Modular P2P Multicast in Wireless Ad-hoc Networks

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Today's world more and more comprises WLAN capable devices. These can be used to set up so-called *ad-hoc networks* which enable multi-hop communication with no explicitly required fixed infrastructure. In this context numerous applications in military, educational, touristic or gaming scenarios arise: Wireless and distributed voice-over-IP, slideshow and chat applications as well as multiplayer games can become highly attractive as, by use of ad-hoc networks, they can be provided wherever WLAN devices gather. We in this demonstration show fully operational implementations (partially visible in Figure 1) of these applications, which run on a set of Windows and Linux notebooks forming a small ad-hoc network.

While people watching the demonstration may freely test and play with the applications and games, our main concern is to show the modular and dynamic composition of P2P multicast services. Indeed, for deploying their full potential, the mentioned applications require a multicast service which meets the respective application's requirements. The latter differ especially when looking at the applications' reliability requirements: While e.g. single packet losses can be handled well by modern audio codecs, missing data is unacceptable for slideshow and chat applications, and low latencies turn out to be crucial for supporting multiplayer games. The integration of multicast services on the network layer of wireless devices thus shows to be complicated, since diverging reliability requirements can hardly be met by all devices network-wide. A more convenient approach can be found in application-layer (P2P) multicast services, which push protocol complexity to the application-layer of group members. Since, here, the service can flexibly be customized, application requirements can easily be met.

Our sample applications thus rely on the P2P multicast service provided by our *MAAM*, i.e. the *Modular Architecture for Application-Layer Multicast*, which we believe is an innovative contribution since it greatly simplifies multicast service and thus application deployment in ad-hoc networks. While we described our architecture's theoretical aspects in [1] and [2], we in this demonstration would now like to show its practical use. The MAAM decomposes a P2P multicast service into different protocol components (modules), integrating functionality such as *Overlay Topologies*, *Transport Mechanisms* and *Generic Scalability Enhancements*. Since modules have standardized interfaces, protocol components can be arbitrarily combined and interchanged. Setting up a multicast service as well as its adaptation to specific application and network scenarios thus becomes as easy as plugging together different modules that integrate functionality tailored to the respective scenarios. For showing and underlining the MAAM's modular character, we in our demonstration also provide a graphical user interface explicitly for configuration purposes. This interface can be used for viewing and altering the multicast service's configuration: Users watching the demonstration can e.g. select the P2P multicast algorithm as well as the transport protocol which will be employed by the MAAM – we have a couple of popular P2P multicast algorithms such as Narada, NICE, PAST-DM and TrAM as well as several transport protocols tailored to different purposes available for selection. As a direct consequence of their choice, users can see the impact of the selected modules on the performance of the applications running on top of the MAAM.

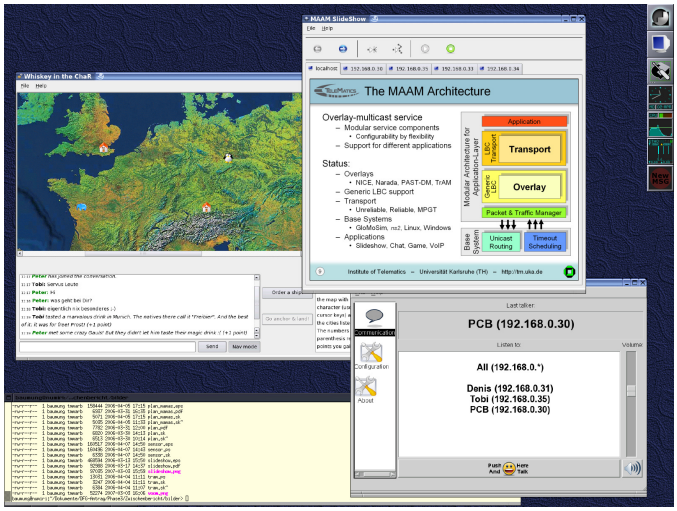

Fig. 1. Presentation (top right), Chat (left) and Voice-over-IP (bottom right) applications running on top of the modular P2P multicast service provided by the MAAM.

As an additional feature our architecture accesses operating system functionality only through a modular wrapper layer. Since, by doing so, the operating system becomes interchangeable, developed protocol components may be easily operated on real-world devices as well as within network simulation software, without any changes of source code. We thus greatly simplify the migration between a protocol's simulative evaluation and its real-world operation. While we focus on the MAAM's operation on real devices, we in our demonstration also show its operation within a network simulation software. As the latter allows complex network scenarios, it is well suited for e.g. visualizing the overlay topologies established by different P2P multicast algorithms used by the MAAM.

References

[1] Peter Baumung, "On the Modular Composition of Scalable Application-Layer Multicast Services for Mobile Ad-hoc Networks," in *Proceedings of The 2006 International Workshop on Wireless Ad-hoc and Sensor Networks (IWWAN 2006)*, New York, USA, Jun 2006.

[2] Peter Baumung et al., "The Modular Architecture for Application-Layer Multicast," http://maam.pcb-net.org, 2005.