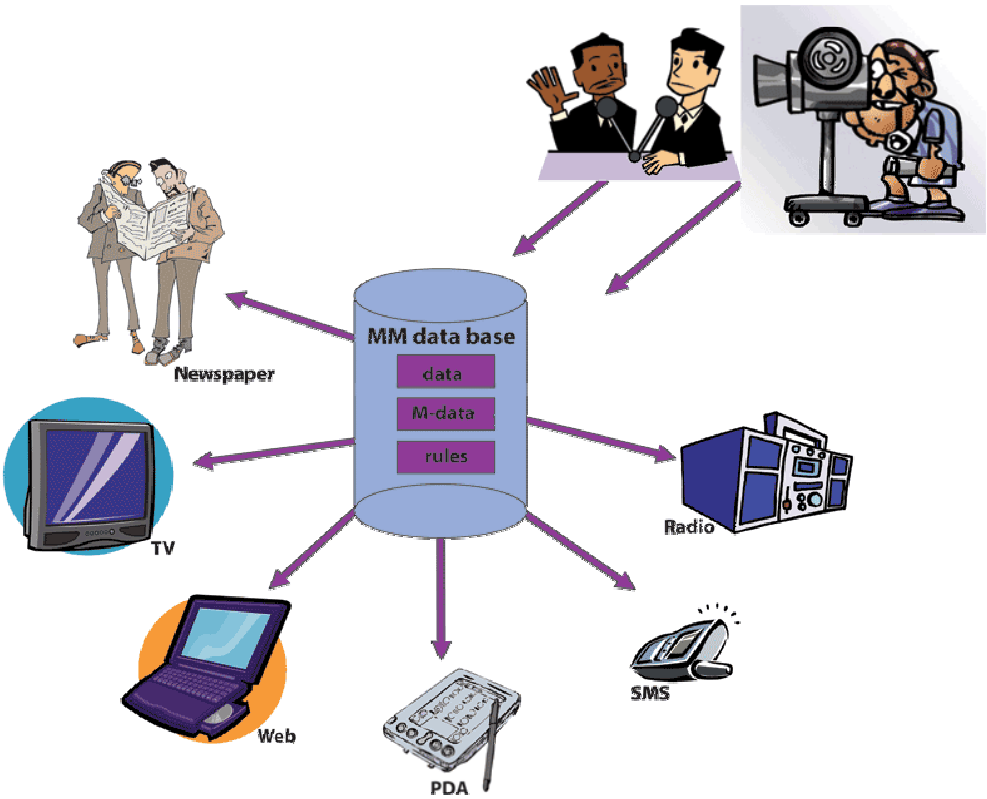
Norsk Regnesentral
NORWEGIAN COMPUTING CENTER

Report

The ChannelS report



Report no 1007

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Date February 2005

ISBN 82-539-0515-7

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About the authors

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Norsk Regnesentral

Norsk Regnesentral (Norwegian Computing Center, NR) is a private, independent, non-profit foundation established in 1952. NR carries out contract research and development projects in the areas of information and communication technology and applied statistical modeling. The clients are a broad range of industrial, commercial and public service organizations in the national as well as the international market. Our scientific and technical capabilities are further developed in co-operation with The Research Council of Norway and key customers. The results of our projects may take the form of reports, software, prototypes, and short courses. A proof of the confidence and appreciation our clients have for us is given by the fact that most of our new contracts are signed with previous customers.

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Title	**The ChannelS Report**
Authors	**Wolfgang Leister and Knut Holmqvist**
Date	February
Year	2005
ISBN	82-539-0515-7
Publication number	1007

Abstract

This report summarizes the ChannelS project. It describes solutions, which enable information and services to be tailored and channeled to various target groups in different work and life situations.

The overall objective is to describe how multi-platform services and information can and should be:

- channeled to specific target groups through multiple technology platforms and end-user technologies
- channeled through heterogeneous kinds of network infrastructures
- organised as a service architecture enabling flexible use and updating

Keywords	multi media, multi channel, architecture, codec, streaming, digital TV
Target group	NR customers
Availability	Open
Project number	11000
Research field	Multi media – multi channel
Number of pages	24

Preface

Managing Director Lars Holden

Norwegian Computing Center, (Norsk Regnesentral, NR) is a private, independent, non-profit foundation carrying out contract research and development within information technology and statistics. NR is one of thirteen technical-industrial research institutes in Norway, and is mainly financed by users of research from Norwegian and international businesses, public sector in addition to several EU projects. NR is also financed by government grants and Strategic Institute Programs (SIP).

ChannelS is a Strategic Institute Program (SIP), which is used to develop NR's area of competencies within the seamless use of multimedia on various platforms and various network service qualities. These competencies are important for many users and therefore we prepare several projects with different users as a result of the work in the SIP. The results from this SIP are publicly accessible, and have resulted in a variety of scientific publications.

NRs vision is to develop research results that are used and visible. Channel S is an example of developments at NR that are used by a variety of companies and public offices. We hope that the technological improvements are visible and explicit.

Project Manager Knut Holmqvist

ChannelS has been a major contribution to the DART Multi Media Multi Channel (M3Ci) competence building and dissemination. Both theoretical and practical oriented sub-projects have been conducted. Practical oriented projects have prepared the ground for the more theoretical projects and vice versa.

No sub-project or theme has dominated the project. The JPEG 2000 subprojects for standard and moving JPEG 2000, however, has taken much of the recourses in the later years of the project. It is in this area where the results are easiest productified.

In the streaming area, the methods, routines and databases produced for the radio streaming have produced important experience used e.g. in the successful VG streaming project. In addition it has been important to the three idealistic radio stations involved, Radio Nova, radiOrakel og Tellus Radio.

The multi channel part of the project has been directed mostly to electronic devises with different size and bandwidth capacities, but also paper based information carriers has been considered. The automatic cropping and resizing of images for different screen sizes is an example of projects in this area. Also the evaluation of video players for PDAs is in this category, as it covers both multi channel and multi media.

New projects, as e.g. Movies run by partner TV2 and supported by the RCN (NFR), projects that hopefully will make our partners stronger, would have had less chance of success without the ChannelS SIP.

Contents

1 ChannelS Overview

1.1 ChannelS projects

Year 2004

Project A-2004: Wrapup

Project B-2004: Multimedia Filesystem SMFS

Project C-2004: Motion JPEG 2000 Encoder

Project D-2004: OSIRIS

Project E-2004: OSIRIS - Skatt

Year 2003

Project A-2003: Radiostream (Radio Database, Speech Recognition)

Project C-2003: JPEG 2000 Image Encoder. (Implementation PackNDo, iTron, MJPEG2000)

Project D-2003: Open Source multimedia tools for Linux, see http://oss.nr.no/

Project E-2003: ProjectLink, (financed by ChannelS and Høykom Fyrtårn)

Year 2002

Project A-2002: Multimedia Multi-Channel Production

Subproject A1-2002: Multimedia Databases and Production

Subproject A2-2002: Media Transformation

Subproject A3-2002: Metadata-based Image Manipulation

Project B-2002: Digital TV / Interactive Television

Project C-2002: JPEG 2000 Multimedia Encoder

Project D-2002: Open Source multimedia tools for Linux, see http://oss.nr.no/

Year 2001

Project A -2001: Multimedia Multi-Channel Infrastructure (M3Ci) Platform

Project B-2001: Structuring Information for Multi-Channel Use

Project C-2001: Studies and Evaluations

Project D-2001: .Net in M3Ci

Project M-2001: MMVM

Project N-2001: Kiss The Tram

Project O-2001: Mobile Karaoke

Project P-2001: 01lab http://www.01lab.org/public/project/radio/

Year 2000

Project A-2000: Multimedia Multi-Channel Infrastructure (M3Ci) Platform

Project B-2000: Information Exchange via Multiple Platforms

Project C-2000: Studies and Evaluations

Channel S is the working title for a Strategic Institute Program awarded to NR by the Research Council of Norway (Norges forskningsråd). It is a five-year, nationally-funded research program addressing "Service Architecture and Service Channeling in the Personal and Professional Information Society". ChannelS was active from 2000 to 2004 with a budget of 9 mill NOK.

The SIP has a superior objective of developing knowledge, methods and technological building blocks for net-based, multi-platform information and service solutions — solutions which enable information and services to be tailored and channeled to various target groups in different work and life situations.

The overall objectives and effort in channel S is characterized by work aimed to delineate, develop and evaluate how multi-platform services and information can and should be:

- channeled to specific target groups through multiple technology platforms and end-user technologies
- channeled through heterogeneous kinds of network infrastructures
- organised as a service architecture enabling flexible use and updating

The concrete goals for the Strategic Institute Program are:

- to produce innovative research and solutions for the most important sectors of Norwegian information, communication and technology industry, as well as public administration;
- to provide technological building blocks which can serve as a basis for commercial products or services related to service channeling; and

- to promote the development and dissemination of specialized competence central to the area of service architecture and service channeling.

1.2 Overview

In the course of these five years twenty-four projects have been performed within the frame of the ChannelS SIP. Several projects have been related to ChannelS, while others are spinoff-projects with industrial partners. Twenty-two researchers have been involved in the SIP. Four theses for the master degree have been delivered with subjects relevant to the SIP.

1.3 Vision

A complete multimedia multichannel infrastructure, create content in one single format and deliver to end users in various formats (e.g., PC, PDA, cell phone). The technical scope includes all aspects of the production line (content creation, storage, transmission, clients, interactivity), processing, storage, and transmission.

2 Presentation of Selected Projects in ChannelS

2.1 M3Ci – Definitions, 2000-A and 2001-A

M3Ci stands for Multi-Media Multi-Channel infrastructure. For the M3Ci a methodology was devised and applied to a selected set of channels and services. The channels and services are specified according to technology and functionality, respectively. The channels impact the services offered. User roles are also characterized, and a «common sense» examination of the suitability of these channel / service / role combinations is elaborated in the project.

When utilizing electronic services, end-users may employ their own personal devices (e.g., mobile phones and PDAs), company-owned equipment (e.g., PCs and laptops) and/or public equipment (e.g., electronic kiosks, bank terminals, TV-based solutions, etc.). When utilizing services, end-users are necessarily involved in different contexts and situations, such as working, shopping, learning, etc. One condition is universal, however: end-users tend to prefer and accept services which are suited for the device with which they are interacting with the service; services which are clumsy, slow, disorganized, etc. may be used "once-but-never-again". In addition, end-users tend to accept services which take into account their own knowledge, understanding and preferences.

Given this background, the objective of this effort has been to evaluate the suitability of different channels with respect to (1) content (2) services, and (3) user groups.

When in use, electronic services necessarily involve some form of interaction. Here, one part of the interaction involves some kind of service receiver, which could either be some person (e.g., an end-user), or with some other (possibly automated) actor. As part of the interaction, content is exchanged between the service receiver and the service; the exchange may be uni- or bi-directional.

A channel (or 'service channel') is said to consist of all hardware and software elements utilized in the provision of and/or interaction with a service. In this context a service channel is said not to include the end-user nor the explicit content delivered or exchanged within a service.

In a nutshell, every electronic service is characterized by at least some degree of interaction, where interaction concerns the exchange of content through one or more channels. The manifestation of every service is dependent upon the channel(s) through which the content is delivered. In contrast, the configuration of a channel is not dependent upon any service.

2.2 Media Transformation, 2002-A2

This subproject addresses a problem area which goes under several different names, including: media (or content) transformation, media adaptation, filtering and/or distillation. The value in addressing this problem area arises from the need for media producers and providers to control the overall volume, variety and complexity of the content they create, administrate and deliver. In a "perfected" media transformation solution, it would be possible for media producers / providers to store a single original version of each media element. The transformation mechanisms would make it possible to adapt any original media element into a form most suitable to the requesting source.

The report produced offers an initial orientation to the problem area, as well as a more extensive review of various dimensions and issues specifically relevant to the area of media transformation. It concludes with a summary of the future work planned within the rest of the project period.

2.3 Digital TV, 2002-B

Television is one of the most important multimedia-channels in our society. The transition from analogue to digital media and transmission channels results in new challenges and opportunities for producers, distributors, and spectators. As a research institute we participate in this technological development.

NR works within coding of multimedia, transmission of multimedia, user interfaces for multimedia, and new opportunities within multimedia. NR looks also into how technology is adapted by the consumers, and how technology is used. This can give producers of content and technology give hints on how to give benefits to the consumer, and to streamline their own production.

NR has together with TV2 elaborated a user interface for future digital TV, which is non-trivial since the TV is not just a PC placed in the user's home, and the target group is different. Especially the use of the remote control and the setting of using the appliance in the home sets challenges.

NR has also worked with coding of digital streams, transmission of data using different broadband networks, and development of applications using the MHP standard. Applications using chat groups with extended possibilities, profiles for TV spectators, and the possiblity for the user to change the viewpoint in a transmission are just some ideas that have been presented in prototypes.

NR researchers have looked into the possibilities for digital and interactive TV. Digital TV will give advantages for all involved parties, but results also in technical challenges. Issues like interactivity, return channel, new program formats, etc. are discussed. There will also be integration between broadcasting and Internet technology, with enhanced possibilities for the user, producer, and service provider.

We looked into the different techniques that enhance the television medium with interactivity. New services as the Electronic Program Guide (EPG) will be available. A return channel by modem or cable will enable the TV set to access multimedia content and additional information, download software, and give possibilities for electronic commerce.

There are a variety of standards and initiatives available within digital and interactive TV. Many manufacturers with different techniques are on the marked with their products. We presented a survey on some of the most promising techniques, including initiatives from MPEG, DVB, NorDig, and ATVEF.

We also look at software available within the wider area of digital TV, and present a selection. In order to demonstrate some of the new aspects, demonstrator applications were developed, and we share experiences from these implementations with our audience.

2.4 JPEG 2000 and MJPEG 2002-C, 2003-C, 2004-C

In today's society we save and transfer enormous amounts of images. Therefore compressing of images is important to utilize the resources at a maximum. The size of an uncompressed color photo is often approx. 6 MB. Transmitting such an image will take time, even if we have broadband connection. Existing formats make it possible to save a ten-fold numbers of images in the same space as one uncompressed image, depending on image quality, and how detailed the images are.

To meet a growing need of transmission and storing of an increasing number of digital images, the expert groups JBIG (Joint Bi-level Image expert group) and JPEG (Joint Photographic Image expert group) have developed the standard JPEG2000, which is designed to satisfy demands like better compression than the existing compression schemes, lossy or lossy compression, simultaneous representation of several bit depths and resolutions, and possibility to unwrap parts of an image.

The image compression format JPEG2000 is much more efficient than the current standards including the JPEG-format. NR has implemented the technology on different operating systems. Among these is TRON, an operating system used in most of the Japanese cellular phones and digital cameras.

Motion JPEG2000 is the movie format of JPEG2000. Like JPEG2000 is more efficient than JPEG, Motion JPEG2000 is more efficient than DV. DV is the format, which is used in next to all digital video cameras. NR is among the first in the world to implement Motion JPEG 2000, a codec, which is a candidate to replace the dominating DV-format. In 2003, NR developed a Motion JPEG2000 encoder and decoder.

Usually when pictures are taken with a digital camera, there is a delay of up to several seconds before the next picture can be taken. Since we cannot wait for the compression to be done more than 1/24 part of a second, this process has to be performed fast.

MPEG 2 is the format for DVD movies, where approximately every tenth frame in the stream is coded separately. The rest of the frames are coded as differences to these images. This can be done since usually there are only minor changes from one frame to the next. Motion JPEG2000 does not support these features. Therefore each frame is coded separately. However, we investigated the possibilities to extend the JPEG2000 technology to support coding by using change vectors or similar techniques with Motion JPEG2000.

Image compression in JPEG2000 comprises of two main parts. First a wavelet transform is performed to localize the energy of the image. Second the transformed image is compressed using the arithmetic encoding. Arithmetic encoding is chosen because of its efficiency in comparison with for example Huffman coding used in JPEG.

At NR we have studied the JPEG2000 standard and implemented an encoder, which is efficient and flexible: See http://www.nr.no/dart/projects/mmmc/packndo

2.5 MediAkit and the NR Open Source Software Center, 2002-D, 2003-D

The NR Open Source Software Center offers a variety of high quality open source software within several areas of use. The software packages available on the server are the outcome of projects at Norsk Regnesentral, where this software is developed, packaged, or used. This server is NR's contribution to the Open Source movement.

Traditionally the users of Open Source software (OSS) have been experts, early adopters, and developers of other OSS packages. As OSS enters the commercial main stream a new emphasis is being placed on usability and user interface design. Non-experts are attracted to OSS not primarily because of the openness of the code, but rather on the basis of cost, quality, functionality, security and support.

Multimedia software is amongst the most complicated software, including advanced algorithms (e.g., codecs), user interfaces, communication between peers, computer graphics, etc. in real time. While many of the components of multimedia systems have been developed on open systems, integrated solutions that are working in a plug-and-play manner have been the domain of the commercial actors.

The development of complex OSS systems like Open Office show that the development of stable systems in OSS-manner is feasible, and creates an alternative to commercial products. The development of complex multimedia applications as OSS is currently progressing, as the development of systems like xmms, xine or mplayer shows. Some OSS products are even ahead of the commercial alternatives in functionality and usability.

However, an overall intergration of multimedia software to be used in major use cases is still lacking; i.e., the use of OSS is still the domain of experts that are used to command line interfaces. Another obstacle for overall acceptance of OSS software is that there are many competing projects with similar functionality available, using incompatible interfaces, and the use of these systems needs knowledge beyond the capabilities of the non-expert.

Therefore, the mission of the NR OSS server and the mediAkit add-on distribution includes the following goals:

- We choose major use cases for multimedia software; select packages that have shown their practicability, package the software, and provide these packages with an easy-to-use installation interface.
- Installation procedure, and user interface for the application programs must be easy-to use, including a state-of-the-art user interface.
- If necessary add software to integrate the parts in an easy-to-use user-interface in order to hide command-line complexity.
- Use the developer pool of OSS to help us develop the missing parts of the software.
- Provide the infrastructure to maintain the distribution of OSS, including support, bug tracking, mailing-lists, version controlled repository, etc.

2.6 Radio Stream, 2003-A1

As part of ChannelS NR has been streaming the radio frequency 99.3 in Oslo, 24/7. The radio stations sharing the frequency are: Radio Nova, the Oslo student radio; radiOrakel, the worlds first "women's radio" and Radio Tellus, an immigrant radio. The project started out as an audio streaming project, utilising open source software. The signals are picked up on a radio receiver, sent to the audio card of a PC, encoded in several qualities of MP3, stored to the disk and streamed to the net.

As all transmissions was stored to disk, the possibility of indexing it and re-playing old transmissions were present. Utilities were made to create pointers to particular parts of a transmission. These utilities are used, mainly by Tellus Radio. Tellus transmit in several languages including Urdu, Tamil, Spanish and English. They make pointers to the different programs, like today's transmission in Urdu. From our logs and from e-mail we know that these links are used from e.g. Pakistan and Sri Lanka.

A data model based on EBU, Dublin Core and other standards were produced, together with routines for utilising the generated database. Utilities to register programs and to automatically make program listing were made. None of the radios has started using these utilities.

2.7 Multimedia Formats and Protocols, 2001-C

The objectives of this subproject were:

- To examine the relevant multimedia standards and their potential application areas.
- To examine the relevant multimedia standards' current presence in the differentmarket segments.
- To analyse the current trends for the relevant multimedia standards.

The scope of this study will be based on the results of an EU project investigating the same standards and formats.

The results and deliverables ware

- Technical note
- Presentation within Program Seminar

In this paper we will consider audio and video related standards. Other standards for multimedia will only be commented on when relevant relative to streaming media.

2.8 Image Clasification Using EXIF Data, 2003-A3

The focus of this sub-project was on a weight-based metadata approach for image classification. The demonstrator for this approach produces an automatic classification of a collection of sample images. This classification is useful in several contexts, for instance for rapidly classificating large collections of images. The automatic classification is tested on a set of sample images from a newspaper.

The number of digital images being produced professionally makes it virtually impossible to classify them manually. The indexing of image retrieval systems often does not keep pace with the number of images stored. Methods for automatic classification, tagging, archiving and

retrieval must be developed in order to handle this amount of images. One task is to classify images in different categories. After categorization methods suitable for specific categories can be applied, increasing the likelihood of automatic procedures to generate a satisfactory result compared to a «one-method-fits-all» approach.

The demonstrator produced cropped and scaled images to different screen sizes, based on classification of images. Some 1500 images were tested.

2.9 Multimedia File System/The ChannelS Server Project, 2004-B

The primary goal of the Channel-S Server project was to design and implement a simple and robust streaming media server. Secondary goals include design of a protocol, prototyping of clients, and a method for bypassing firewalls.

Contemporary streaming media systems have become very complex. The thesis behind the Channel-S Server project was that much of this complexity is redundant because it is already handled by functionality in other parts of the system. For example file caching and flow control are already handled by the OS kernel.

Hence, the project attempted to create an extremely simple streaming system by offloading all redundant functionality to the OS kernel. A deliberate design choice was to make the streaming server as simple as possible, at the expense of letting the client be responsible for dealing with the server in a sensible manner. Specifically, the server is stateless, except that it uses TCP instead of UDP. The server is content agnostic, i.e., it knows nothing about the particular media format that it is streaming.

An important limitation of the system is that it can only be used for streaming media files; it is not intended for real-time media streams.

2.10 OSIRIS

NR participates in the Osiris project. Work connected to the contribution and work with the international Osiris project has been done as a subproject to ChannelS.

2.11 OSIRIS Skatt

This is a report for Skattedirektotratet discussing their channel strategy for personal tax reporting.

3 Related Projects

The projects presented here contain topics related to the Channel S SIP.

3.1 LAVA (1994-1998)

LAVA (Delivery of video over ATM) was part of the Norwegian broadband program HUGIN. The project developed a video streaming system for high quality video over broadband ATM networks, including the Elvira Video Server, the LAVA communication system and a UNIX-based video player.

3.2 LAVA-Learning/PROJECTLINK (1999-2004)

Main goal was the use of multimedia in e-learning technologies. Development of a prototype used in schools in Norway. The work includes a streaming concept for low-bandwidth connections to the world outside.

3.3 LAVA-K/Digital TV (1997-1999)

Based on the experiences with LAVA the projects looked into digital TV technologies.

3.4 MIT (1998-1999)

In conjunction with TV2. The project looked into usability issues for services like news and weather, including a prototype.

3.5 ENNCE (1999-2001)

Trading policies for multimedia, NFR project of the «grunnleggende teleforskning» program.

3.6 Course INF5080, held at Ifi, Universitetet i Oslo

Multimedia coding and streaming. http://www.uio.no/studier/emner/matnat/ifi/INF5080/

3.7 GMN/GMSP

The GMN project developed a client-server system for streaming multimedia content to mobile phones. A prototype was implemented for a service for news on demand over GSM connections, including animated news reader, images, and text.

3.8 GMSP

Development of a generic server system for streaming multimedia content.

3.9 01lab

Laboratory for artists and scientists within multimedia technology, video and sound.

4 Spinoff-Projects

Projects started as a consequence of work in ChannelS or that used work done in ChannelS as a basis for the work.

- Dropzone (2002/2003)
- KDI (2003-2005)
- VG Streaming (2001-2003)
- PixCom (2004)
- LAP
- Drylab (application sent)
- MOVIS - TV2 Streaming (application sent)
- OSIRIS (application sent)

5 Researchers

5.1 Researchers involved in ChannelS and its projects (2000-2004)

- Peter Holmes
- Arve Larsen
- Knut Holmqvist
- Wolfgang Leister
- Thor Kristoffersen
- Jørn Inge Vestgården
- Hans Jakob Rivertz
- Svetlana Boudko
- Eirik Maus
- Bent Foyn
- Laurence Habib
- Håkon Steinbakk
- Håvard Hegna
- Thorstein Lunde
- Eva Mjøvik
- Anund Lie

5.2 Other contributing researchers

- Olaf Owe
- Bent Ø Johansen
- Michael Gritzman
- Roar Samuelsen
- Bjarte M Østvold
- Dalip Dewan

5.3 Students

- Henning Kulander
- Henrik Olsen
- Benedikte Lund
- Lill Anita Pedersen

6 Publications

6.1 2004

(E1) Wolfgang Leister, Digital-tv krever nye applikasjoner
Computerworld Norway 4/2004
Newspaper article with focus on applications in digital TV
http://publications.nr.no/digitaltv-cw.pdf

(E2) Wolfgang Leister: Streaming for the masses
Content Distribution Infrastructures in Dagstuhl Seminar 04201 12.05.2004
Presentation
Musings on broadcast technology and content delivery networks (CDN).
http://publications.nr.no/dagstuhl2004-wvl-aop.pdf

(E3) Henning Kulander: Redigering av distribuert sanntidsvideo
Master thesis August 2004
Tutors: Dalip Devan and Wolfgang Leister

(E4) Thor Kristoffersen, Jørn Inge Vestgården, Hans-Jakob Rivertz: Design and Implementation of the Channel-S Streaming Server
DART/07/04, December 2004, Note.
This note describes the implementation of a simple and robust streaming system called the Channel-S Streaming System. The main idea is to offload as much functionality as possible to the operating system kernel. The result is a stateless streaming protocol based on TCP, and a server that is stateless except for the state contained in its TCP client connections.

(E5) H.J. Rivertz and S. Budko: The NR JPEG 2000 Codec
DART 08/04, December 2004, Note.
This note describes the implementation of the NR JPEG 2000 Codec, and the characteristics of the implementation.

(E6) Ingvar Tjøstheim: Distribusjonskanaler – elektroniske tjenester
DART 11/04, December 2004, Note.
In the information society, electronic services should be available to all citizens. In this note it is documented that the group of elderly citizens can make use of electronic services if they are made available at the postal offices and banks.

6.2 2003

(D1) Wolfgang Leister, Per Røe, Jørn Inge Vestgården, Ole Aamot: mediAkit and the NR Open Source Software Center
NR report Nr. 996, November 2003. ISBN 82-539-0503-3
This report gives an overview of open source software, with an emphasis on multimedia software for the Linux platform. As a special case an application for authoring and producing DVDs from camera content is chosen. This application is put together in a software distribution for RedHat 8.0. A web site, the NR Open Source Software Center, was installed in order to maintain the software distribution. Software catalogues on maintenance tools for OSS, and

multimedia applications for Linux are included in the report
http://publications.nr.no/report-996.pdf

(D2a) Wolfgang Leister: Åpen kildekode kan styrke konkurranseevnen.
Computerworld Norway nr. 44, 2003, 17. oktober, Newspaper article
http://publications.nr.no/cw-oss.pdf

(D2b) Wolfgang Leister: Kommentarer fra Norsk Regnesentral til høringsnotatet "Åpen programvare i Norge",
NHD, 31. januar 2004,
http://publications.nr.no/osshoering1.pdf

(D2c) Håvard Hegna and Wolfgang Leister: Åpen kildekode
Høringsuttalelse
Teknologirådet, høring om programvarepolitikk, 3. september 2003, foredrag.
Debattinnlegg og høringsuttalelser om programvare med åpen kildekode.

(D3) Wolfgang Leister and Henrik Olsen: Virtually moving cameras for digital TV using IBR,
Seminar in Computer Graphics, Fornebu, (Simula Research Laboratory), 3. march 2003,
Paper and presentation of the IBR application developed in (C8) and (C10)
http://publications.nr.no/dtvibr-fbu2003.pdf

(D4) Master Thesis: Benedikte Lund: Topic Segmentation of Speech Through Automatic Speech Recognition
Tutor: Knut Holmqvist
This thesis describes the segmentation of speech in order to extract phrases that are indexed for searching purposes. Statistical analysis is used in order to classify documents.

(D5) Henning Kulander: Rapport fra en DVD produksjon,
Norsigd Info, 2/2003, Article
The article describes the production of a personal DVD with software available for personal use, both commercial products and open source software. Document has relations to (D1).
http://www.norsigd.no/nsi-2-03.pdf

(D6) Knut Holmqvist, Eirik Maus: En oppsummering av delprosjekt Radiostrømmer i ChannelS 2003
Report Nr. 1004, ISBN 82-539-0512-2
This report summarizes the sub project "Radiostrømmer". The emphasis is on the data models used and the user scenarios that lead up to the proof of concept application developed.

6.3 2002

(C1) Wolfgang Leister, Eirik Maus, Bjørn Nordlund, Ole Aamot, Joachim Lous: Developing a Multimedia Distribution.
DART/02/02, December 2002, Note.
This is the project report for the first year of the Open-Source project. Final report is (D1)
http://publications.nr.no/setup.pdf

(C2) Arve Larsen: Image Classification using Heuristic Weights on Metadata,
IMEDIA/09/02. August 2002, Note
http:/intern/space/ChannelS/publications/imedia2002_09.pdf
Design notes of an application for parallel publishing that classifies images using the EXIF standard and image analysis. The results are preliminary; the work is continued in document (C3a).
http://publications.nr.no/imedia2002_09.pdf

(C3a) Arve Larsen and Knut Holmqvist: Image Clasification based on heuristic weights on EXIF data.
4th European Workshop on Image Analysis for Multimadia Interactive Services 2003.
http:/intern/space/ChannelS/publications/exif-article.pdf

(C3b) Knut Holmqvist and Arve Larsen: Image Classification Using Heuristic Weights on EXIF Data.
NORSIGD Info Nr. 2/2003; ISSN 0803-8317,
Both articles describe an application for image clipping in parallel publishing. The images are classified using parameters from the EXIF standard, and simple image analysis.
http://www.norsigd.no/nsi-2-03.pdf

(C4) Holmes, Peter and Holmqvist, Knut: On Decision Machines for Media Transformation,
MEDIA/08/02, Note
Starting with the value chain for multimedia delivery to multiple channels, the document presents several issues for transforming and adjusting multimedia content. Transformation is divided into requests and rules, planning, and execution.
http://publications.nr.no/imedia2002_08.pdf

(C5) Laurence Habib: Interactive Digital Television - A Literature Review
IMEDIA/02/02, February 2002, Note
The document gives a sociological and historical overview of interactive television. Possible uses in e.g., entertainment, leisure, education, daily activities, etc. are mentioned, and several issues (cultural, privacy, moral, etc.) are discussed.
http://publications.nr.no/imedia_2002_02.pdf

(C6) Wolfgang Leister: Digital TV og datagrafikk
NORSIGD Info 1/2002, ISSN 0803-8317, April 2002
Newspaper article
Short introduction to digital TV and MHP, where new applications with graphics content can be used, e.g., the IBR application of (C8) and (C10)
http://publications.nr.no/nsi-1-02.pdf

(C7) Wolfgang Leister: Survey Digital TV.
Seminar organized by Dataforeningen and Norsk Sivilingeniør Forening 28. mai 2002.
Presentation
Foil set of a survey on digital TV, held prior to publication of (C8). The document from the course at Ifi is a further development of this course content
http://publications.nr.no/IDigitalTV-HO.pdf

(C8) Wolfgang Leister, Svetlana Boudko, Ole Aamot, Peter Holmes: Digital TV - a survey
NR report Nr. 988, ISBN 82-539-045-9 December, 2002
The techniques and standards used for digital TV are presented. The report also includes a list of software for digital TV, and the result of two demonstrators: client-side rendering with IBR, and a chat application xlet for a digital set-top box.
http://publications.nr.no/digitv.pdf

(C9) Wolfgang Leister: JPEG 2000 - A standard for images
Norsigd Info 2/2002,
The important parts of the JPEG 2000 are presented.
http://publications.nr.no/nsi-2-02.pdf

(C10) Master Thesis: Henrik Olsen: Bruk av "Image Based Rendering" for beregning av virtuelle kameraposisjoner som digital-TV tjeneste
The thesis investigates the implementation of client-side rendering using IBR methods. The report presents an implementation in Java, and considerations on streaming, compression, etc.

6.4 2001

(B1) Knut Holmqvist: Multimedia Standards and Formats
IMEDIA/09/01, September 2001. Note
The report gives a short overview of streaming architectures (QuickTime, Real System IQ, MPEG4 and Windows Media Technologies) and multimedia players for handheld devices. Potential application areas and trends in multimedia standards are covered.
http://publications.nr.no/imedia_2001_09.pdf

(B2) Lill Anita Pettersen, Security in M3Ci
IMEDIA/17/01, August 2001, Note
Gives an overview over Security APIs, e.g., GSS-API, IDUP-GSS-API, GCS-API, Microsoft CryptoAPI, BSAFE-PKCS Cryptoki, CAPI, GAA-API, Java API, SecuDE), and protocols in different layers.
http://publications.nr.no/imedia_2001_17.pdf

6.5 2000

(A1) Arve Larsen: A First Look At Delivery of Information Services through Multiple Channels
IMEDIA Report/01/01, January 2001
The document defines the term «channel». It is a case study of user interfaces for services related to the SPACE project, where the cases for Web/PC and WAP/mobile phone are investigated, especially delivery of content from public services to an end user. (Project B-2000)
http://publications.nr.no/imedia_2001_01.pdf

(A2) Bent Foyn, Peter Holmes: Multi-Channel Production Issues
IMEDIA Note/06/00, December 2000
The study identifies issues on content production on six pages. The report provides bullet list on some production issues.
http://publications.nr.no/imedia_2000_06.pdf

(A3) Peter Holmes, Håkon Steinbakk, Arve Larsen: The Multimedia Multi-Channel Infrastructure Platform: Scope and Definition
IMEDIA Note/05/00, December 2000
After defining the term "channel" the document presents vision and approach of ChannelS. The main research areas and preliminary architectural elements are identified.
http://publications.nr.no/imedia_2000_05.pdf

(A4) Håvard Hegna, Peter Holmes: Examining the Suitability of Channels for Services and User Roles
IMEDIA Report/04/00, December 2000
The report investigates three channels (PC, PDA, WAP) for three user categories and roles (professional, occasional, recreational). Alternative implementations of a NetBank Assistance are discussed. The impact from the properties of the used channels is discussed.
http://publications.nr.no/imedia_2000_04.pdf

(A5) Thorstein Lunde, Eva Mjøvik: Mobile Communication Technologies: Technical Capabilities and Time-to-Market
IMEDIA Report/01/00, September 2000
The document gives a technology and conceptual overview of mobile communications systems, with an emphasis on telecommunications ssystems like GSM, 2G+, and 3G systems. Wireless LAN and direct link / ad-hoc networks are discussed shortly.
http://publications.nr.no/imedia_2000_01.pdf

(A6) Anund Lie: Evaluation for NetCom
GEM Report/04/00, September 2000, Classified
The report presented a security evaluation of the Midas payment gateway at NetCom. Midas is delivered by Siemens AS, based on the MBroker product from More Magic Software. Midas protects web/WAP content and offers a set of payment alternatives. The report analyses the concrete setup at NetCom with respect to security issues.

6.6 Articles in newspapers written by journalists

(O1) Per Kristian Bjørkeng: Trådløst nettverk på kroppen
Avis 1
Thorstein Lunde om bluetooth teknologien.
http:/intern/space/ChannelS/publications/CHS-thl-bluetooth.pdf

(O2) Yngve Vogt: Advarer mot UMTS forventninger,
Computerworld Norwat
Thorstein Lunde om UMTS teknologien.
http:/intern/space/ChannelS/publications/CHS-thl-umts.pdf

(O3) Ingrid Spilde: Bilde krymp deg!
Forskning.no 09.apr 2004
Knut Holmqvist og Hans Jakob Rivertz, om komprimering av bilder.
http://www.forskning.no/Artikler/2004/april/1080824152.48

6.7 Related Documents

(R1) Wolfgang Leister, Gorm Paulsen, Pål Spilling: Tranding of QoS pollicies in ENNCE
DART Note /03/02.
This is the final report of the ENNCE project. The document describes an architecture and implementations of negotiation of QoS for multimedia.
http://publications.nr.no/enncetrad.pdf

(R2) Arve Larsen, Peter Holmes: An Architecture for Unified Dialogue in Distributed Object Systems
IMEDIA Note /03/98, April 1998,
Report from the SPACE project.
http://publications.nr.no/imedia_03_98.pdf

(R3a) Leister, Wolfgang; Hegna, Håvard; Kristoffersen, Thor; Aarhus, Lars; Moen, Anders og Østvold, Bjarte M.: Multimedia-presentasjoner på mobile terminaler med lav båndbredde
Norsigd Info 1/2002 Artikkel.
http://publications.nr.no/nsi-1-02.pdf

(R3b) Aarhus, Lars; Hegna, Håvard; Kristoffersen, Thor; Leister, Wolfgang; Moen, Anders and Østvold, Bjarte M.: Streamed Multimedia Presentation for Low-Bandwidth Mobile Terminals: A Virtual Machine Approach.
OMNI Note/07/01, March 9, 2001.

(R3c) Aarhus, Lars; Hegna, Håvard; Kristoffersen, Thor; Leister, Wolfgang; Moen, Anders and Østvold, Bjarte M.: Streamed multimedia presentation for low-bandwidth mobile terminals: A virtual machine approach.
3Gwireless'2002. Proceedings. San Francisco, USA May, 2002. Paper
http://publications.nr.no/gmn-arch-3gw2002.pdf

(R3d) Leister, Wolfgang; Hegna, Håvard; Kristoffersen, Thor; Aarhus, Lars; Moen, Anders and Østvold, Bjarte: Multimedia-Präsentationen auf persönlichen digitalen Assistenten mit geringer Übertragungsrate.
Simulation und Visualisierung 2002 Proceedings der Tagung Simulation und Visualisierung 2002 am Institut für Simulation und Graphik der Otto-von-Guericke-Universität Magdeburg am 28. Februar und 1. März 2002, SCS Europe 2002. Paper
http://publications.nr.no/sivi2002.pdf

(R4) Wolfgang Leister: INF 5080,
University of Oslo.
Course in Multimedia Coding and Transmission, held at Department of Informatics
http://www.uio.no/studier/emner/matnat/ifi/INF5080/v04/pensumliste.xml