NEXUS
Spatial World Models for Mobile Context-Aware Applications

Collaborative Research Center 627
Sonderforschungsbereich 627

ANNUAL REPORT 2010
This is the 2010 annual report of the Collaborative Research Center Nexus, located at the University of Stuttgart. Nexus is a comprehensive and internationally renowned research effort in the field of mobile context-aware systems and applications, funded by Deutsche Forschungsgemeinschaft (DFG). The research program of Nexus spans a wide range of disciplines, including Computer Science, Geoinformatics, Industrial Manufacturing, and Philosophy of Science and Technology. Our interdisciplinary research on globally federated context models constitutes a major building block of the vision of a “World Wide Space”.

In 2010, we again made substantial progress towards this vision. Nexus researchers were invited to present their work on numerous conferences, symposia, and workshops, including ACM SIGSPATIAL International Symposium on Advances in Geographic Information Systems (ACM GIS 2010), International Database Engineering and Applications Symposium (IDEAS 2010), International Conference on High Performance Computing and Communications (HPCC 2010), and Conference of the European Association for Computer Graphics (Eurographics 2010). Demos of Nexus technology were presented at the IEEE International Conference on Pervasive Computing and Communications (PerCom 2010) and also at the International Technology & Persons with Disabilities Conference (CSUN 2010).

In addition to the research conducted by the individual subprojects, Nexus researchers organized the IEEE workshop on Context Modeling and Reasoning (CoMoRea 2010) and also a lecture series focusing on business processes and context awareness. Moreover, members of Nexus were invited as keynote speakers at prestigious events, such as IEEE PerCom 2010.

The year 2010 concludes the last funding period of Nexus. We can look back at 8 years of fruitful interdisciplinary research, which significantly influenced the state of the art in mobile and context-aware systems as well as various related fields. The high scientific impact of Nexus is demonstrated by about 400 peer-reviewed publications. More than 50 of them are cross-publications, involving two or more scientific disciplines.

In the past years Nexus organized about 20 internationally visible colloquia and workshops. For example, the international workshop “Quality of Context” brought researchers from Europe, Asia, and USA to Stuttgart to discuss the different facets of context quality and to make a consolidated contribution towards an integrated way of treating them. Also, Nexus organized five lecture series which all found great interest among the students and other members of the University of Stuttgart.

The Nexus research center attracted many talented young scientists and gave them the opportunity to develop their own research profile and scientific reputation. Five of them have been appointed as full professors and another three Nexus researchers
accepted offers for assistant professorships. Several others occupy leading positions in industry today.

We highly appreciate the continued dedication and creativity of the members of the Nexus team which was the solid foundation for the success of Nexus for so many years. We would also like to especially thank our collaboration partners and friends from academia and industry for their long-standing support.

Stuttgart, February 2011

Prof. Dr. Kurt Rothermel
(Center Coordinator)
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The research builds on the results of DFG Forschergruppe Nexus (2000–2002).
## Preface

1

## Participating Research Groups

5

## Content

7

1. **Vision**

9

2. **Scientific Goals**

11

3. **Research Program**

13

3.1. **Research Area: Communication & Security**

16

3.1.1. Project: Context-Aware Communication Control

16

3.1.2. Project: Context-Aware Communication

18


19

3.2. **Research Area: Management of Context Models**

21

3.2.1. Project: Homogenized & Virtualized Model Management

21

3.2.2. Project: Hybrid Model Management

23

3.2.3. Project: Dynamic, Time-Referenced Model Data

24

3.3. **Research Area: Model Interaction & Sensors**

26

3.3.1. Project: Consistency & Generalisation of 3D Geo Data

26

3.3.2. Project: Sensor-Supported, Context-Based Consistency Analysis

28

3.3.3. Project: Context-Aware Mobile Visualization

29

3.3.4. Project: Context Synthesis using Computer Graphics Models

30

3.4. **Research Area: Applications & Acceptability**

32

3.4.1. Project: Smart Factory

32

3.4.2. Project: Context-Based Assistant Systems for People with Sensory Handicaps

33

3.4.3. Project: Reflection & Evaluation

35

3.4.4. Project: Influencing Factors of Demand Willingness of Location Based Services

36

3.5. **Research Area: Application Support**

38

3.5.1. Project: Context-Aware Workflows

38

3.5.2. Project: Semantic Methods for Managing Context Models

39

3.5.3. Project: Distributed Situation Recognition Based on Evaluated Context Information

41

3.6. **Cross-Section Project: Metrics & Valuation of Context**

42

3.7. **Working Group: Mobility & Security**

44


46

4. **Professional Activities**

49

4.1. **Nexus Related Scientific Events**

49

4.1.1. Colloquium: Ringvorlesung 2010

49


50

4.2. **Committees**

51

4.3. **Publications**

52
The proliferation of sensor technology, along with advances in wireless communication and mobile devices, allow for context-aware applications. Those applications take into account the context of real world entities, such as a user’s current location, physical environment, or even activity. They are able to act upon and adapt to changes in the real world and select and present information depending on the application’s context. Since almost all application domains can benefit from context information, we envision most applications to be context-aware in the near future.

Billions of sensors located in our physical environment collect a huge amount of context information. This information will be fed into numerous spatial context models building the basis for context-aware applications. The models may include stationary objects, like streets or buildings, as well as mobile objects, such as people or vehicles. The spatial models may differ in various ways, e. g., in topographical or topological nature, in different levels of detail, or in coverage of different areas and aspects of the real world.

For both economic and technical reasons, it is highly desirable for context information to be shared by a wide variety of applications. We envision - in analogy to the WWW - a World Wide Space, which provides the conceptual and technological framework for integrating and sharing context models. It is open in the sense that any commercial and non-commercial provider can "place" context models into this space. The collection of context models is federated and leads to a large scale context model, offering a global and consistent view on the context data. The federation allows for complex spatial queries, including continuous evaluation and stream-based processing. If the context model is enriched by temporal concepts, applications can query not only the current model state, but also states of the past or even predicted ones. To protect context data, application-specific views can be defined for individually controlling model access. We envision the World Wide Space to be the common basis for future context-aware applications.
Scientific Goals

Scalability | Consistency | Security | Acceptability
The main research objective is to investigate methods to create, manage, visualize and use federated context models, which are the foundation of the envisioned World Wide Space. The context models under investigation are large-scale, highly dynamic, and complex in terms of the abstractions supported.

In particular, the abstractions to be offered include stationary geographic objects, mobile objects, objects associated with dynamic state information, as well as virtual objects augmenting reality. Moreover, the research will focus on innovative context-aware applications built on spatial context models. It is also investigated how the existence of those models affects the system-level concepts and mechanisms themselves. Of particular interest is the quality of context, which impacts almost all areas of research in Nexus. The investigations focus on quality concepts and metrics as well as algorithms considering context quality.

Therefore we see research challenges in the following areas:

- Modeling and Extensibility Concepts
- Federated Model Management
- Integration of Temporal Aspects
- Generic Integration of Sensor Data
- Concepts of Consistency
- Model-based Communication
- Security Concepts
- Automatic Acquisition of Model Data
- Model Presentation and Interaction
- Security, Acceptability, Business Models
- Quality of Context Information
- Higher Level Context
- Homogenized Query Processing
- Application Support

Figure 1: Complexity Dimensions -- shows the development of the complexity from the first to the second funding period. First, we consider not only the modeling of geographic, mobile, and virtual objects, but also higher-level context information (situations) derived from observable context information. Secondly, we investigate context model management in hybrid system structures consisting of infrastructure-less and infrastructure-based parts. Thirdly, besides current context information, we also consider time concepts. As cross-cutting topic, the influence of context quality is investigated.
Research Program
Management | Communication | Presentation | Applications
## Research Program

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Context-Aware Communication Control</td>
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<td>Smart Factory</td>
<td>Context-Aware Workflows</td>
</tr>
<tr>
<td>Kirstädter, IKR Kühn, IKR</td>
<td>Mitschang, IPVS</td>
<td>Fritsch, IFP</td>
<td>Westkämper, IFF</td>
<td>Leymann, IAAS</td>
</tr>
<tr>
<td>Context-Aware Communication</td>
<td>Hybrid Model Management</td>
<td>Sensor-Supported, Context-Based Consistency Analysis</td>
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<td>Semantic Methods for Managing Context Models</td>
</tr>
<tr>
<td>Rothermel, IPVS</td>
<td>Marrón, IPVS Rothermel, IPVS</td>
<td>Levi, IPVS</td>
<td>Ertl, VIS</td>
<td>Schütze, IMS</td>
</tr>
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<td>Kirstädter, IKR Kühn, IKR</td>
<td>Mitschang, IPVS Rothermel, IPVS</td>
<td>Ertl, VIS</td>
<td>Hubig, WTTP</td>
<td>Levi, IPVS Rothermel, IPVS</td>
</tr>
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<td>Dachsbacher, VISUS</td>
<td>Gerpott, MSM</td>
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</table>

### Mobility & Security

### Spatial World Models & Application Support
The overall structure of the research program is composed of five research areas:

**Research Area 1: Communication & Security**
Context-aware systems raise new communication and security challenges, but they also enable new solutions. Both aspects are studied within this project domain. In the area of communication, the research agenda includes both the development of new transport protocols and mechanisms to optimize network-demanding applications, as well as the design of new communication mechanisms relying on the use of context information, such as the contextcast. A new aspect in this project period is the utilization of situational context. Security research topics include trust models and reputation systems, privacy preserving methods, and the investigation of technical requirements that arise from the actual deployment and commercial usage of context-aware services. The focus lies on open system architectures that can accommodate a large variety of different information providers.

**Research Area 2: Management of Context Models**
The main task of this domain is the development of concepts for the distributed management and provisioning of data of the world model. The world model contains location-based data and objects, which consist of partly proprietary data of different information providers and which are made available to applications in a unified representation and language. To provide this comprehensive information service, the subprojects have to deal with problems of the system architecture, the federation and processing of data, and the quality and timeliness of data. The scalability and openness of the system architecture are especially important. In the second period, the requirements resulting from the provisioning of temporal, stream-based and three dimensional data are considered, in terms of management in dynamic infrastructures as well as in infrastructureless and hybrid systems.

**Research Area 3: Model Interaction & Sensors**
Domain 3 integrates projects working on the efficient processing of model data and the consistent preparation of acquired sensor data. In order to generate a consistent spatial world model from semantic and sensory information, heterogeneous data has to be consolidated. Quality aspects such as fuzziness, uncertainty, incompleteness and impreciseness shall be considered to provide appropriate methods for the solution of occurring inconsistencies. In addition, cost-benefit analyses will be developed to decide if resolving an inconsistency is worthwhile or if the respective application can handle the available inconsistent data in a meaningful manner. Further main research topics are the acquisition, modeling and generalization of 3D object surfaces, as well as the preservation of geometric consistency for spatial models. Mobile context-
aware visualization methods will be developed especially for multi-dimensional context quality.

Research Area 4: Applications & Acceptability
In this area, several context-aware applications are developed, to both validate the concepts of federated context models and to explore the potential of context-awareness in two given application domains. This work also gives a deep insight on the acceptability of context-awareness in applications. The research activities of the Smart Factory are oriented towards the homogenization of sensor information related to production and management fields and the improvement of communication between factory resources, as well. Context-based assistant systems are multi-purpose assistant systems which allow users with sensory handicaps and minor cognitive or physical disabilities a safe and independent mobility. All developments are accompanied by philosophical reflections and acceptability considerations, focused on security and privacy. Also, the economical aspects of mobile context-aware applications will be examined.

Research Area 5: Application Support
In order to develop context aware applications, new approaches and concepts are necessary that take into consideration the information about the characteristic properties of the applications (e.g. mobility, context quality and heterogeneous system environments). As architectures of application environments have been a major topic during the past years, the second research period focuses on architectures and functionalities as well as the generation of context aware applications using components like distributed situation recognition. These applications require further information in addition to the context data that has been used so far. Therefore, the project domain 5 was established which deals with the generation of components for the derivation of such information. The three main topics are: the identification of complex situations, the accumulation of natural language context information from text modules that can be found in the World Wide Web and the creation of software architectures and development tools for context aware applications. The subprojects give support to the application related projects of project domain 4.

Cross-Section Project & Working Groups
In addition, there are two interdisciplinary working groups and a cross-section project that are concerned with research issues relevant to all of the above research areas:

- Cross-Section Project: Metrics and Valuation of Context
- Working Group 1: Mobility and Security
- Working Group 2: Spatial World Models and Application Support
Context-aware services are highly interactive as new context information might change the state of the service or trigger an interaction between service and user. This leads to bursty traffic patterns that make these devices difficult to serve. To cope with this challenge and to support transmissions with different priorities, e.g. for time-critical data, we developed the Context-Aware Resource Allocation (CARA) framework. This new approach enables a base station to exploit additional information from the users’ environment, thereby, allocating its resources more efficiently. We demonstrated CARA’s high performance and feasibility by studying it as network utility maximization problem. A comparison to traditional proportional fair scheduling clearly shows that knowing more about a user’s context is worth the effort [PKV11].

Additional information about the environment, such as the present interference level or cell loading, also helps to balance the trade-off between the total cell throughput and the degree of fairness among the users in a cell. We designed self-optimizing scheduler, which dynamically adapts its parameterization to maintain fairness targets and improves cell throughput [PMB10].

In our previous work, we focused on improving the start-up phase of a TCP data transmission. We now extended our work and use additional fast feedback information about the network work state to adapt the sending rate during the whole data transmission. We investigated a technique called chirping, which probes for spare band-
width based on the principle of self-induced congestion. Here, groups of data packets called chirps are sent at different rates to non-intrusively probe for available capacity. The realization of chirping however is challenging because of the exact timing of the packets required to build the chirps. We developed and analyzed a chirping-based congestion control implementation in the Linux kernel. Our results show the feasibility of using fast feedback information and constitute an important step towards a congestion control that adapts more quickly, e.g. based on the requirements of interactive services, without causing congestion by overshooting.

Interactive context-aware services further require a distinction in priority when competing with long-lived transmissions in the Internet. LEDBAT is a congestion control algorithm which allows background traffic to be friendly to time-critical interactive traffic. We investigated the LEDBAT algorithm and actively contribute to the standardization of LEDBAT in the Internet Engineering Task force (IETF).
Project A2 researches context-based communication mechanisms, focusing on a novel communication paradigm called “contextcast” as well as geographic routing mechanisms (geocast).

In 2010, we have completed our research in the area of Contextcast [GDR10]. We designed a directed contextcast routing approach that exploits similarities in user context information. For a directed routing of contextcast messages, the context routers require information about the available users for their forwarding decision. Propagating and maintaining this complete information in the network, however, places a tremendous load on the system. We have therefore proposed a similarity metric for user contexts as well as algorithms to aggregate and disaggregate user contexts. We have designed the similarity metric to incorporate both the structural similarity of user contexts, i.e., which attributes two contexts contain, as well as the value similarity of these attributes.

The designed aggregation algorithm allows the system to continuously aggregate and disaggregate user contexts into more general contexts with low overhead. In particular, it avoids a recalculation that is necessary in numerous clustering algorithms. These changes allow the system to reduce the amount of redundant context information in the network. Also, it no longer requires that every context update must be propagated due to the coarser information in these more general aggregated contexts. These changes significantly reduce the administrative load on our system, without sacrificing the advantages of a directed forwarding on the basis of user contexts.

Moreover, we finalized our research on geocast routing in close collaboration with Project B3. In particular, we designed geocast protocols for Wireless Mesh Networks (WMN) that support geometric addressing based, for instance, on GPS coordinates as well as symbolic addressing based on symbolic location names such as room or floor numbers. First, we designed an ad-hoc geocast routing algorithm that operates on pure symbolic addresses rather than geometric ones [WDR10]. Second, we integrated this symbolic routing protocol with existing geometric routing protocols such as GPSR to allow for seamless routing between symbolic and geometric domains [DWR10].
Security, privacy and accounting aspects are crucial factors for the acceptance of context-aware systems, especially if services process sensitive personal data of their users. Therefore, this project focuses on mechanism to evaluate the trustworthiness and authenticity of entities as well as on revenue models, identity management and mechanisms for authorization, accounting and charging in context-aware systems. These research activities as well as work in the area of privacy protection are currently being completed.

It is important to evaluate the authenticity and trustworthiness of context providing or requesting entities in open context-aware systems. Reputation systems combine opinions of entities and compute resulting authenticity and trustworthiness values. The reputation system developed in this project enables users to express degrees of belief, disbelief and ignorance in the trustworthiness of other users and in the authenticity of users and keys. It uses a paraconsistent logic and inference rules to draw conclusions even in case of uncertain and conflicting opinions. The project developed, implemented and evaluated different exact algorithms and approximations to compute the resulting confidence values. In addition, we designed simplification algorithms, which transform trust and authenticity networks into equivalent but simpler networks to reduce the computation time (see Figure 5). We demonstrated that the computed trust values can be used for example for trust based access control (i.e. only trustworthy entities can query the location of a user) and to identify providers who offer high quality context information [BBD+10].

Practical revenue strategies and provider models are crucial factors for the economic success of context-aware systems. The project therefore analyzed the flows of context data from context and service providers to users in different scenarios and derived technical requirements for direct and indirect revenue models. We analyzed existing online and offline accounting infrastructures with pre- and post-payment methods and discussed whether they can be applied to context-aware systems. For low-value payments we showed that volume dependent billing models can cause significantly higher operational costs than volume independent models. Small payments should therefore be aggre-
gated before charging to reduce charging fees. Indirect revenue models (e.g., advertisements embedded into 3D models) can be viable alternatives to direct payments because they do not impose inconvenient payment procedures on users [BBB+10].

In addition, we developed a framework to integrate and evaluate trust, accounting, billing, auditing and charging functions and strategies already in early development stages of prototypes [KLB+10].

We investigated an accounting system that is based on the current congestion level in the network. Making end-systems accountable for the amount of congestion they cause will support a fair sharing of the available network resources with respect to the priority of different transmissions. re-ECN is a proposed protocol that exposes the needed information about the congestion level in the network. Based on this information every sender can decide how to react appropriately in a congestion situation. We implemented the re-ECN protocol in Linux and evaluated the behavior based on simulation with real kernel code. Additionally, we investigated the case where the receiver is the connection initiator. If data is requested by a client, the server will not be able to decide about an appropriate data handling as the intention of the client is not known. To address this problem we developed two different architectures to transfer so-called congestion credits either online or offline from the client to the server. Figure 6 shows the different steps for the online processing. Moreover we investigated solutions for out-of-band signaling to communicate the preferences of a client, e.g. by offering a premium service (in a congestion situation) when a client is willing to watch an advertisement before downloading a video [KSL10].
In the past decade many data stream processing systems have been proposed, however, tool support for those systems has not been an issue. An integrated tool that supports developers of streaming applications, when designing new or modifying existing ones, helps reducing development time and prevent errors that might occur at design time. We developed the NexusEditor [CWGN11], an integrated tool for the support of management and modeling of context data, as well as extensions for the NexusEditor called NexusDSEditor [CLD11], which add tooling support for the NexusDS platform.

Fig. 7 depicts the embedding of the NexusDSEditor in the overall system architecture. The NexusEditor is the central component in supporting the development process and bridging the world of Nexus Experts and Domain Experts. On the right, Nexus Experts develop and maintain the context data management platform (consisting of the Nexus and NexusDS platforms, the NexusEditor as well as the NexusDSEditor). On the left, Domain Experts exploit the NexusEditor’s functionality to develop context-aware streaming applications. Examples for such applications were demonstrated in [LBCS10]. Users use the context-aware streaming applications, which Domain Experts have developed beforehand. These applications usually run on clients, such as desktop computers or mobile devices.
While location-based applications gain in importance and the number of customizable applications increases, there is almost no combination of these techniques available. Therefore, we introduced Gamework [Sta10a], a framework for customizable mobile location-based games. We identified four classes of customization techniques in this area differing in required programming experience and scope of adaptation possibilities: Using the context in games (e.g., by setting the game directly into the player’s environment), adding user-generated content (a technique well known in the Web 2.0 domain), adapting the game-flow (by describing the whole game as an editable and processable finite state machine) and creating new games from scratch (by providing reusable modules). Our framework supports each of them.

We use games just as a specialization for customizable mobile context-aware applications and services in general. Hence, in future work, we will disengage from the area of mobile location-based games and use the experience gained thereby in the more common field [Sta10b]. As an example for such a more common application we introduced vHike [Sta11].

In the domain of spatial data management, achievements towards native spatial RDF databases were made. Semantic Web technologies, most notably RDF, are well-suited to cope with typical challenges in spatial data management including analyzing complex relations between entities, integrating heterogeneous data sources and exploiting poorly structured data, e.g., from web communities. This calls for efficient data management systems which are capable of querying large amounts of RDF data and support spatial query predicates. We developed a native RDF triple store implementation with deeply integrated spatial query functionality [BNM10]. We modeled spatial features in RDF as literals of a complex geometry type and expressed spatial predicates as SPARQL filter functions on this type. This makes it possible to use W3C’s standardized SPARQL query language as-is, i.e., without any modifications or extensions for spatial queries. We evaluated the characteristics of our system on very large data volumes and achieved good performance results.
Project B3 investigates mechanisms to efficiently manage context data in hybrid systems where infrastructure-based and infrastructure-less networks are integrated. In particular, we consider public sensing scenarios in urban areas where mobile devices have ad-hoc and infrastructure connectivity.

In 2010, we investigated mechanisms for the automated mapping of urban areas that provide a virtual sensor abstraction to the applications. This is the base for a participatory system that exploits widely available devices such as mobile phones to cooperatively read environmental conditions like air quality or noise pollution, and map these measurements to stationary virtual sensors. We developed spatial and temporal coverage metrics for measuring the quality of the acquired sensor data that consider the conditions of urban areas and the uncontrolled movement of nodes. To achieve given quality requirements and efficiency in terms of energy consumption, we proposed two algorithms for coordinating sensing in [WDR10a]. The first is based on a central control instance which assigns sensing tasks to mobile nodes based on movement predictions. The second algorithm is based on coordination of mobile nodes in an ad-hoc network. Figure 8 shows the assignment of sensing tasks to mobile nodes based on the node trajectories depicted on the left. On the right hand side, the node coverage is shown and the subset of nodes is selected that fulfills the coverage requirement. By simulative studies, we showed that these algorithms achieve a high quality of readings, which is about 95% of the maximum possible. Moreover, the algorithms achieve a very high energy efficiency allowing for drastic savings compared to uncoordinated sensing. In addition to generating maps of environmental conditions, we investigated how to automatically generate road maps [BWD10], and how to efficiently detect mobile objects [WWDR11].

Beyond this work, we studied routing mechanisms on symbolic and hybrid location models in cooperation with project A2 that allow for addressing specific locations, e.g., rooms or streets [WDR10], [DWR10]. These mechanisms provide an efficient means for the coordination of the mobile devices to fulfill their public sensing tasks.
Project B5 investigates concepts for the management of dynamic, time-referenced context information. In detail, the work is organized into the following three research fields: (1) Efficient retrieval of context information through scalable indexing of context providers by a Context Broker. (2) Optimized access to dynamic context information on mobile devices. (3) Storage and analysis of time series in History Servers and Warehouses.

In the year 2010, we finalized our concepts for a Context Broker implementing a global discovery service for context providers [LDR10b]. On the one hand, we proposed a powerful formalism for describing the contents of context sources and for formulating compatible queries. This formalism refines existing approaches that describe the sources by constraints on the attribute value ranges in several ways: It allows for complex, nested descriptions based on defined classes. It supports alternative descriptions to express that a source may be discovered by different combinations of constraints. Finally, it allows for adjusting between positive matching, similar to keyword-based discovery, and negative matching, as used in existing logic-based approaches. Supporting different matching semantics allows for trading off the relevance of a provider against the number of discovered providers. On the other hand, we proposed the SDC-Tree for indexing source descriptions. To allow for efficient source discovery, the SDC-Tree features multidimensional indexing capabilities for the different attributes and the IS-A hierarchy of a shared ontology.

Moreover, we finalized our research on the efficient management of mobile object trajectories by implementing a prototypical system, which was also demonstrated at PerCom 2010 [LDR10a]. In particular, this system implements our Generic Remote Trajectory Simplification (GRTS) protocol, which optimizes storage, processing, and communication costs for storing and updating trajectories.

To reduce the data volume of time series data for permanent storage, we defined usability criteria of compression algorithms and classified the algorithms according
to them [HGRM10]. In our problem scenario we want to apply the compression algorithms within a compression operator in a stream-based data processing scenario (conf. Fig. 9). We found out that to choose an appropriate algorithm for a specific problem scenario, not only the performance of the algorithms and their ability to reduce the data volume (where most algorithms provide comparable good results) is important, but also, e.g., the ability to process stream-based data, to use different distance functions, and to do multiple compression steps in aging trajectories, as well as result characteristics, e.g. point-based results vs. continuous trajectories. We classified simple compression algorithms like linear regression to line simplification approaches. For the special case of trajectory data, we compared them with a map-based approach, consisting of map matching and storing the first position on every entered segment. On the one hand the map-based approach is a genuine location-aware approach, on the other hand we cannot recommend it, because it has disadvantages not only on compression and calculation time, but also we regard the basic idea (only objects with network-related motion) as too restricted in general.
One of the main tasks in subproject C1 is to provide a geometric basis for spatial world models for context aware applications. For this purpose, methods for the automatic derivation of 3D building structures from sensor data of heterogeneous quality have been developed [Bec10]. Resulting 3D building models can be used for various scenarios. In cooperation with subproject D2, strategies have been worked out to make the 3D building structures applicable in navigation systems for blind people. Based on façade models in which detailed façade structures are represented by explicit 3D geometry and semantic information, 2D maps can be derived for each floor where windows and doors are described by annotated polygons. Especially the position of doors may be helpful for blind people when searching for the entrance of a building. Figure 10 shows the Central Administrative Building of the University of Stuttgart as 3D façade model (left) and 2D map of the ground floor (right).

Beside pedestrian navigation, a number of other applications can take advantage of semantically interpreted 3D building models. For example, detailed façade models allow for energetic estimates of a building’s heat loss by calculating the ratio of wall to window areas. Furthermore, they are appropriate to complement BIM models which are used for facility design, construction and asset management. Façade structures can also be used to simulate high-resolution SAR images in order to support Persistent Scatterer Interferometry (PSI) focused on single urban objects [ABBB10].
However, most applications require not only geometric and semantic knowledge but also quality information about the building structures. Therefore, application dependent quality criteria for façades have been developed which are appropriate to be used in various scenarios. Such evaluation criteria consider the ratio of void to solid of a façade, the form and size of windows as well as their arrangement [Bec10].

Concerning the generalisation of 3D building models, amongst others, texture adaptation and means for an identification and aggregation of building blocks were examined.

The texture adaptation steps are 1) groundplan adjustment of the generalized model following [Pet09], 2) rotation and viewport change in OpenGL in order to show exactly one face of the generalized model and 3) rendering of all visible faces of the original model into the texture of the generalized model. However, one of the aims of the texture adaptation step was to represent as much geometry lost during the generalisation in the texture of the generalized model. In order to achieve this, additionally to the straightforward orthogonal projection (see Figure 11 middle image) different perspective projection methods were examined. The best results to propagate the lost geometry into the texture, however, could be achieved using explicit geometrical changes to the original model before the final rendering step. As it is visible in the right hand side image in Figure 11, slightly tilted side walls of the front building result in it being represented inside of the texture, although both side walls are visible from all points of view, which is one of the disadvantages of this approach.

Secondly, the examination of means for the identification and aggregation of building blocks in 3D city models resulted in a region growing approach, followed by the identification of enclosed buildings and a final simplification using the approach presented by [KPF09].

Figure 11: Left to right: Original building; generalized building textured using ortho mode; generalized building textured using perspective mode.
Concepts are developed for the evaluation of the quality of sensor data, in order to be able to integrate indistinct measurements and inaccurate results into distributed environment models. A quality measure shall be applicable to different context information treating different quality criteria, in order to resolve the conflicts in environment models. The focus in 2010 was on information aging for data fusion of sensors which can’t be synchronized and on an implementation of a situation recognition based on inaccurate sensor data.

Information Aging is used to combine measurements from different camera systems on a single hardware platform to reduce deviations when using unsynchronized sensors. This enables a robust and highly dynamic object tracking [KHL10]. As part of the Reference Model for the Quality of Context Information methods for rating and minimizing degradation of sensor data and situation information were described [BBD+10].

Based on the determination of preconditions for a situation recognition using uncertain sensor data for a logistic regression an interpretation of sensor data in Bayesian networks was developed. A new method is introduced for correcting bayesian networks and calculating quality ratios based on user feedback [ZHKL09].

Our embedded SensorContextServer was introduced as a prototype for acquiring images for situation recognition. Hereby the significance of historic reference data is analyzed [MHS+10].
We extended our cooperation regarding our flow visualization application developed together with the B1 project. We simulate the air flow in a room considering moving obstacles and the status of the windows, which is provided by the C6 project. Together with the B3 project we extended our application to support mobile devices, see Figure 13.

In contrast to our flow visualization application, which is using C++ modules to optimize performance, we cooperated with the B1 project with focus on realizing a transparent visualization with Java operators only [LBCS10].

Moving entities generate large amounts of trajectories, like the moving persons entering a room, see Figure 14. The C6 project extracts such trajectories from videos and has the goal to develop a classifier which classifies them according to different movement paths. They first generate feature vectors out of the trajectories which are classified by decision trees. We developed an analytics tool which displays the feature vectors through 2D or 3D scatterplots which can show 2 or 3 dimensions at a time and introduced a navigation technique between scatterplots. The navigation uses the decision tree of the classifier. Our technique allows the exploration of the multivariate feature vectors by preserving context through a smooth transition between scatterplots.
The goal of this project is the generation of synthetic context information through fusion of multimodal sensor data and computer graphics models and simulations. In contrast to sensor data, the latter is obtained from modeling and simulating real-world processes instead of measuring or capturing them. These models require few, and thus typically more reliable, input parameters and thus the generated information can be used to complete sensor data, to validate measurements, or even for mutual correction of models and measurements.

Particularly the environmental lighting conditions have been the focus of this research phase, as these are important for augmented reality applications, context-aware mobile visualization (C5), and computer vision tasks (C6). In order to draw comparisons between real-world (sensor) and synthetic data two tasks had to be accomplished: the acquisition of environmental lighting conditions – focusing first on outdoor lighting scenarios including sun and sky light and weather conditions – and developing a method for simulating light transport that is efficient enough to meet real-time constraints for user interaction, while taking only few parameters as input which are deducible reliably from sensors and available context information in the Nexus world model.

With regard to the simulation of atmospheric phenomena, such as clouds and scattering – both phenomena that have to be considered when acquiring real-world data with cameras – a new method has been developed that computes atmospheric single-scattering very efficiently [ED10]. This approach has then been extended to arbitrary scattering conditions allowing for realistic simulation of participating media and thus reliable validation of sensor data [END10].

Indoor lighting conditions are likewise important for Nexus applications, but require different simulation techniques as other light transport components, e.g. indirect illumination, and reflection off artificial materials (glass, plastic, etc.) play a more prominent role than in outdoor scenarios. Only light transport simulation based on Monte Carlo (MC) techniques can provide the necessary accuracy for meaningful comple-
tion and validation of sensor data. To enable interactive performance we developed an acceleration technique for performing such simulations on graphics hardware [NHD10, NHD11]. For approximate, yet unbiased and high-quality, simulation results a novel method based on quasi-MC approaches has been developed speeding up the computation by several orders of magnitude [NED11].

Figure 16:
A Monte Carlo simulation of light transport. Left: a (noisy) preview image computed at interactive speed, right: a (more converged) result after 10 seconds.
The Smart Factory approach represents our solution for a real-time and context-sensitive manufacturing environment overcoming the external and internal turbulences in factory operation.

Based on the Smart Factory Data Model which builds the foundation for the context-aware applications the last research results are represented by the implementation of the Smart Factory demonstration scenario for context-aware failure management. It provides shopfloor managers and maintenance workers context-aware support, by delivering context information about the failure, the required tools and spare parts in order to handle failures in the shopfloor efficiently. The context-aware failure management process consists of the following main steps: a) Failure Data Acquisition, b) Failure Analysis, c) Implementation of Measures and d) Repairing and Intuitive Documentation. Figure 17 shows the main steps and the developed hard and software components. For the execution of the context-aware failure management process and the communication with the shopfloor manager and maintenance workers, the Smart Workflow Management System, the Mobile Smart Workflow Application and the Smart Factory Web Client have been developed in interdisciplinary cooperation with the Project E1. Additional to these software components several adaptors between Smart Factory equipment/machines (CNC-machine tool, Assembly Line and
This year’s research focused on broadening the base of our TANIA system (Tactile-Acoustical Navigation and Information Assistant), especially by allowing a greater variance for the world model upon which the system is running. By using the Nexus platform developed in the project “Homogenized & Virtualized Model Management” as the base for our world model, it is possible to use maps from different sources and with differing format for the navigation. Additionally, other location-based information can be integrated into the system in order to further facilitate navigation.

With the technological advantage of using the Nexus platform as a common base, the possibilities of using a wide variety of sources were explored in cooperation with other Nexus projects. In those cases, the other projects contributed the information sources, whereas this project was responsible for integrating the information into the navigation system and presenting them to the user in an adequate way.

Localization System), factory specific information systems (Manufacturing Execution Systems – MES) and the Nexus federation platform have been implemented. Furthermore in order to support the maintenance activities, an RFID-glove and an intelligent toolbox as hardware have been developed. The latter enables the intuitive acquisition of the context information of tools and spare parts during repairing. The progress of our research was disseminated to the international and national scientific community on different events [LC10, WLS+10].

### Project: Context-Based Assistant Systems for People with Sensory Disabilities

### Researcher: Bernhard Schmitz

3.4.2

**Figure 18:** Using the Nexus platform allows the TANIA system to integrate a wide variety of information sources.
The information thus made available to the user includes façade maps of buildings, created by a method developed in project “Consistency & Generalization of 3D Geo Data” that allow the user to find the entrance of a building and are especially helpful in combination with standard street maps, which were also added to our system. Furthermore, spatial information available in text form in the World Wide Web was included in the system, based on methods developed in project “Semantic Methods for Managing Context Models”.

This includes colloquial area names, live information about the environment, such as the state of elevators and escalators, and live departure times of bus and train stations. By employing the Nexus platform and displaying all the information on our tactile-acoustical map – regardless of where its original source was located – the navigation is improved considerably both regarding the covered area and in its usability.

A smaller aspect of our research was conveying information to blind users by vibrations. In addition to building a final version of the ViibraCane, a cane that gives direction indication via vibration [Sch10], a method was developed that can transmit map information to the user via a rumble gamepad with two analogue sticks [SE10].
In 2010 the project first focussed the public and scientific discours and communication on Ubiquitous Computing, Mobile and Context-aware Systems. Klaus Wiegerling gave several lectures with a focus to social and ethical aspects and especially to medical applications of Context-aware Systems. For example he was invited two times to the KIT Karlsruhe to lecture on “Die Vision des Ubiquitous Computing und ihre philosophische Bewertung” in May and within the framework of an expert-workshop to lecture on “Embodied Computing: Digitale Leiber und neue Körper?” in November. At the TU Darmstadt he lectured on “Zur sozialen Ambivalenz ubiquitärer Systeme” in February and at the TU Vienna on „Medienethik in imaginären Lebenswelten - Ausblick auf künftige Handlungsprobleme und –strategien“ in May. On the “eHealth Conference 2010 - Telematik bringt mehrWERT” (Hannover, September 14-16) he lectured on “AAL-Systeme im Kontext ubiquitärer Systeme – Grundprobleme und spezifische Probleme” and at the Symposium „Medizinphilosophie 2010‘ in Karlsruhe (November 13-14) he lectured on „Der technisch aufgerüstete Körper und die Frage nach der Gesundheit“.

A second focus of the project was trust, security and data privacy protection of context-aware systems. In different papers and Panels Sandro Gaycken focussed new questions of information-technology-security, which arise by new possibilities of the so called ‘Information warfare’. Among other papers he published a new monography with the title “Cyberwar: das Internet als Kriegsschauplatz”.


And least in August Sandro Gaycken organized and moderated at the TU Berlin “The First Dutch-German Workshop on Challenges for the Philosophy of Technology in the 21th Century” with a section which had a special focus on context-aware systems.
Subproject D6 investigates the acceptance of innovative context-aware mobile data services, with a focus on business issues. In 2010, research activities were expanded to a specific subset of these services, namely “Pay-as-you-drive” (PAYD). This is a context-aware car insurance innovation based on second/third generation mobile telecommunications technologies. Empirical survey data were collected in order to explore impacts of service-, individual- and context-related variables on residential customers’ willingness to adopt, use and pay for PAYD offerings.

To date, results of the subproject D6 are primarily based on four completed surveys:

- Residential customer survey on “acceptance of and willingness to pay for location-based services” conducted in May 2008 (n = 2,379);
- Laboratory experiment with student subjects on “acceptance of and willingness to pay for location-based services” conducted from November 2008 to January 2009 (n = 90);
- Expert survey exploring the “status quo, potentials and barriers of the use of location-based services” in German enterprises from April to May 2009 (n = 60);
- Residential customer survey on “acceptance of and willingness to pay for PAYD” conducted from November 2009 to February 2010 (n = 623).

The first three data sets were statistically analyzed to explore research issues concerning actual and intended use of location-based services (LBS), perceived LBS privacy risks and willingness to pay for LBS. Furthermore, LBS perceptions were compared between LBS users and non-users of such services. The data reveal that LBS are – apart from navigation services – (still) rather unknown. The most crucial drivers of a residential customers’ willingness to adopt LBS are (1) the need for “on-the-move-information” and (2) the perceived endorsement of LBS use among a participant’s close social contacts and (3) concerns regarding the misuse of personal LBS data.

Overall, the LBS findings show that mobile network operators (MNO) may be well advised to consider a step-by-step user introduction, entailing a free limited trial period prior to a binding subscription of such services and to initially focus their communication efforts on customer segments with a „mobile lifestyle” (i.e. frequent travelers).

With regard to innovative PAYD car insurance offerings the residential customer market potential for primary insurers in Germany was conceptually analyzed both through the lens of industrial economics and consumer behavior frameworks. The analysis revealed that from a German primary insurer’s perspective the benefit-cost-differential of PAYD is by no means clearly positive. Therefore, PAYD diffusion in Germany is likely to take place only in case that the adoption of this new type of insurance is backed by state interventions which are in turn motivated by macroeconomic PAYD benefits such as CO2-reduction or decreases in road maintenance costs.

Based on the fourth survey data set collected by D6 conjoint analyses were conducted to explore impacts of various characteristics of PAYD offerings on PAYD pref-
ferences of residential users. Results show that PAYD price advantages relative to conventional car insurance rates had the strongest effect on PAYD preferences. The possibility to subscribe to other services such as rescue alerts also enabled by the hard- and software, which has to be installed for PAYD, and the drive characteristics used to calculate a PAYD car insurance premium had moderate impacts on consumers’ PAYD preferences. Modes of data transfer implemented to carry driving information to a unit in charge of analyzing the data to derive an individual insurance premium had only a weak influence on PAYD preferences. The results indicate that primary insurers willing to launch PAYD in Germany should develop the PAYD market by first addressing price sensitive and safety oriented customer segments with communication campaigns emphasizing the cost advantages of PAYD relative to prior traditional premiums and the driving safety improvement through PAYD technology.
The aim of subproject E1 is to support the development of context-aware applications in process-oriented domains like the Smart Factory (developed in subproject D1). For that, context-aware workflows were developed (Context4BPEL). Furthermore, we developed generic concepts for the integration of context into standard BPEL workflows to enable modeling of smart workflows. In order to ensure a human oriented realization of the context-aware workflows we defined in cooperation with subproject D1 and D3 new methods for conserving the privacy of workers.

The main goal in the year 2010 was the realization of a prototype based on the previous works. The aim of the prototype is to show the research results of subproject E1. Together with subproject D1 a Smart Factory Demonstrator was developed based on context-aware workflows. The demonstrator implements an important process in production environments, the failure management process. The first challenge was to define the process as generic as possible in order to cover many failure types in production environments. The resulting process is shown in Figure 21. The next step was the realization of the process as context-aware workflow containing context-aware human tasks. This realization has been described in following publication: [WLS+10].

The context-aware failure workflow contains many tasks that have to be done by humans. This is realized with context-aware human tasks. For interaction of the workers with these tasks user interfaces are needed. In a master thesis [Sch10a] two of these user interfaces have been developed and have been published in [WLS+10]. First, a mobile Android application as mobile task map (see Figure 22). Furthermore, an application for the management level of the production company has been devel-
Relations between objects have an important role in a context-aware system (e.g. hierarchical relations between administrative objects). Methods from the field of Natural Language Processing (NLP) can be used to acquire new relations or to verify existing relations in the Nexus context model. The development of a competitive relation extraction system needs a high amount of annotated data. Therefore, we invented a novel method, which is called self-annotation, to minimize the manual annotation effort. Our approach uses existing structured data resources to create annotated data. This can be part of the Nexus context model or part of the structured part of Wikipedia.

In [BS10a] we consider relations between suburbs and their related towns. In most freely available data sets this relation is modeled by a simple heuristic which often fails. Our work shows how to create an annotated training corpus in an automatic way by using structured and unstructured data from Wikipedia. Our approach uses each article about towns or suburbs from the German Wikipedia edition. We simplified the
annotation task by considering only the first sentence of the article as unstructured data. For the structured data we considered a defined attribute-value pair of the German infoboxes about towns. Our annotation process extracts in the first step one relation from the structured data and uses this knowledge in the second step to annotate the text. The resulting annotated text can be used as training or evaluation data for any relation extraction system.

In our second work [BS10b] we went a step further and considered also attribute-value pairs that include natural language as value. This is in some cases necessary because the amount of cleanly modeled attribute-value pairs is too low. Therefore we evaluated some heuristics that can be used to solve this task with self-annotation. Figure 23 shows a self-annotated document. All named entities (e.g. names for places and rivers) and relevant relations are highlighted.

Furthermore we implemented a component that extracts information about defunct escalators from the Web pages of the Transit and Tariff Association Stuttgart (Verkehrs- und Tarifverbund Stuttgart, VVS). This information is helpful for project D2 to improve the planning of the optimal route for a blind person.
The target of the joint project E3 is to develop a general distributed situation recognition approach and integrate it in the Nexus platform.

During 2010, different approaches were examined to detect and identify possible inconsistencies between situation templates. For that a so called Meta-Template-concept has been developed and integrated in the already existing template approach [HHL+10]. This new Meta-Template-Model has been discussed in detail in [BBD+10]. Furthermore, strategies (e.g. Reward-And-Punishment) were examined to resolve inconsistencies accordingly.

For evaluation and testing a platform-independent software-demonstrator has been implemented to integrate the developed methods and final results of the project. For testing the reasoning and recognition process, an exemplary meeting scenario has been chosen. Because of already available and correctly labeled sensordata provided by sub-project C3, a batch-learning approach was implemented. Furthermore, the template approach and Bayesian reasoning for recognition have been compared with a centralized implemented recognition method (logistic regression) implemented in C3. During the evaluation and the comparison of the results several optimizations to increase the efficiency and reasoning have been realized.

Moreover, we have worked on the design and the implementation of new placement algorithms that enable us to distribute the reasoning process in an efficient way. First we have proposed a new distributed placement algorithm that places the reasoning operators to minimize the bandwidth-delay product. A detailed description of the algorithm is given in [RDR10]. The bandwidth-delay product is an indicator of the network load put onto the system by the deployment of a query. Therefore, the minimization of this metric implies the efficient usage of the network resources, which ultimately leads to higher scalability.

As a next step we have studied other variations of this placement problem. In particular, we have introduced a restricted variation of the initial optimization problem, where the QoS requirements are expressed as constraints. To solve this constrained optimization problem, we have proposed another placement algorithm that strives to fulfill QoS requirements in terms of delay, while minimizing the network load. In our approach we first find an operator placement that minimizes network usage and subsequently we distort the optimal solution such that the QoS constraint is fulfilled while minimizing the impact onto the network usage. This algorithm is further described in [RDR10b].
The goal of Project Q is the design of a reference model for quality of context that integrates three different quality aspects of context information: degradation, consistency, and trust. For each aspect, suitable quality metrics and calculi are investigated. Project Q is organized as a cross-section project involving various research projects of the Collaborative Research Center.

In the year 2010, we finalized the concepts for quality metrics and calculi for the different quality aspects and finally proposed a quality reference model. The following description briefly summarizes the final outcome of Project Q. Further details and references can be found in [BBD+10].

Degradation: With respect to the quality aspect degradation, we investigated quality metrics and calculi for simple scalar sensor data, position information, and complex context information, namely three-dimensional models and situations. For scalar sensor data, the Normalized Arithmetic Mean Algorithm was designed to minimize the degradation of fused sensor data. For position information, a unified degradation model was designed based on Partial Spatial Distribution Functions (PSDF) that is compatible with the different existing specific models. Moreover, we designed corresponding quality-aware query interfaces for the major query types, namely position, range, and neighbor queries. For 3D models, we considered quality metrics for 3D surfaces derived from clouds of degraded 3D point measurements. Here, we identified co-variance matrices resulting from the process of error propagation and correction as suitable metric to describe the degradation of single surface segments (e.g. walls) as well as whole 3D objects (e.g. buildings). To describe and derive uncertain situations, we used probabilistic models and the Bayes inference method together with learning mechanisms.

Consistency: For the quality aspect of consistency, we have developed a consistency metric, which represents the degree of consistency as a value from the interval [0, 1]. Using this metric, the consistency of different values for the same attribute of an object, typically stored by different data providers, can be measured. The central properties of the metric were defined in cooperation with application projects. Identical values have the consistency 1, contrary values the consistency 0. When taking degradation into account, there may be values which are neither identical nor contrary, those values have consistencies between 0 and 1, depending on the degree of overlap. The actual implementation of the metric depends on the data types and degradation model, we defined metrics for discrete values, for continuous values with and without probability density function and for 3D geometries. For higher level context information, we developed an approach for using the consistency of situations to refine the situation recognition process.

Trust: The quality aspects trust and reliability describe to which degree users can rely on the correctness of context information and on assigned quality ratings. It is useful and necessary to distinguish between trustworthiness and reliability. Reliability describes the expected probability that context information is correct (within the limits of accuracy), whereas trustworthiness describes the degrees of belief and disbelief...
that the issued ratings of a person about the reliability (or degradation and consistency properties) of context information are correct, i.e., that this person is competent and honest to rate the correctness and quality properties of context information. Thus, the resulting reliability value for context information is computed as follows: First, a reputation system evaluates all available trust statements of the users according to its trust model and computes for each user and provider a resulting trust value. The trust value computation is based on probabilistic reasoning with inference rules and a paraconsistent logic. The estimation for the reliability of a piece of context information is the average of all respective reliability ratings weighted with the linearized trust value of the rating issuers. The resulting reliability value and quality ratings can then be used for example to resolve inconsistencies, i.e., to select the value from the more reliable context provider.

Reference Model:
To define the quality reference model, we first analyzed the relationships between the different quality aspects. As Figure 25 shows, these aspects are interdependent. In this example, position O8 is captured by two providers with different accuracies (±5m, ±4m). The consistency depends on whether both positions can be correct at the same time. The reliability is defined by the trust of the user in the providers, independent of the degradation or consistency of the positions.

Finally, we defined a quality-aware processing model for context information (Figure 26). This generic model allows for the flexible processing of context information. Operators can be defined to fuse context information based on their degree of degradation, consistency, and trust. The fused values are then processed according to the possible worlds semantics, which was extended to handle uncertainties.
The aim of this working group is to encourage and coordinate interdisciplinary research activities in the area mobility and security, amongst others in the areas mobile communication, privacy protection, reputation systems, trust models, acceptance, and economic topics like accounting, charging and pricing in context-aware systems. The activities have been coordinated by the three task forces mobility, reputation and trust, and charging and pricing (the task force privacy was completed in 2008).

Mobility
The task force mobility extended its integrated demonstrator for 3D web visualization and transport protocol tuning. Enhancements in the network stack by using the Quick Start protocol improved the performance for applications that require short response times and have a high bandwidth demand. The used example application is a navigator tool through the city of Stuttgart. We included new data for a more detailed 3D city model. Stuttgart including several suburbs can now be visited virtually in a more detailed representation. Most of the buildings in the inner city even show the original texture based on photographic images. Moreover, this new data allowed us to differentiate more precisely which buildings need to be loaded. To adapt the amount of transmission data to the actual network state, we extended the interface between the network stack and the application in such a way that information about the available start sending rate is visible for the application. Subsequently, the application can decide which buildings of the current perspective should be displayed. Thus larger building in the foreground can be displayed first.

Figure 27 shows the achieved improvements in response time in comparison to the same interaction sequence without Quick Start. Additionally, the same sequence was replayed with different network conditions.
Reputation and trust
The task force reputation and trust coordinated interdisciplinary research activities on the design, implementation and use of models to represent trust and authenticity relations between users and service providers and on methods to evaluate these statements in order to derive an estimation for the degree of trustworthiness and authenticity of other entities. In 2010, the research activities have been completed and the results have been consolidated. The results comprise philosophical and technical justifications for the developed reputation system, a classification for reputation systems, discussion of their properties, counterintuitive effects, general limitations and possible social implications of the use of reputation systems as well as approaches for the use of reputation systems to analyze and improve the quality of context information [BBD+10].

Charging and Pricing
The task force charging and pricing focused on economic aspects of context-aware systems. Research activities include the development and comparison of generic value chains for context-aware systems, different revenue and service creation models as well as interaction schemes for content and service providers. In addition, the task force evaluated accounting and charging infrastructures, electronic payment systems and their applicability to context-aware systems. The results cover technical aspects of possible accounting, charging, billing and pricing approaches as well as discussions of to the economic potential of the proposed revenue and interaction models. The research activities in this task force have been completed. The results are documented in [BBB+10].

Figure 28:
Demonstrator
Within the working group “Spatial World Models & Application Support” interdisciplinary questions concerning modeling and architecture of spatial world models are discussed. This includes application specific extensions of the world model as well as extensions arising from the developed reference model for context quality. The second area of focus is application support for context sensitive applications.

**Modeling and Architecture**

With respect to the architecture, we developed a three-tier-architecture depicted in Figure 29. The Context Information Layer consists of Context Providers (CP) from arbitrary context-data providers which offer context data (such as sensor data or historical data) within the Augmented World Model (AWM). The Federation Layer represents a distributed platform consisting of many Federation Nodes (FNs) which can execute different platform services, such as Distributed Query Processing or Context Reasoning. Thereby the different FNs range from infrastructure-based computing nodes to mobile nodes within As-hoc networks. Within the Application & Middleware Layer applications using the provided services and additional middleware services, such as a service for Context-Aware Workflows, reside.

For data modeling, the AWM has been retained without modifications. The AWM is an extensible data model based on object-oriented concepts and supports multi-inheritance, metadata and temporal concepts.

![Figure 29: Architecture of the Nexus platform](image)

**Situation**

In 2010, the work of the subgroup “Situation” was especially focused on evaluating the results and optimizing the successfully developed methods of the taskforces. For this purpose several projects of different research fields have been synergizing in the subgroup “Situation.”
According to the results of the already finished taskforce “Definition” and taskforce “Situation template” a cross publication of E1, E3 and D3 [HHL+10] has been published successfully. In this work the concept of the template-model and the basic idea of the tree-based algorithm were discussed. Another focus of this work was to publish and discuss the definition of situation and its related terms in Nexus. To complete the work of the finished taskforces, the results have been tested by implementation in a demonstrator.

The main focus of the taskforce “Integration” was to integrate the developed template-concept into the Nexus data model [RHD+10]. The integration has been evaluated by example of recognizing a meeting-situation in close cooperation with the projects E3 and C3. For evaluation and testing, a platform independent software-demonstrator has been implemented to integrate the successfully developed methods. Furthermore in close cooperation with E3 and the Q-project, the results of the taskforce “Degradation” has been evaluated. In particular the quality-aspects, its resulting cost-metrics and the Meta-Template-concept [BBD+10], which are required to detect and resolve inconsistencies on the level of situation recognition, have been implemented in the software-prototype.

3D Data
The Subgroup “3D data” fulfilled the task to provide data from the individual projects to all other projects through the NEXUS framework. No open request remained to fulfill nor newly created.
Professional Activities

Conferences | Workshops | Colloquia | Committees
Professional Activities

Nexus Related Scientific Events

4.1

COLLOQUIUM: Ringvorlesung 2010

4.1.1

This year the lecture series has been organized by the Institute of Architecture of Application Systems (IAAS). Therefore, the topics of the lecture series came from the research areas business processes and web services, combined with the Nexus topic of context-awareness. The first speaker was Prof. Hauswirth, Vice-Director of the Digital Enterprise Research Institute (DERI), Galway, Ireland and professor at the National University of Ireland, Galway (NUIG). He gave insights on how to enable technologies for smarter enterprise environments. The next speaker was Gerhard Pfau. He is an IBM Senior Technical Staff Member and a member of the IBM Academy of Technology. He gave a talk on human-centric BPM with WebSphere - trends and directions. The next lecture was given by Prof. Dr.-Ing. David, Chair for Communication Technology at University of Kassel. He gave a talk on context-sensitivity and future, mobile applications. The fourth speaker, Prof. Dr. Ing. habil. Magedanz from TU Berlin, Fraunhofer Institut FOKUS, presented how to implement value added services over LTE and comparable technologies. The fifth speaker Prof. Dustdar heading the Distributed Systems Group at Vienna University of Technology gave a talk on services in mixed systems and presented models, methods, and algorithms for that area. Finally, as last speaker Dr. Carro from UPM Madrid presented how to use program analysis for complex systems.
The aim of the CoMoRea workshop is to advance the state of the art in context modeling and reasoning and discuss fundamental issues in context processing and management. The goal is to identify concepts, theories, and methods applicable to context modeling and context reasoning as well as system-oriented issues related to the design and implementation of context-aware systems. In the year 2010, the 7th CoMoRea workshop was collocated with the 8th IEEE international conference on Pervasive Computing and Communications (PerCom) in Mannheim, Germany. The workshop program included 6 high quality papers that were carefully selected out of 22 submissions. The workshop started with a tutorial given by the workshop organizers for providing an overview of the state of the art in context modeling and reasoning techniques. Afterwards, three papers in the area of context modeling, privacy, and adaptation in context-aware systems have been presented. Furthermore, three papers about context reasoning have been presented. After that, a general discussion about trends and challenges for future context-aware systems concluded the workshop.
Nexus researchers were involved in the organization of the following events:

- Workshop Chair CoMoRea 2010 (Mannheim, Germany, March 29, 2010)
- Program Committee Member PerCom 2010 (Mannheim, Germany, March 29 – April 2, 2010)
- Program Committee Member WS-REST 2010 (Raleigh, NC, USA, April 26, 2010)
- Program Committee Member MDM 2010 (Kansas City, USA, May 23 - 26, 2010)
- Program Committee Member ICWE 2010 (Vienna, Austria, June 5 – 9, 2010)
- Program Committee Member ICWS 2010 (Miami, FL, USA, July 5 – 10, 2010)
- Program Committee Member CLOUD 2010 (Miami, FL, USA, July 5 – 10, 2010)
- Steering Committee Member IEEE SERVICES 2010 (Miami, FL, USA, July 5 – 10, 2010)
- Senior Program Committee Member BPM 2010 (Hoboken, NJ, USA, September 13 – 16, 2010)
- Program Committee Member CASEMANS 2010, (Copenhagen, Denmark, September 26 – 29, 2010)
- Program Committee Member EDOC 2010 (Vitoria, Brazil, October 25 – 29, 2010)
- Program Committee Member CoopIS 2010 (Hersonissou, Crete, Greece, October 25 – 29, 2010)
- Program Committee Member UBICOMM 2010 (Florence, Italy, October 25 – 30, 2010)
- Program Committee Member ECOWS 2010 (Ayiy Napa, Cyprus, December 1 – 3, 2010)
- Program Committee Member ICSOC 2010 (San Francisco, CA, USA, December 7 – 10, 2010)
- Program Committee Member MSN 2010 (Hangzhou, China, December 20 – 22, 2010).
4.3 Publications


