Background and Mission

MediaTeam Oulu (MediaTeam), founded in 1997, is a research group of about 40 people at the Information Processing Laboratory in the Department of Electrical and Information Engineering at the University of Oulu. MediaTeam is a multidisciplinary research group, having researchers with backgrounds in electrical and information engineering, computer science and linguistics.

MediaTeam’s mission is to carry out leading-edge long-term research, which produces new scientific knowledge and novel technological solutions for mobile, distributed multimedia and communications.

MediaTeam conducts research on the features, use, and applications of multimedia and digital media types (image, sound, video, text) in information and communication systems. MediaTeam’s research combines the different areas of information and telecommunications technology, with a special focus on mobility and wireless features as well as future generations of communication technology. MediaTeam’s main fields of interest are distributed computing, image and video processing, information hiding, language and audio technology, mobile services and packet networks.

Scientific Progress

The Stardust - Business Analysis and Economic DRM Models in Mobile Distribution of Rich Digital Content project funded by the National Technology Agency and industry ended in spring 2005. The project was conducted jointly by the Department of Economics at the Faculty of Economics and Business Administration and MediaTeam. The project focused on developing methods of digital watermarking and the use of cryptography in digital rights management (DRM). Additional effort went into researching the mechanisms of electrical mobile commerce and the economic models related to the protection of digital contents as parts of future network and application services. During 2005 a DRM enabled multimedia player was implemented to a mobile phone, allowing users to play and share protected digital content. The player was used to demonstrate new content protection methods and value added services developed in the project, such as a secure counter to restrict the number of times content can be played and audio protection with encryption and watermarks. Mobile content superdistribution was demonstrated with a mobile card service, where users were able to send Christmas cards with MMS messages to their friends’ mobile phones from a web page.

The Rotuaari - Context-aware Mobile Multimedia Services project funded by the National Technology Agency under the FENIX - Interactive Computing Technology Programme, an international industrial consortium and the city of Oulu continued in 2005. MediaLab of the Helsinki University of Art and Design joined the research consortium for the third project year. This multidisciplinary project approaches context-aware mobile multimedia services from a number of different but complementary viewpoints: context-aware computing, mobile ubiquitous multimedia, consumer behaviour, business and R&D networks, human computer interaction, and security and safety. The three key components of the project are a multifaceted service system, large-scale field trials and value networks. The service system includes multiple wireless networks, versatile service platforms and a number of new prototype services developed by the project and industrial partners. The services are empirically evaluated in large-scale field trials in the true environment of use, involving genuine end users and companies. The research is based on a seamless value network, which is modelled for the purpose of recognizing the necessary conditions and processes of an effective R&D network. This way the project aims at stimulating a local ecosystem for producing new innovative mobile multimedia services based on viable business models. In 2005, the project organized two large field trials (SmartCampus 1, SmartRotuaari 3) and three smaller concept evaluations (MobiLenin, Location-Aware Game, CityTag). The highlights in 2005 included the highly successful Mobile Fair Diary service, evaluated at the national housing fair in Oulu, and the Best Arts Paper Award presented to Jürgen Scheible and Timo Ojala for their MobiLenin paper in ACM Multimedia 2005, the premier annual international conference on multimedia. The results are reported in a large number of scientific publica-
tions and theses. More detailed information is available at the project’s web site (http://www.rotuaari.net).

The All-IP - Application Supernetworking project funded by the National Technology Agency and industry continued in 2005. The project has focused on research of All-IP peer-to-peer and plug-and-play middleware, applications and services. It is seen as a prominent area for novel applications and services, but the concept leverages a wider aspect of All-IP communications where all network traffic (real-time and non-realtime) will eventually be carried over IP (Internet Protocol). Thematically this contributes to vertically integrated heterogeneous networks, services and applications. The Plug-and-Play Application Platform (PnPAP) developed in the project enables mobile P2P applications to communicate seamlessly using different communication protocols and connectivities. Run-time optimization can be achieved with reloadable and lightweight state machines integrated to the PnPAP. In 2005, the concept of application supernetworking was crystallized with a new prototype application combining navigation application and peer-to-peer communications. Mobile file sharing and navigation-aided P2P prototype applications on PnPAP were developed for Symbian S60 platform, demonstrating multi-device interoperability and fixed-mobile convergence. For service life-cycle management, especially considering session start-up and licensing in P2P based group communications, a method called Agile Content Push Control (ACPC) was proposed. PnPAP intercommunication with SIP (Session Initiation Protocol) was specified and defined with first stage prototype implementation. This enables transfer of context and control information with a PIDF (Presence Information Data Format), to which an extension was proposed and respective standardization proposal to SIMPLE WG was presented at the Internet Engineering Task Force (IETF).

The three-year-long CAPNET - Context-Aware Pervasive Networking research program, funded by the National Technology Agency and industry, was completed in 2004. However, as there was intense interest in the work done and encouraging prospects for the CAPNET approach, a new three-year-long CAPNET2 program was launched in early 2005. The goal of the first CAPNET program was to create a foundation for new information and communications technologies and for business in the field. The CAPNET2 program will continue this work, deepening the research on context exploitation, enhancing intuitive interaction with ubiquitous services (e.g. visualising the context and tangible interfaces) and creating enabling technologies that can be linked with mainstream technology development and thus shortening the time for business deployment. During the first year, the CAPNET
architecture was optimized for the Symbian platform, which enabled the implementation of several prototypes. For example, requesting pervasive services by touching RFID’s acts as a showcase for the multidimensional CAPNET research: intuitive interface design, enhanced RFID technology adoption and a mobile service user perspective. The basic research was carried out on essential domains of pervasive networking: service discovery, connectivity management, context recognition and context data exploitation in pervasive services.

The new Zirion - Mobile Media Containing Value Adding Services project funded by the National Technology Agency and industry started in June 2005. The project continues MediaTeam’s research on information hiding, with a new focus on integrating state-of-the-art technologies, such as multi-watermarking, digital rights management and technologies of electronic commerce, into new value-adding services to the mobile environment. A mobile audio recorder application was developed that is able to extract a watermarked web link from the audio played through loudspeakers and recorded with a mobile phone. A similar concept is being investigated with images, where watermarked images are printed and scanned for watermark extraction. Several copyright protection mechanisms have also been developed. Audio content can be encrypted and the number of times a user has played particular content can be counted using watermarking techniques.

The new Citizen’s Network project of the panOULU - COMPETENCE Oulu 400 Program funded jointly by the City of Oulu and the University of Oulu started in October 2005. The goal of the project is to provide our expertise on wireless networks for the use of the COMPETENCE Oulu 400 program and the panOULU network. This includes, for example, the piloting of new centralized management solutions, wireless point-to-multipoint links and mesh networks in the implementation of the network. The panOULU network has provided the University of Oulu with an extensive and unique public research laboratory, and the project allows the network to be flexibly used for research and development also in the future. In addition, the project serves as an excellent support for the social contribution function and image of the University of Oulu.

MediaTeam’s research program on content-based multimedia retrieval is realized in two ongoing research projects funded by the Academy of Finland: CBIR - Content-based Information Retrieval and Prosody of Emotions - Multiparametric Prosodic Analysis of Phonetic and Phonological Correlates of Emotions. This program investigates multimedia content analysis and its application in content-based video and audio retrieval systems. The main objective is to develop methods for narrowing down the “semantic gap” between the concept-based and content-based approaches to database indexing, and the utilization of these methods in practical retrieval applications. Filling the gap is important in order to enable a design of databases and search engines where it is easier to map user-specified search criteria to off-line/online computed index terms and the meta-data of the database. The problem is especially unresolved as regards forthcoming media types like digital speech, music, image, and image sequence, where the search criteria often include semantic concepts. The problem is tackled with a cross-disciplinary approach involving information engineering, linguistics, natural sciences, and information studies.

The potential of prosodic/acoustic cues in recognizing different affective speaker-states is gradually receiving more attention in the form of prosodic data mining and applications have been developed for major languages such as English. One of the goals of our research program has been to develop this novel speech technology for a small language, i.e. Finnish. For this purpose we have put together MediaTeam Speech Corpus, the first large Finnish emotional speech database. It contains in total 450 emotional speech samples of five different emotions, produced by professional actors. For carrying out the acoustic analysis we have developed the f0Tool, speech analysis software implemented in the MATLAB language. The results are very promising, and they can be utilized in the development of more intelligent speech corpus search engines capable of analyzing the emotional semantic content of the data.

A specific and important goal in our research program is successful participation in the annual TRECVID competition. The purpose of the competition is to promote progress in content-based multimedia retrieval via open and well-defined evaluation. It is the premier international benchmark in multimedia retrieval, bringing together the world’s leading research groups in the field. TRECVID has provided an excellent benchmark for the VIRE video retrieval system, which is one of the main results of our program. VIRE is based on cluster-temporal browsing, a novel approach for interactive browsing and retrieval of large video databases. The approach combines the traditional timeline presentation of a video shot with that obtained by unsupervised multi-modal content-based clustering with self-organizing maps into a single representation of the video database. The resulting 2-D view into the video database allows efficient interactive navigation in two semantic spaces, temporal adjacency and content similarity, simultaneously. The view can be refined with optional semantic filtering, which corre-
sponds to detecting the presence of any designated semantic concept(s) in the video data represented to the user. Additionally, VIRE supports manual query-based retrieval of video shots. The experimental results obtained at the international TRECVID competitions in 2004 and 2005 showed that VIRE provides an efficient approach for realizing interactive video retrieval.

**Exploitation of Results**

The research results have been disseminated to the academic community in the form of about 50 scientific publications. MediaTeam also places lots of emphasis on the popularisation of science, which has resulted in dozens of articles in major Finnish newspapers, professional magazines and periodicals, radio and television interviews, and on-line news archives.

A concrete example of the popularization of science is the future video browser implemented for the Oulu Expo exhibition, which is available at the Science Centre Tietomaa in Oulu. The browser facilitates searching from a large video archive using novel content-based access and browsing technology. The video archive in the demonstration contains a 16-hour collection of news footage from the Finnish Broadcasting Company YLE.

Another concrete example of exploitation of results is the SmartLibrary service developed in the Rotuaari project in collaboration with Oulu University Library. The SmartLibrary enhances the traditional library database searches by providing adaptive browsing interfaces for different mobile devices together with map-based guidance. The service is equipped with a content provider interface, which allows library staff to maintain the content. Once the service was evaluated to provide sufficient functionality in the two SmartLibrary concept evaluations, it was handed over to the library for production use in early 2005. Since then it has become one of the ten most popular web services provided by the library.

The results of the long-term basic research have also been exploited in subcontracted research projects commissioned by local industry, which provide an efficient form of technology transfer. For example, the new digital watermarking methodology developed in our research group has been utilized in several innovative application demonstrations.

**International and Domestic Collaboration**

During its eight years of operation, MediaTeam has networked with a wide cross-section of partners in the public sector and the business world. The group has been the main driver, for example, in developing community services for people in its hometown of Oulu in northern Finland. Perhaps the most well known of these services is panOULU (Public Access Network OULU), provided jointly by the University of Oulu, the city of Oulu, Oulu Polytechnic and Oulun Puhelin Plc. panOULU is a unique public network that offers free wireless Internet access to everyone within its coverage area. The latest addition to the concept is the panOULU subscription offered by operators, which allows local organizations to offer panOULU coverage in their premises for the benefit of their customers and visitors.

Another well-known community service is the Digital Oulu Cultural Database. It was originally initiated in the Rotuaari project for the purpose of producing rich mobile multimedia content of local relevance for the use of the field trials carried out in the project. Thanks to the fruitful collaboration between the project, Oulu Polytechnic and different cultural institutions, the Cultural Database has grown into a versatile web service, which combines modern multimedia technology with vast local cultural information. The service provides multiple browsing interfaces adapted for different devices including mobile phones. In the desktop user interface, the database can be browsed with a 3D panorama view of the city centre, where virtual tour guides provide you with interesting little stories. The Digital Oulu Cultural Database is available at [http://www.rotuaari.net/dok](http://www.rotuaari.net/dok).

MediaTeam values close collaboration with its partners as an essential factor in conducting leading edge research and in transferring research results into practical solutions. The most important partners are the following funding bodies, companies, and research organisations: the National Technology Agency, the Academy of Finland, Capricode, Elektrobit Group, IBM, Jutel, Nokia, OPOY/Finnet Group, Oulun...
Liíkekeskus ry., Serv-It, Solid Information Technology, Targetor, TeliaSonera Finland, TietoEnator, Verkkoasema, VTT Electronics, Mobile Forum, Ocu-
topus, City of Oulu, University of Maryland (USA), Oulu Polytechnic, and various research groups and 
laboratories in Finland and at the University of Oulu.

Future Goals

MediaTeam will continue to strive towards becoming 
one of the leading authorities in multimedia research. 
MediaTeam will pursue its goals of providing practi-
cal, easily adaptable solutions to the multimedia ap-
lication industry and of performing eminent research 
in its fields of expertise. MediaTeam will remain in 
active contact with industry as a whole, as well as its 
existing partners, and strengthen and develop its in-
ternational network. MediaTeam will further improve 
its innovation process, to ensure an even more effi-
cient manner of transforming research results into the 
practical applications.

Personnel

| professors & doctors | 8 |
| graduate students    | 8 |
| others               | 22 |
| total                | 38 |
| person years         | 30 |

External Funding

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