrastructure. All other access systems provide additional connectivity alternatives to the infrastructure. Those access systems may provide either continuous connectivity or only connectivity in hot-spot areas. The cell sizes and the cell structure may vary between the different access systems. The different access systems may also provide different Quality of Service provisioning capabilities. This network structure is the general form of a Multi-Access system.

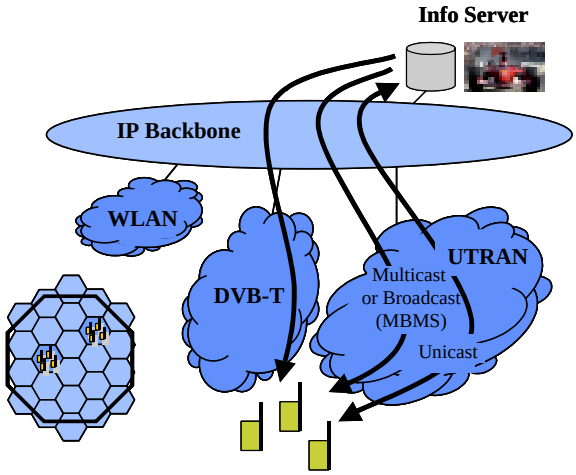

Figure 3: Hierarchical, Hybrid Multi-Access System

In Figure 3, a specific configuration as under study within the IST project OverDRiVE is depicted. The system includes a digital broadcast system (here DVB-T) and the UMTS radio access network (UTRAN). The UMTS system also offers multicast or broadcast transmission capabilities in the network and also on the radio. These are new transmission features, which are currently standardized for 3GPP release 6. The work-item is called Multimedia Broadcast and Multicast Service (MBMS) [3], [4] and shall enable efficient multicast or broadcast transmissions in the UMTS packet domain.

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

Multimedia Broadcast and Multicast Services (MBMS) is a work item for 3GPP Release 6. The MBMS [3],[4] is a point-to-multipoint service in which data is transmitted from a single source entity to multiple users. Transmitting the same data to multiple users allows network resources to be shared. The 3GPP Service and Architecture working group (SA2) has produced a technical report to describe and discuss the architectural issue of multicast and broadcast support in 3GPP. The technical report is closed now and the work on a technical specification has started.
The MBMS point-to-multipoint bearer shall be interoperable with IETF IP Multicast and IP Multicast addressing shall be used. The overall ambition is to support multicast and broadcast services efficiently also on the radio interface. Therefore, 3GPP differentiate between two point-to-multipoint UMTS modes:

- Broadcast Mode: data are transmitted to all users in a broadcast area.
- Multicast Mode: data are transmitted to a group of users that have subscribed to become member of that group.

As in a classical IP multicast implementation, both of the modes shall support service announcements in order to discover active MBMS services.
The current architecture proposal is depicted in Figure 4. MBMS architecture introduces a new functional element: the Broadcast Multicast - Service Centre (BM-SC). It offers interfaces to content providers and shall provide functions for authorization and authentication as well as functions to determine the quality of service for the MBMS transmission.

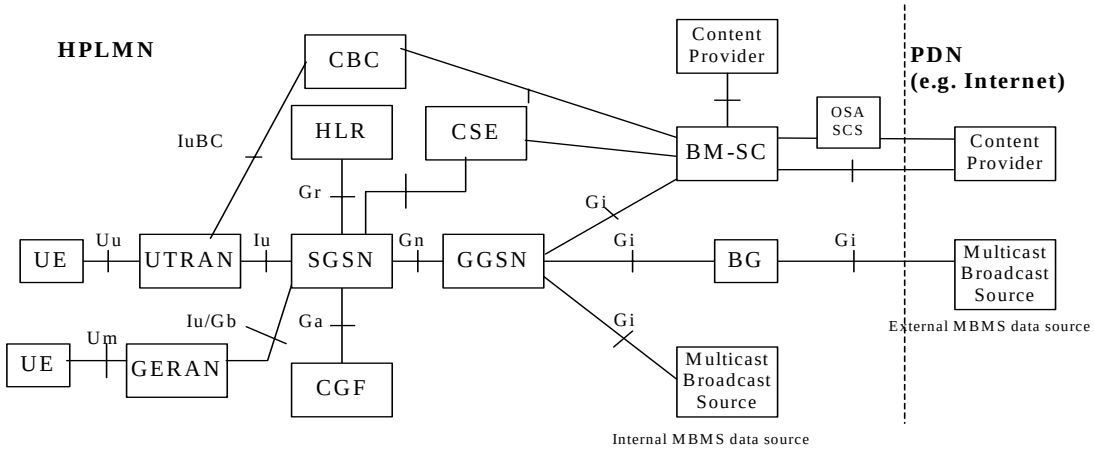

Figure 4: MBMS Architecture

The BM-SC is an MBMS data source. MBMS data may be scheduled in the BM-SC, e.g. for transmission to the user every hour. It offers interfaces over that content provider can request data delivery to users. However, the architecture allows also internal and external broadcast and multicast sources. Internal data sources may directly provide their data through Gi interface (see Figure 4). External data sources are linked to the GGSN through the Border Gateway (BG) that controls data delivery. The Cell Broadcast Centre (CBC) is optional and may be used to announce MBMS services to the users. SMS cell broadcast is not the only way to achieve MBMS Service announcement and 3GPP is currently discussing different options among which are:

- SMS cell broadcast (CBS)
- Using MBMS broadcast mode to announce MBMS multicast services
- PUSH mechanisms (WAP, SMS,…)
- Browsing a web server

Two approaches are currently specifying for MBMS data transfer through the core network. One approach uses IP unicast (only packet replication in GSN nodes) and the other approach uses also IP Multicast for data transmission. Both methods use the GPRS tunnelling protocol (GTP) to transport the multicast packets to the receivers. Using IP multicast for data transmission in the core network would be more efficient but requires that the transport network includes additional multicast routers and that network entities (including RNC and GGSN) support IGMP/MLD.

(f) Expected results

The proposed research activity will result in generic system enhancements to provide service to different sized of groups of mobile users in systems beyond 3G. Multicast and Broadcast network capabilities or networks will be seen in future as integral capabilities of a Multi-Access system,

(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

[1] Janneteau C. et al., "Comparison of Three Approaches Towards Mobile Multicast", accepted to IST Mobile Summit 2003.

[2] Thorsten Lohmar et al, “Architectural issues for multicast group partitioning in mobile, hybrid networks“, accepted to IST Mobile Summit 2003.

[3] 3GPP TR 23.846 v6.1.0, “3rd Generation Partnership Project, Technical Specification Group Services and System Aspects, Multimedia Broadcast/Multicast Service, Architecture and Functional Description, (Release 6)", December 2002.

[4] 3GPP TS 22.146 v6.1.0, "3rd Generation Partnership Project, Technical Specification Group Services and System Aspects, Multimedia Broadcast/Multicast Service, Stage 1, (Release 6)", September 2002.

[5] R. Tönjes, K. Mößner, T. Lohmar, M. Wolf: "OverDRiVE - Spectrum Efficient Multicast Services to Vehicles", IST Mobile Summit, Thessaloniki, 16-19.June, 2002.

[6] T. Paila et al.: "Flexible Network Architecture for Future Hybrid Wireless Systems", Mobile Summit 2001; Barcelona; 10.-12. September 2001

[7] IETF RFC 2710, S. Deering, W. Fenner, B. Haberman, “Multicast Listener Discovery (MLD) for IPv6”, October 1999.

[8] ETSI EN 300 468 v 1.1.4. : "Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems”

[9] Stephen Adler, “The Slashdot Effect: An Analysis of Three Internet Publications”, available at: http://ssadler.phy.bnl.gov/adler/SDE/SlashDotEffect.html

[10] „Slashdot Effect - a whatis definition“ available on: http://whatis.techtarget.com/definition/0,289893,sid9_gci214064,00.html