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# Facts and Figures About the SmartKom Project

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**Summary.** The SMARTKOM project *Dialogue-Based Human Computer Interaction by Coordinated Analysis and Generation of Multiple Modalities* was one of six lead projects in the area of human computer interaction funded by the Federal Ministry of Education and Research and the Federal Ministry of Economics and Labour of Germany. We describe the intention of this initiative and summarize the organizational and funding structure of the SMARTKOM project. The final functionalities of the demonstrator system are compiled as well as an overview of the reception of the project in the research community and in the media.

## 1 Lead Projects in Human Computer Interaction

In 1998 the Federal Government of Germany initiated an ideas competition for lead projects on human computer interaction. Based on the main interaction and communication means of humans including speech, gestures, facial expressions, haptic signals and visualization and integrated in a multimodal approach these projects were to develop new assistance systems and agents for intelligent information and knowledge processing.

The projects were to be strongly interdisciplinary and to generate both scientific impact for further research and application-oriented prototypes as demonstrators addressing a broader public. Inviting research partners from science and industry to participate in this kind of large strategic collaborative project was aimed at developing attractive scientific solutions with a high market potential and it resulted in a total of 89 project proposals. High emphasis was put on the usability and the ergonomics of the new forms of interaction and their user acceptance. Design and development of systems and prototypes were based on conducting preliminary user studies as well as accompanying and final evaluations.

Finally emerging out of the project ideas proposed, six major lead projects were selected by a jury and recommended for funding. Starting in mid-1999, the Federal Ministry of Education and Research and the Federal Ministry of Economics and Labour launched the four-year projects with a funding volume of 82.6 million €. The total funding requirement for a total of 102 project partners yielded 152.2 million €.

Covering a large range in human computer interaction the lead projects funded addressed additional but disjunct areas focussing on the following highlights:

- ARVIKA:  
Mobile systems for action in mixed real/virtual working environments. Practical concepts for the design of augmented reality systems
- EMBASSI:  
Intelligent user interfaces for consumer electronics. Individually adaptable access to public terminal systems for disabled persons
- INVITE:  
Combining intuitive visualization and personalized navigation, semantic search, automated classification and implicit recording of knowledge
- MAP:  
New ways of using and integrating computers in mobile activities. A wireless, networked pocket-size personal assistant
- MORPHA:  
Service robots for use in private homes and in production. Quick intuitive programming by pointing and showing what is to be done
- SMARTKOM:  
Human computer interaction in dialogues. Situation-based understanding of vague, ambiguous or incomplete multimodal input at the semantic and pragmatic levels

In parallel to the start of the lead projects a scientific advisory board with international membership was installed. The advisory board continuously monitored and evaluated the projects during the funding period and advised the two ministries on the steering decisions to be taken. The members of the advisory board were:

- Professor R. Reichwald, TU Munich (chairman)
- U. Klotz, IG Metall, Frankfurt/M. (SMARTKOM reviewer)
- M. Bartels, IPmotion GmbH, Marburg
- Professor P. Cohen, Oregon Graduate Institute, Beaverton, USA
- Professor M. Gross, ETH Zurich, Switzerland
- Dr. G.B. Hantsch, Deutsches Handwerksinstitut e.V., Karlsruhe
- Professor R. Hoffmann, TU Dresden
- Professor M.K. Lang (Ordinarius i.R.), TU Munich
- Professor S. Maaß, University of Bremen (SMARTKOM reviewer)
- Dr. M. Maybury, MITRE Corporation, Bedford, USA
- Professor A. Ourmazd, Communicant AG, Frankfurt/Oder
- Dr. J. Redmer, Remshalden-Grunbach
- Professor G. Rigoll, TU Munich
- Professor J. Sauter, ART+COM AG, Berlin
- P. Zoche, Fraunhofer-ISI, Karlsruhe

For a comprehensive overview of the six lead projects on human computer interaction see Krahl and Günther (2003).

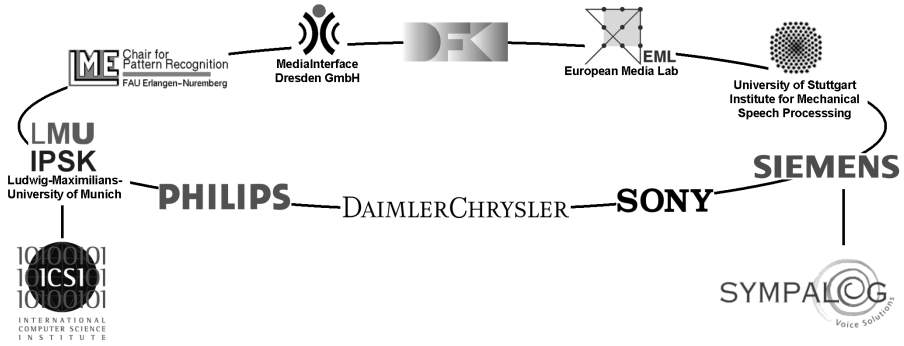


Fig. 1. The SMARTKOM consortium

## 2 SmartKom: A Lead Project in Human Computer Interaction

The SMARTKOM project was designed as a four-year initiative. The network plan was set up in spring 1999 defining nine subprojects with a total of 70 workpackages. Within the twelve research groups (see next section) a total of 218 person years were allocated. The project started September 1, 1999 and ended September 30, 2003.

### 2.1 The SmartKom Partners

The SMARTKOM consortium consisted of twelve partners, integrating research centers, large-scale industry, SME and universities (see Fig. 1).

- **Research centers:**
  - German Research Center for Artificial Intelligence GmbH, Kaiserslautern and Saarbrücken (DFKI, Main Contractor)
  - European Media Laboratory GmbH, Heidelberg (EML)
  - International Computer Science Institute, Berkeley/USA (ICSI)
- **Large-scale industry:**
  - DaimlerChrysler AG, Stuttgart (DCAG)
  - Philips Speech Processing, Aachen
  - Siemens Aktiengesellschaft, Munich
  - Sony International (Europe) GmbH, Stuttgart
- **SME:**
  - MediaInterface Dresden GmbH (MID)
  - Sympalog Voice Solutions GmbH, Erlangen
- **Universities:**
  - Chair for Pattern Recognition, Friedrich-Alexander-University Erlangen-Nuremberg (FAU)
  - Institute for Natural Language Processing, University of Stuttgart (IMS)
  - Institute of Phonetics and Speech Communication, Ludwig-Maximilians-University Munich (LMU)

**2.2 Funding and Controlling**

The SMARTKOM project was funded by the German Federal Ministry of Education and Research (BMBF, see Fig. 2, grant no. 01 IL 905) and additionally financed by the industrial and SME partners. Until the year 2003, 16.8 million € was allocated to the project. In addition the industrial and SME partners brought in 8.9 million € (see Table 1). Universities and research centers received a full 100% funding, while industrial partners contributed 60% of their costs.

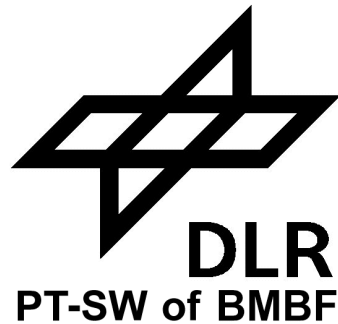
**Table 1.** Funding

BMBF-Funding, 01.09.1999 – 30.09.2003	16.8 Mio. €
Industrial and SME investment	8.9 Mio. €
<b>Overall volume</b>	<b>25.7 Mio. €</b>

The project was controlled by the German Aerospace Research Establishment (DLR), Berlin (see Fig. 3).



**Fig. 2.** German Federal Ministry of Education and Research



**Fig. 3.** German Aerospace Research Establishment

**2.3 Management and Organization Structure**

The SMARTKOM project was jointly managed by the Scientific Management, the SMARTKOM Steering Committee and the Group of Module Managers (see Fig. 4). The Scientific Management organised, coordinated and supervised the project and evaluated the progress of the implementation in close contact with the funding agency.

The assignment of the SMARTKOM Steering Committee was to support the Scientific Management in ensuring the scientific excellence of the work. The SMARTKOM Steering Committee consisted of ten project partner leaders to adjust the project

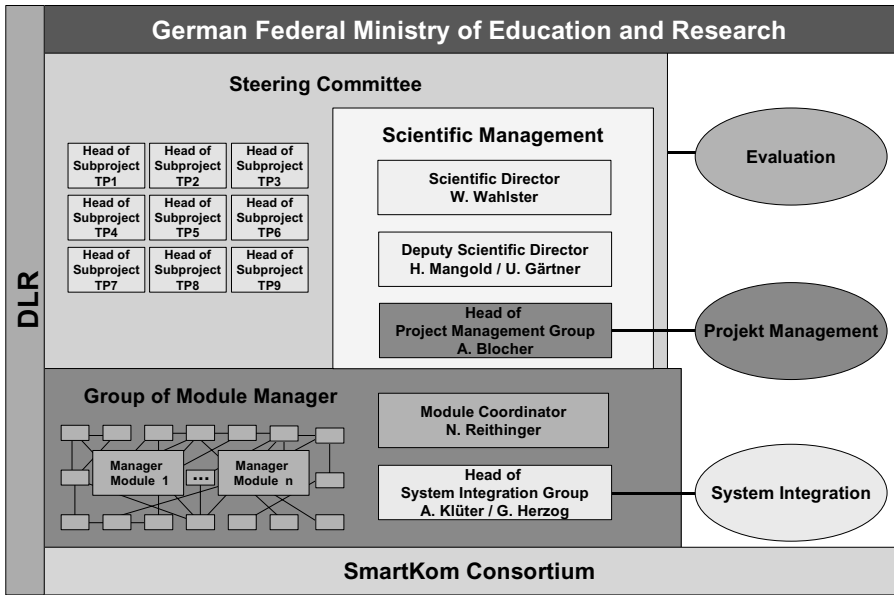


Fig. 4. The management structure of the SMARTKOM Project

plan to new scientific results or trends in HCI technology and to react immediately to problems that arose in the development and implementation process. A total of 15 meetings (including the constituent one) were held. Within the SMARTKOM Steering Committee there were assigned responsibilities for subprojects and working areas (WA) (see Table 2).

Table 2. Subprojects and working areas

Subproject/WA	Title	Lead partner
1	Modality specific analysis	DCAG
2	Multimodal interaction	FAU
3	Application interface	Sony
4	Genaration and multimodal media design	IMS
5	SMARTKOM-Public	Siemens
6	SMARTKOM-Mobile	EML
7	SMARTKOM-Home/Office	Philips
8	System integration	DFKI
9	Project management	DFKI
WA	Evaluation	LMU
WA	Technical integration	MID

The main task of the Group of Module Managers was to tie together and bundle the distributed development forces. In the meetings of the Group of Module Man-

**Table 3.** Large project workshops

<b>Date</b>	<b>Topic</b>	<b>Place</b>
11.-13.10.1999	Data collection	Munich
17.-18.11.1999	System integration	Kaiserslautern
29.-30.11.1999	Domains	Aachen
10.-11.04.2000	System integration	Kaiserslautern
11.-12.05.2000	Interpretation and ontology	Stuttgart
08.-09.08.2000	Module coordination	Stuttgart
14.12.2000	Module coordination	Munich
14.-15.03.2001	System integration	Kaiserslautern
18.-19.04.2001	Function modeling	Stuttgart
26.06.2001	Module coordination	Ulm
09.-10.10.2001	System integration	Kaiserslautern
13.11.2001	Module coordination	Saarbrücken
15.01.2002	Module coordination	Stuttgart
10.-11.04.2002	Domain ontology/XML	Saarbrücken/Heidelberg
18.-19.06.2002	System integration	Kaiserslautern
18.02.2003	Module coordination	Kaiserslautern
19.05.-20.05.2003	UserState processing	Saarbrücken

agers all important decisions concerning interface definitions, offline data flow, delivery schedules, and integration cycles were prepared, discussed and communicated. The implementation process was tightly monitored and supervised. It also provided contact points for the Scientific Management and gave feedback to the SMARTKOM Steering Committee.

Beside numerous bilateral and multilateral workshops, 17 large project meetings were held to discuss the scientific matters, to fine-tune details of the realization process, and to synchronize the inter-module communication (see Table 3).

**Table 4.** Project steering and review meetings

<b>Project steering meetings</b>		<b>Project review meetings</b>	
10.05.2000	Stuttgart	13.12.2000	Munich
22.05.2001	Heidelberg	18.12.2002	Saarbrücken
10.05.2002	Heidelberg	05.09.2003	Stuttgart

**2.4 Reviews and HCI Events**

The SMARTKOM reviewers and the BMBF/DLR were informed in three milestone review meetings and in three steering meetings about the progress of the project (see Table 4). During these large project meetings the results achieved as well as the ongoing and planned work were presented in a total of 51 scientific talks with more

than 1000 slides. In the accompanying demonstration sessions the current SMARTKOM systems were shown and industrial SMARTKOM spin-offs of the partners were first presented.

In the framework of the six HCI lead projects two International Status Conferences were held to reach a high degree in visibility both in the international research community and in the media. In order to optimize the cooperation with and to strengthen the understanding of the HCI partner projects several workshops on topics of general interest were organized (see Table 5).

**Table 5.** HCI events

Date	HCI event
28.09.1999	HCI Start Meeting
29.09.2000	WS Multimodal Interaction and Modeling
29.01.2001	HCI Congress
22.02.2001	WS Domain Modeling and Ontologies
17.05.2001	WS Architecture
03.07.2001	WS Tracking
25.09.2001	WS Adaptivity
26.10.2001	Int. Status Conference Lead Projects "Human Computer Interaction" 2001
25.02.2002	WS Usability
07.03.2002	WS Benchmarking
03.-04.06.2003	Int. Status Conference Lead Projects "Human Computer Interaction" 2003

### 3 The SmartKom System

#### 3.1 Milestones and Final System Functionalities

The first important milestone, the first fully integrated SMARTKOM demonstrator, was reviewed in December 2000 (13.12.2000). This first SMARTKOM demonstrator was unveiled to the public at the national conference Mensch&Computer 2001 (04.-08.03.2001). The first English SMARTKOM demonstrator was presented at the international conference Eurospeech (03.-07.09.2001, see Wahlster et al. (2001)). The first SMARTKOM demonstrator system covered basic functionalities in the SMARTKOM-Public scenario and worked in the cinema reservation domains: selection of cinemas, information on movies, and seat reservation.

The final SMARTKOM demonstrator was presented in June 2003 at the HCI Status Conference (03.-04.06.2003; scenarios Public and Home/Office) and during Mensch&Computer 2003 (07.-10.09.2003; scenario Mobile). At CeBIT'04 (18.-24.03.2004) all three scenarios were shown. The final SMARTKOM demonstrator allows the user symmetric multimodal interaction in 14 applications with 52 functionalities (see Table 6). An exemplary interaction with the SMARTKOM system can be found in Reithinger and Herzog (2006). For technical data of the SMARTKOM demonstrator see Herzog and Ndiaye (2006).

**Table 6.** Multimodal addressable functionalities in SMARTKOM

<b>Home</b>			
EPG (Electronic- Programming Guide)	General program	Information for one	7
	Channel selection	single broadcast	
	Channel information	Time-based operations	
TV	Selection based on genre	Help functions for genres	2
	On/off	Channel selection	
VCR control	On/off	Wind/rewind	6
	Record	Programming using EPG	
	Play	and the calendar	
	Pause		
Lean-Forward/ Lean-Backward	Select Lean-Backward Deactivate Lean-Backward	Context-aware presentations	3
<b>Total Home</b>			<b>18</b>
<b>Public</b>			
Telephone	Manipulative key operations	Audio handling	4
	Telephony functions	Address book	
Hand contour biometry	Selection of biometry type	Presentation and camera control	3
	Hand contour biometry	Address book (see above)	
Voice biometry	Presentation and audio control	Address book (see above)	2
	Voice biometry	Selection of biometry type (see above)	
Signature biometry	Presentation and tablet control	Address book (see above)	2
	Signature biometry	Selection of biometry type (see above)	
Fax	Presentation and interaction	Address book (see above)	3
	Fax handling	Camera control	
E-mail	Presentation and interaction	Address book (see above)	2
	E-mail handling	Camera control (see above)	
Cinema	General program	Seat reservation	4
	Movie information	Cinema location	
<b>Total Public</b>			<b>20</b>
<b>Mobile</b>			
Car navigation	Selection of start and goal city	Selection of parking garage	5
	Route type selection	Information about	
	Car route computation	parking garages	
Pedestrian navigation	Selection of map type	Selection of points of interest	6
	Selection of start and goal	Information for points of interest	
	Route computation	Integrated car and pedestrian route planning	
Map manipulation	Resize	Help functions	3
	Change viewpoint	for map interactions	
<b>Total Mobile</b>			<b>14</b>
<b>Total SMARTKOM</b>			<b>52</b>



The economic and scientific impact of the SMARTKOM project is described in Wahlster (2006). A list of SMARTKOM-related scientific papers, keynotes, talks and presentations is available at the web site <http://www.smartkom.org>.

### 3.2 Public Relations

SMARTKOM has been shown at two press conferences and in various presentations to a large number of representatives of science, industry and politics (see Table 7).

**Table 7.** Press conferences and highlight presentations

<b>Press conferences</b>	
14.12.2000	Munich
05.09.2003	Stuttgart
<b>Highlight presentations</b>	
03.-07.09.2001	EUROSPEECH'01
22.05.2002	Dr. Angela Merkel (Party President CDU)
22.08.2002	Josef Brauner (Deutsche Telekom AG)
26.08.2002	Saarland Minister for Economic Affairs and Labour Dr. Hanspeter Georgi
	German Federal President Johannes Rau
	Minister President of the Saarland Peter Müller
	Saarland Minister for Education, Culture and Science Jürgen Schreier
17.-20.09.2002	President of Saarland University Prof. Margret Wintermantel
	ICSLP'02
07.01.2003	EU executive Mr. Horst Forster
24.09.2003	Indian State Secretary of the Department of Science and Technology
	Prof. V. S. Ramamurthy
03.12.2003	Information Day "Mensch-Technik-Interaktion: Impulse für den Maschinenbau" of the German Engineering Federation (VDMA)
18.-24.03.2004	CeBIT'04
11.05.2004	German Language Technology Congress "LT Summit" at DFKI
29.-30.06.2004	Congress and Exposition "Empower Deutschland"
15.04.2005	Jürgen Gallmann,
	General Manager, Microsoft Germany, Vice President, Microsoft EMEA
	Dr. Said Zahedani, Director Developer Platform & Strategy Group
	Pierre-Yves Saintoyant, Director European Microsoft Innovation Center
	Walter Seemayer, NTO Microsoft Germany

In addition the SMARTKOM system has been demonstrated — amongst others — to representatives of: Adam Opel AG, ALCATEL, ATR Spoken Language Communication Research Labs, Bentley Motors, BMW AG, CapInfo, FUJI RIC, Harvard University, Hitachi Central Research Lab, NTT DoCoMo and DoCoMo Euro-Labs, NTT (Nomura Research Institute), RICOH (Japan), Robert Bosch GmbH, Siemens AG, Siemens Medical Solutions, Volkswagen Autostadt and Volkswagen Research.

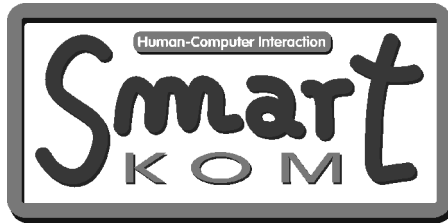
The project was covered in several scientific or news TV programs and far more than 100 relevant press articles were published about SMARTKOM (see Table 8).

**Table 8.** Selected TV programs and press articles

<b>Selected TV programs</b>	
11.03.2001	3sat "hitec"
21.04.2001	N-TV
29.11.2001	zdf "heute"
20.01.2002	RTL "SPIEGEL TV Magazin"
19.08.2002	RTL "future Trend"
29.09.2002	ZDF "heute"
05.09.2003	Saarländischer Rundfunk "Aktueller Bericht"
03.02.2004	ZDF "heute-journal"
08.10.2004	3sat "Nano - Die Welt von Morgen"
<b>Selected press articles</b>	
03.03.1999	Saarbrücker Zeitung <i>Bonn fördert Saarbrücker Forscher mit Millionen</i>
15.03.1999	c't <i>Rechner ohne Tastatur und Maus</i>
22.03.1999	Computerworld <i>Nur wegbeamen kann man sich nicht</i>
06.10.1999	Technisch Weekblad <i>Spraakgestuurde databankprojecten</i>
30.01.2001	Die Welt <i>Eine Maschine versteht Gesten des Menschen</i>
19.02.2001	Handelsblatt <i>Sprechen und Zeigen statt Tippen</i>
23.03.2001	VDI nachrichten <i>Maschinen lesen Wünsche von den Augen ab</i>
01.06.2001	c't-News <i>Maschine versteht Sprache, Gesten und Augenbewegungen</i>
07.06.2001	Computerzeitung <i>Mimik und Augenbewegungen steuern Computer</i>
04.02.2002	CHIP <i>Er hört aufs Wort</i>
12.03.2002	Frankfurter Allgemeine Zeitung <i>Sprich mit mir</i>
14.03.2002	Financial Times Deutschland <i>Verständige Maschinen</i>
22.04.2002	Salzburger Nachrichten Online <i>Deutscher Zukunftspreisträger entwickelt einen Computer-Butler ohne Maus und Tastatur</i>
06/2002	Spektrum der Wissenschaft <i>Redselige Chips</i>
27.08.2002	Saarbrücker Zeitung <i>Mit dem Bus zum roten Teppich</i>
29.09.2002	Handelsblatt <i>Maschinen, die Menschen besser verstehen</i>
08.10.2002	Süddeutsche Zeitung <i>Grimassen für den Computer</i>
26/2002	c't <i>Talkmaster</i>
05.03.2003	Hindustan Times <i>Talking computer in the making</i>
14.04.2003	i-com - Zeitschrift für interaktive und kooperative Medien <i>SmartKom - Multimodale Mensch-Technik-Interaktion</i>
10.06.2003	Berliner Zeitung <i>Verständnisvolle Computer</i>
13.06.2003	VDI Nachrichten <i>Computer und Roboter lernen Menschen zu verstehen</i>
16.06.2003	c't <i>"Wenn wir schreiten Seit' an Seit' ..."</i>
07.07.2003	dpa <i>Die Technik soll den Menschen verstehen lernen</i>
15.09.2003	Computerzeitung <i>Intelligente Schnittstellen erhöhen Produktakzeptanz</i>
06.11.2003	Handelsblatt <i>Computer reagieren künftig auch auf Fingerzeig</i>
28.01.2004	Saarbrücker Zeitung <i>Der Computer gehorcht aufs Wort / Das Handy lernt sehen</i>
13.03.2004	Handelsblatt <i>Elektronische Sekretärinnen erkennen Gesten</i>
07.04.2004	Die Zeit <i>Und wie viele Chips hat Ihrer?</i>
13.05.2004	Saarbrücker Zeitung <i>Mit den Maschinen reden lernen</i>

To give a deeper insight into the final SMARTKOM system, its scenarios, applications and functionalities and into multimodal interaction in general terms, videos — in English and German — can be downloaded from the SMARTKOM web site <http://www.smartkom.org>:

- SMARTKOM Complete: Covering all three scenarios Public, Home and Mobile (MPEG,  $\approx$  170 MB)
- SMARTKOM Mobile: Special long version of the Mobile scenario (MPEG,  $\approx$  67 MB)



**Fig. 5.** The SMARTKOM logo

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