CHIL

Functional Requirements & CHIL Cooperative Information System Software Design

Deliverable D2.1 (Part 1: Functional Requirements)
of the Project CHIL (Computers in the Human Interaction Loop)
IP 506909

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Synopsis	This document describes the requirements for the CHIL system and those for the software architecture in all intended CHIL scenarios.
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0 Preface

The project CHIL – "Computers in the Human Interaction Loop" is an Integrated Project (IP 506909) funded by the European Union under its 6th Framework Program. The project started on January 1st, 2004 and has a planned duration of three years.

The CHIL team is a consortium of internationally renowned research labs in Europe and the US, who collaborate to bring friendlier and more helpful computing services to society. Rather than requiring user attention to operate machines, CHIL services attempt to understand human activities and interactions to provide helpful services implicitly and unobtrusively. The CHIL consortium is coordinated jointly by the Fraunhofer Institut für Informations- und Datenverarbeitung (IITB) and the Interactive Systems Labs (ISL) of the University of Karlsruhe.

Considerable human attention is expended in operating and attending to computers, and humans are forced to spend precious time on fighting technological artefacts, rather than on human interaction and communication. CHIL aims to radically change the way we use computers. Rather than expecting a human to attend to technology, CHIL attempts to develop computer assistants that attend to human activities, interactions, and intentions. Instead of reacting only to explicit user requests, such assistants proactively provide services by observing the implicit human request or need, much like a personal butler would. To achieve this goal, machines must understand the human context and activities better; they must adapt to and learn from the humans' interests, activities, goals and aspirations. This requires machines to better perceive and understand all the human communication signals including speech, facial expressions, attention, emotion, gestures, and many more.

Based on the perception and understanding of human activities and social context, a new type of context aware and proactive services can be developed. Within the first three years of the CHIL project, four instantiations of such CHIL services will be implemented:

- The Connector: This service attempts to connect people at the best time by the best media, whenever it is most opportune to connect them. In lieu of leaving streams of voice messages and playing phone tag, the Connector tracks and knows its masters' activities, preoccupations and their relative social relationships and mediates a proper connection at the right time between them.
- The Memory Jog: This is a personal assistant that helps its human user remember and retrieve needed facts about the world and people around him/her. By recognizing people, spaces and activities around its master, the Memory Jog can retrieve names and affiliations of other members in a group. It provides past records of previous encounters and interactions, and retrieves information relevant to the meeting.
- Socially supportive workspaces: This service supports human gathering. It offers meeting assistants that track and summarize human interactions in lectures, meetings and office interactions, and provide automatic minutes and create browseable records of past events.
- The Attention Cockpit: This agent tracks the attention of an audience and provides feedback to a lecturer or speaker.

CHIL represents a vision of the future - a new approach to more supportive and less burdensome computing and communication services. The research consortium includes 15 leading research laboratories from 9 countries representing today's state of the art in multimodal and perceptual user interface technologies in European Union and the US. The team sets out to study the technical, social and ethical questions that will enable this next generation of computing in a responsible manner.

The CHIL results will be disseminated and made available to a wide community of interested parties. Several major deliverables, including this document, will be placed in the public domain to promote an active exchange of ideas.

For further information on CHIL refer to the project web site at http://chil.server.de.

This document deals with the first part of deliverable D2.1, the *Functional Requirements* for the CHIL system.

1 Introduction

CHIL will develop technology components and accordingly use them towards providing non-obtrusive services. These services will be based on the composition, interpretation and integration of a rich set of perceptual inputs providing information about who, where, what, when, why and how. Since sensors and perceptual components will be distributed in the scope of the CHIL spaces, there is a need for providing a physical networked infrastructure, as well as a software/middleware infrastructure enabling the composition, aggregation, processing and interoperation of the various distributed components.

Instead of 'gluing' components in an ad-hoc fashion, CHIL will endeavour to provide a structured architecture allowing the integration of distributed components, as well as application coordination in a ubiquitous computing environment. It is envisaged that architecture can boost interoperability, scalability, configurability and technological longevity of a CHIL enabled space.

The purpose of this document is to identify the requirements for an envisioned CHIL system as a whole, to determine the conditions under which the CHIL system will work and to identify a set of requirements for the architecture of the CHIL project. Also, an attempt to prioritise these requirements is made, taking into account the imminent objectives of the project. Note that these requirements are based on working assumptions about CHIL technologies and scenarios, and are therefore subject to changes.

2 System Description

2.1 Purpose of the System

The purpose of the CHIL system is to free people to interact with people by reposition the machines to hover in the background, observing the humans and -like electronic butlers- attempting to anticipate and serve their needs. The system will engage in an unobtrusive manner and serve what a human really needs at any moment by continuously modelling, understanding and appreciating the context and activities of humans, including their perceptual and cognitive abilities, and the social roles in a given space. It will therefore provide services supporting human activities, while being largely invisible and less intrusive. The CHIL system will provide services within indoor environments, particularly focusing on offices and lecture rooms.

2.2 Overview of the System

The CHIL system under development will gather all relevant information (speech, faces, people, writing, emotion, etc.) and will model and interpret human activity, behaviour, and actions. Perceptual interfaces will provide the functionality of tracking, identifying, recognizing and understanding the role, purpose and content of human communication, activities, state and their environment. Since the perceptual clues are embedded in a continuing signal stream, noisy and often hidden and there is also no explicit signal that a communicative event is about to start, the perceptual system must decide what the type and purpose of a given signal and its addressee (if any) might be.

Based on these perceptual interfaces the system provides a series of services like Connectors, Memory Jogs, and Meeting Support (including Attention Cockpits and Socially Supportive Workspaces). Each of these services is critically enabled by knowledge of human activities and intentions, and provides context aware and socially appropriate support. Depending on what people are doing, what they want, with whom and how they interact with each other, these services try to establish connections, remind people of needed info, track and record minutes, track and record conversations efficiency, and support collaboration. In contrast to manual operation, CHIL services will attempt to deliver these services implicitly and personalized whenever and however most appropriate for each user. Initially, the knowledge will be simple and coded, but subsequently more sophisticated cognitive models will learn task knowledge and user preferences from the social environment and from continuing usage.

The Connector is an environment that connects people intelligently for communication depending on their human and social state. It eliminates phone tag and missed calls, by judging each party's activities and the parties' mutual social relationships to decide when and how to build a connection between them.

The Memory-Jog provides one, two, or more individuals background information and memory assistance, in the course of human encounters. It will maintain names, organizations of people attending a meeting. Moreover, it will provide records related to those conversations, all in an effort to provide real-time on-demand information depending on the state of the user, the activity at hand, and the individuals with whom one is interacting.

Meeting Support provides more extended services and could include the Connector and the Memory-Jog. It tracks and maintains lecture records, selects and reviews key information in

past records, remembers people, items and activities of past meetings, and provides tools for better collaboration, depending on the state of the users, and the environment, and for monitoring participants' attention.

The perceptual interfaces and services are linked together within a dynamically networked and self-healing architecture and infrastructure to further reduce unwanted distraction of the user by the software artefacts. Furthermore, the architecture contains cognitive models of humans and agents involved which allows the system to

- Model human purpose and intent (at least within the goals of a service)
- Embody a needed level of self-awareness and self explanation
- Track, model, predict, and service individual differences and personal preferences of all participants to provide targeted, personalized, and private support
- Learn from past experience and past observations and carry out dialogs with the user in order to learn or disambiguate human intent
- Be responsive to social norms and preferences to provide the right mix between autonomy and control, and personalized and generic support.

While a set of services are identified as candidate to demonstrate the CHIL concept, the project system will not concentrate on building a system supporting services with strictly defined aspects and product level robustness and accuracy. Rather the CHIL system will support multiple prototype services.

Also note that in practice different instances of the CHIL system will be developed, corresponding to the four different sites that set up CHIL rooms and implement CHIL services. However, it is envisioned that all these instances will share the characteristics described in the scope of this paragraph.

2.3 Hardware devices and sensors

In terms of hardware devices the following components will be glued:

- A variety of sensors including cameras, microphone close talking microphones, microphone arrays as described in ***Initial Specification of the Sensor Setup*** [2] [1];
- Controlling workstations (e.g. hosting sensor controller and perceptual software);
- End user terminals (e.g. laptops, PDAs, smart phones);
- Auxiliary peripherals and devices (in particular a projection screen).

In terms of software components, the following types of distributed entities are assumed in the scope of this document:

- [1] Note that ***Initial Specification of the Sensor Setup*** [2] specifies a minimum sensor set for the CHIL system; additional sensors may be introduced in later stages of the project.

Sensor Controllers

Sensor Controllers constitute the entities that are hosting the sensor control software (e.g. the capture driver of an audio or video stream). These entities are usually directly connected (i.e. attached) to the sensors, and make available the sensors' raw data to other entities (Figure 2-1: Sensor Controllers and Device Controllers).

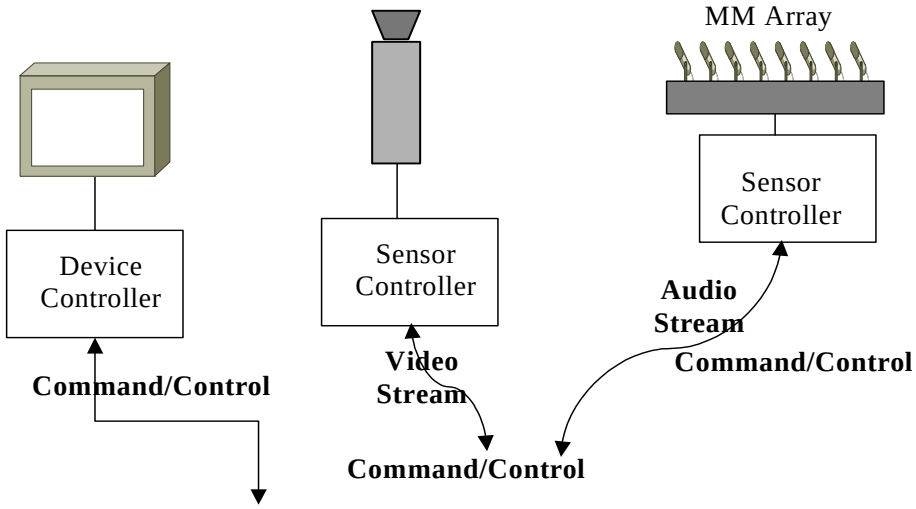

Figure 2-1: Sensor Controllers and Device Controllers

2.4 Perceptual Components

These are software components realizing perceptual processing of raw sensor data. They receive raw data input from sensor controllers and produce output relating to "Who", "Where" and "What" – as shown in Figure 2-2: Technology Components (ASR, SpeakerID, etc.) and a Context Aware Entity. An initial set of perceptual components has been identified in the scope of the technology development work packages of the project (i.e. WP4, WP5, WP6).

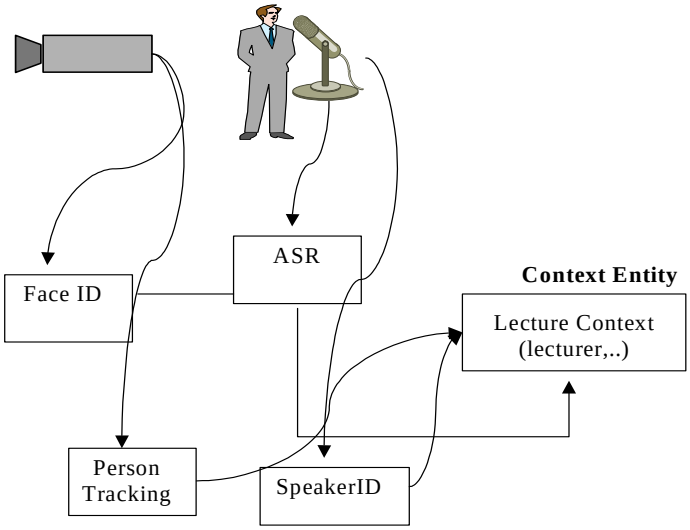

Figure 2-2: Technology Components (ASR, SpeakerID, etc.) and a Context Aware Entity

Context (Aware) Entities

These entities process perceptual components output (from one or more perceptual entities) and encode contextual information at higher levels of abstraction than single perceptual entities (Figure 2-2: Technology Components (ASR, SpeakerID, etc.) and a Context Aware Entity).

2.5 Service entities

This class of components comprises applications exploiting perceptual components outputs, as well as higher layer information (e.g. context) towards providing information and automating tasks in a non-obtrusive manner (Figure 2-3: Service Entities).

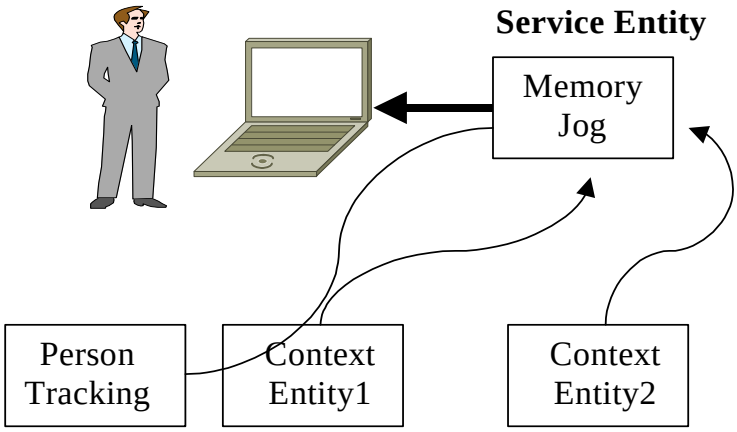

Figure 2-3: Service Entities

3 Description of the functionality

In contrast to be operated directly and explicitly (by keying in commands), the CHIL system will deliver its services to humans in an implicit, indirect and unobtrusive way. The computing devices are context aware and able to utilize the advanced perceptual interfaces developed and the infrastructure in CHIL to free the user and allow him/her instead of serving the device to be served and supported in the tasks and human-to-human interactions he/she needs to focus on.

The main input to the system is communication of users with other people. This communication is observed and interpreted by the system (speech recognition, body tracking, lip reading, context recognition, etc.). The user's needs are perceived by the system and the relevant information is presented to the user, either as targeted audio or visual on his/hers personal computing device.

3.1 Scenario(s)

The scenario(s) reflected in the document ***Initial Specification of the CHIL Scenario(s)*** [3] constitute(s) a working hypothesis for drafting the following requirements from the CHIL architecture. The detailed scenario(s) to be realized in CHIL are currently under discussion.

Most of the services described in the CHIL proposal will be demonstrated in this/these scenario(s). The services will provide information to meeting participants and the official speaker about other meeting participants, as well as the topics discussed. Automation in execution of tasks will be demonstrated, too.

From the technical point of view phase diagrams can realize a scenario's description. The following figures illustrate this.

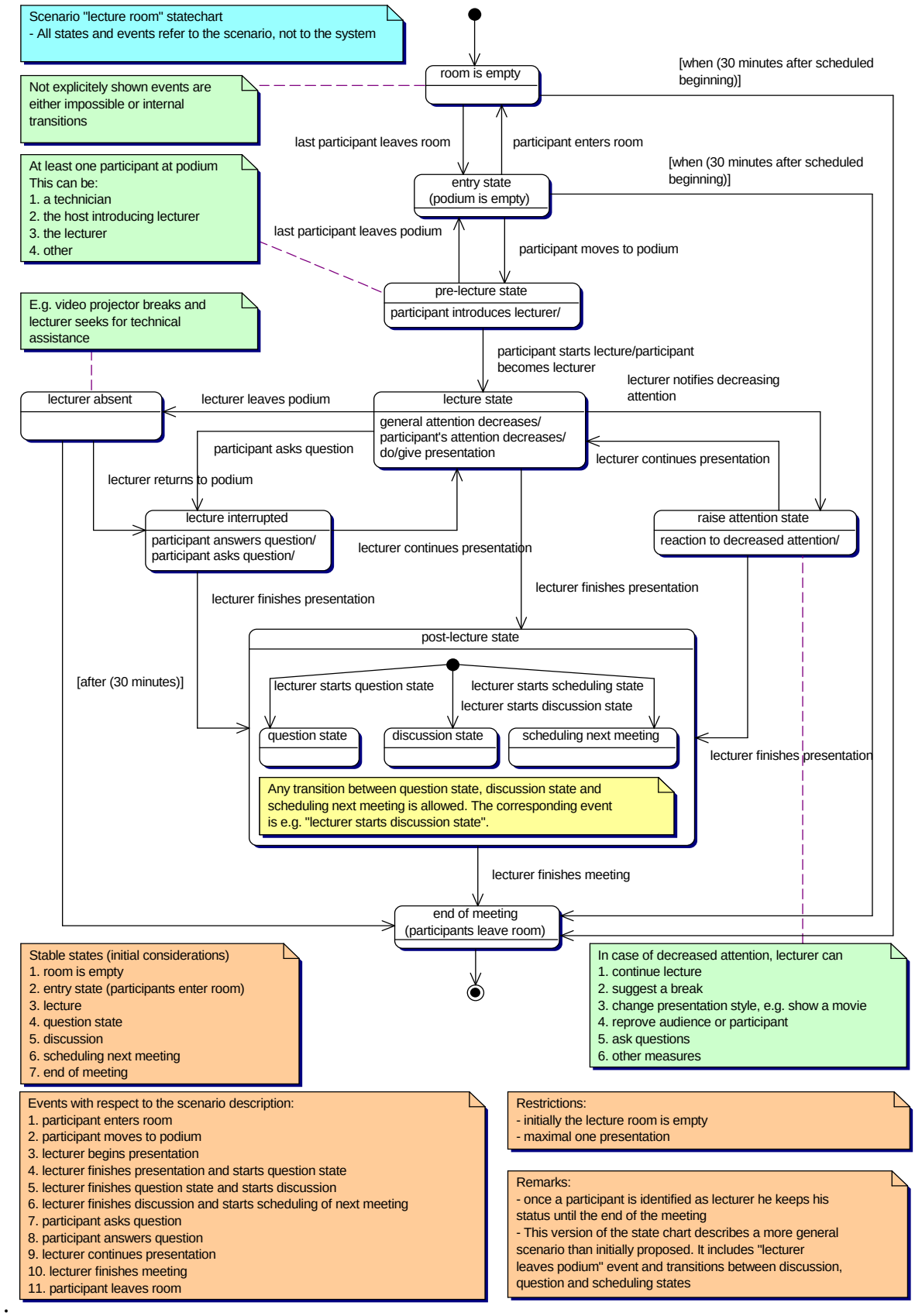

Figure 3-1: State chart model for the "Lecture Room Scenario"

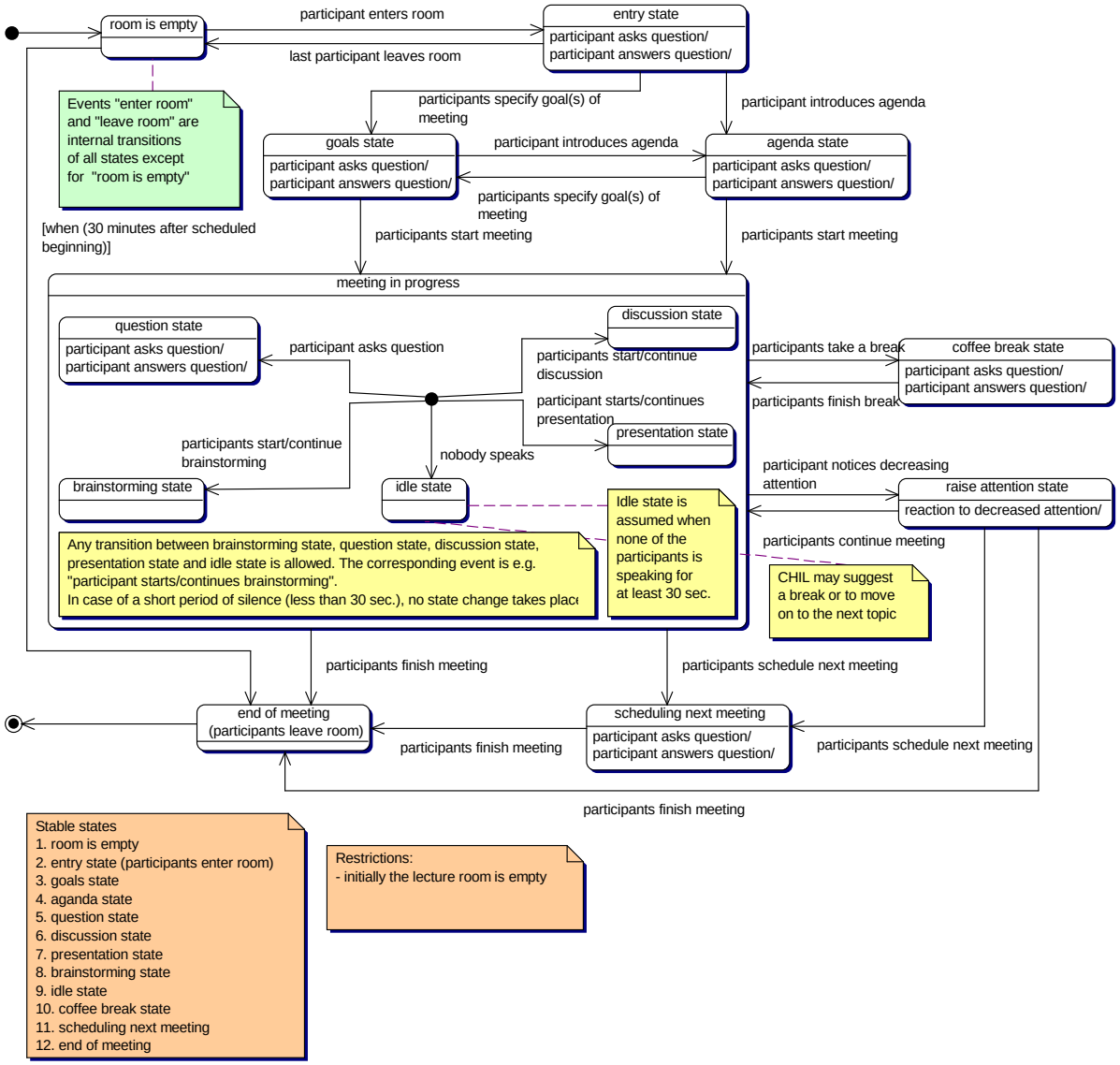

Figure 3-2: State chart model for the "Small Meeting Room Scenario"

3.2 Use Cases

The following exemplary use cases will appear in CHIL.

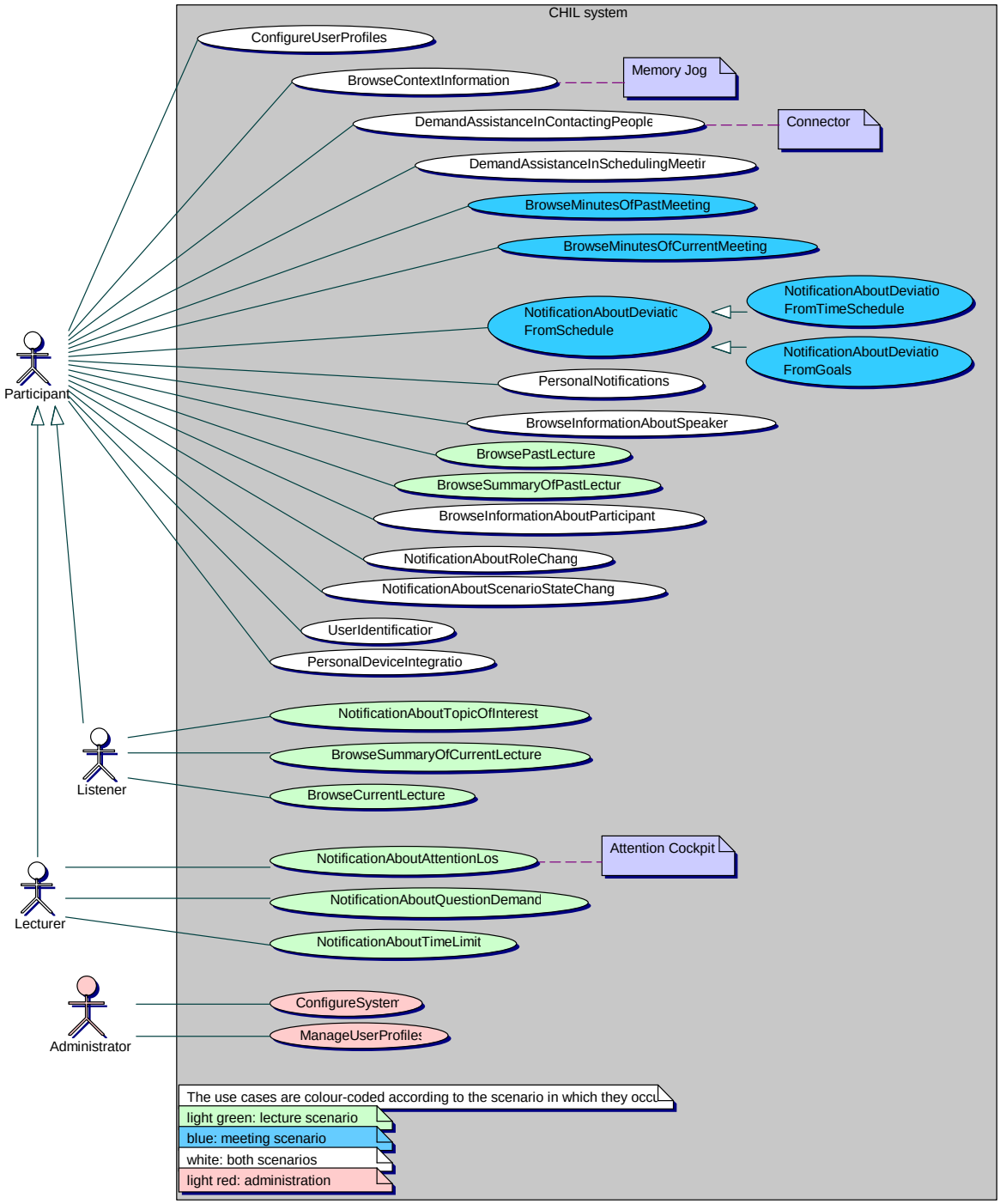

Figure 3-3: Use Cases in the CHIL System

Table 3-1: Summary of exemplary use cases

Use Case	Description	Actors			Scenario	
		Listener	Lecturer	Administrator	Lecture Room	Meeting Room
BrowseContextInformation	A user wants to browse information relevant to the topic currently under discussion.	x	x	(x)	x	x
BrowseCurrentLecture	A user wants to browse the current lecture.	x	-	(x)	x	-
BrowseInformationAboutParticipant	A user in a meeting or lecture scenario wants to have details about another participant.	x	x	(x)	x	x
BrowseInformationAboutSpeaker	A user in a meeting or lecture scenario wants to have details about the person who is currently speaking.	x	x	(x)	x	x
BrowseMinutesOfCurrentMeeting	The user wants to browse the minutes of the meeting he/she is attending.	x	x	(x)	-	x
BrowseMinutesOfPastMeeting	A user wants to browse the minutes of a past meeting.	x	x	(x)	-	x
BrowsePastLecture	A user wants to browse a past lecture.	x	x	(x)	x	-
BrowseSummaryOfCurrentLecture	A user wants to be updated on what has been discussed so far.	x	-	(x)	x	-
BrowseSummaryOfPastLecture	A user wants to browse the summary of a past lecture.	x	x	(x)	x	-
ConfigureSystem	The CHIL system administrator wants to configure the CHIL system.	-	-	x		
ConfigureUserProfiles	A user wants to change his/her profile settings.	x	x	(x)	x	x
DemandAssistanceInContactingPeople	A user wants to contact somebody.	x	x	(x)	x	x
DemandAssistanceInSchedulingMeeting	The user wants to schedule the next meeting or lecture	x	x	(x)	x	x

ManageUserProfiles	The CHIL system administrator wants to manage user profiles.	-	-	x		
NotificationAboutAttentionLoss	A user has requested notification about a lack of attention in the audience.	-	x	(x)	x	-
NotificationAboutDeviationFromGoals	A user has requested notification about deviations from the preconcerted goals of the meeting he/she is attending.	x	x	(x)	-	x
NotificationAboutDeviationFromSchedule	A user has requested notification about deviations from the agenda of the meeting he/she is attending.	x	x	(x)	-	x
NotificationAboutDeviationFromTimeSchedule	A user has requested notification about deviations from the time schedule of the meeting he/she is attending.	x	x	(x)	-	x
NotificationAboutQuestionDemand	A user has requested notification about a question demand	-	x	(x)	x	-
NotificationAboutRoleChange	A user has requested notification about a role change, either his/her own or that of another participant.	x	x	(x)	x	x
NotificationAboutScenarioStateChange	A user has requested notification about a change of state within the current scenario.	x	x	(x)	x	x
NotificationAboutTimeLimit	A user has requested notification about the lecture time running short.	-	x	(x)	x	-
NotificationAboutTopicOfInterest	A user has requested notification about his/her topic of interest being discussed now in the presentation.	x	-	(x)	x	-
PersonalDeviceIntegration	A user in the CHIL meeting or lecture room wants to use his/her personal device.	x	x	(x)	x	x
PersonalNotifications	A user wants to be notified when there is news about a personal matter.	x	x	(x)	x	x
UserIdentification	A user enters the CHIL meeting or lecture room and wants to be identified by the system.	x	x	(x)	x	x

3.2.1 Use Case BrowseContextInformation

Preconditions:

- The user is either in the "meeting scenario" or "lecture scenario"
- The user is identified by the system
- The meeting or lecture is in progress

Description:

A user wants to browse information relevant to the topic currently under discussion. For example he/she is not familiar with an expression used in the presentation but does not want to interrupt the lecturer. Relevant information can come from dictionaries, encyclopaedias, minutes and slides of past meetings, pictures, media files or publications related to this topic.

The following steps are performed to browse relevant information:

1. The user requests access to material related to the current topic.

   Exception: The system could not identify the current topic.

   Alternatives:
   a) General sources of information like dictionaries and encyclopaedias are offered.
   b) The user is asked to specify the current topic.

   Exception: There is no material available for the current topic. The system informs the user, that no material is available for the current topic.

2. The system shows a list of available material.
3. The user chooses one or more items from the list.
4. The system checks if the user's profile allows access to the requested data.

   Exception: The user's profile does not allow access to the requested material. The system informs the user that he/she is not authorised to access the requested data.

5. The system determines the preferred output form, format and device from the user profile.

   Exception: No preferred output form, format and device are specified in the user profile.
   Alternatives:
   a) Default settings are used.
   b) The user is asked to specify form, format and output device.

6. The material is converted into the desired form and format.

   Exception: The material cannot be converted into the desired form or format.
   Alternatives:
   a) The default format is used.
   b) The user is asked to specify another form or format.

7. The material is made available for browsing on the desired output device.

Postconditions:

- Relevant information is provided on the desired user component in the preferred form and format.

3.2.2 Use Case BrowseCurrentLecture

Preconditions:

- The user is listener.
- The user is identified by the system.
- The user is in the "lecture scenario".
- The lecture is in progress.

Description:

A user wants to browse the current lecture. He/she asks the system to give him material of the lecture. Relevant data are an audio/video stream of the lecture, the material (slides) presented, a summary of the topics discussed and possibly a list of participants.

While browsing the material of the lecture, the system assists the user in quickly finding the relevant information by letting him search the material for key words.

Such a service allows a listener to recapitulate a specific topic in the current lecture. It also helps a listener to prove his/her point in case he/she thinks there is a discrepancy between the current statement and what has been said before in the lecture.

The following steps are performed to browse lecture data:

1. The user requests access to material of the current lecture.

   Exception: There is no data available for the current lecture. The system informs the user, that no data is available for the current lecture.
2. The system shows a list of available material.
3. The user chooses one or more items from the list.
4. The system checks if the user's profile allows access to the requested data.

   Exception: The user's profile does not allow access to the requested material. The system informs the user that he/she is not authorised to access the requested data.
5. The system determines the preferred output form, format and device from the user profile.

   Exception: No preferred output form, format and device are specified in the user profile.

   Alternatives:
   a) Default settings are used.
   b) The user is asked to specify form, format and output device.
6. The material is converted into the desired form and format.

   Exception: The material cannot be converted into the desired form or format.

Alternatives:
a) The default format is used.
b) The user is asked to specify another form or format.

7. The material is made available for browsing on the desired output device.

Postconditions:

- The user is given access to the available recording and material (slides, etc.) of the lecture.

3.2.3 Use Case BrowseInformationAboutParticipant

Preconditions:

- The user is either a listener or the lecturer.
- The user is identified by the system.
- The user is either in the "meeting scenario" or in the "lecture scenario".

Description:

A user in a meeting or lecture scenario wants to have details about another participant, e.g. participant's name, organisation and professional status. For example a user wants to address another participant but does not know his/her name. What kind of information is provided depends on the scenario, the user's role and his/her profile settings.

The following steps are performed to obtain information about a participant:

1. The user requests information about a participant. The system asks the user to specify the participant, e.g. either by looking at him or by browsing through a list of pictures of all participants.

   Exception: The participant is not identified by the system. The system informs the user that no information about this participant is available.

   Exception: There is no information available about the participant. The system informs the user that no information about the participant is available.

2. The system checks if the user's profile allows him to request information about the participant.

   Exception: The user's profile does not allow access to the requested information. The system informs the user that he/she is not authorised to access the requested data.

3. The system determines the preferred output form, format and device from the user profile.

   Exception: No preferred output form, format and device are specified in the user profile.

Alternatives:
a) Default settings are used.
b) The user is asked to specify form, format and output device.

4. The information data is generated depending on the scenario, the user's role and his/her profile settings.
5. The data is converted into the desired form and format.

   Exception: The material cannot be converted into the desired form or format.

   Alternatives:
   a) The default format is used.
   b) The user is asked to specify another form or format.
6. The information is made available for browsing on the desired output device.

Postconditions:

- Information about the participant is provided.

3.2.4 Use Case BrowseInformationAboutSpeaker

Preconditions:

- The user is either a listener or the lecturer.
- The user is identified by the system.
- The user is either in the "meeting scenario" or in the "lecture scenario".

Description:

A user in a meeting or lecture scenario wants to have details about the person who is currently speaking, e.g. speaker's name and personal background. This information can help him understand the speaker's point.

In case the user is a listener in the lecture scenario, he/she asks the system for information about the lecturer and the content of his/her lecture.

In case the user is the lecturer in the lecture scenario where a participant asks a question regarding the currently discussed topic of the lecture, the lecturer is interested in the questioner's academic record to help him understand the question.

In a meeting scenario, the user asks the system for information about the participant who is currently speaking. The system provides available information like participant’s name, organisation and professional status.

What kind of information is provided depends on the scenario, the user's role and his/her profile settings.

The following steps are performed to obtain information about the speaker:

1. The user requests information about the speaker.

   Exception: The speaker is not identified by the system. The system informs the user that no information about the speaker is available.

   Exception: There is no information available about the speaker. The system informs the user that no information about the speaker is available.

2. The system checks if the user's profile allows him to request information about the speaker.

   Exception: The user's profile does not allow access to the requested information. The system informs the user that he/she is not authorised to access the requested data.

3. The system determines the preferred output form, format and device from the user profile.

   Exception: No preferred output form, format and device are specified in the user profile.
   Alternatives:
   a) Default settings are used.
   b) The user is asked to specify form, format and output device.

4. The information data is generated depending on the scenario, the user's role and his/her profile settings.

5. The data is converted into the desired form and format.

   Exception: The material cannot be converted into the desired form or format.
   Alternatives:
   a) The default format is used.
   b) The user is asked to specify another form or format.

6. The information is made available for browsing on the desired output device.

Postconditions:

- Information about the speaker is provided.

3.2.5 Use Case BrowseMinutesOfCurrentMeeting

Preconditions:

- The user is in the "meeting scenario".
- The user is identified by the system.
- The meeting is in progress.

Description:

The user wants to browse the minutes of the meeting he/she is attending.

The minutes of the meeting are generated automatically from the recorded multimodal stream of communicative signals. Content processing includes summarization, named entity extraction, topic classification and detection of key highlights.

The following steps are performed to get the minutes of the meeting:

1. The user requests to browse the minutes of the current meeting.
2. The system checks if the user's profile allows access to the minutes.

   Exception: The user's profile does not allow access to the minutes. The system informs the user that he/she is not authorised to access the minutes.
3. The system generates the minutes of the meeting (unless up-to-date minutes are already available due to several contemporary requests).

   Exception: The minutes cannot be generated. The system informs the user, that the minutes of the current meeting could not be generated.
4. The system determines the preferred output form, format and device from the user profile.

   Exception: No preferred output form, format and device are specified in the user profile.
   Alternatives:
   a) Default settings are used.
   b) The user is asked to specify form, format and output device.
5. The minutes are converted into the desired form and format.

   Exception: The minutes cannot be converted into the desired format.
   Alternatives:
   a) The default format is used.
   b) The user is asked to specify another form or format.
6. The minutes are made available on the desired output device.

Postconditions:

- The minutes of the meeting are provided.

3.2.6 Use Case BrowseMinutesOfPastMeeting

Preconditions:

- The user is in the "meeting scenario".
- The user is identified by the system.
- The meeting is in progress.

Description:

A user wants to browse the minutes of a past meeting.

The system asks the user for the date of the meeting he/she wants to browse the minutes. If the user does not know the date but either a topic of the meeting, the meeting place or the name of a participant he/she can ask the system to give him a list of all meetings that match the given keys. Alternatively, the user can browse through a list of all meetings and minutes he/she is granted access to. What kind of material is accessible by a user is controlled by user profiles.

The minutes of the meeting are generated automatically from the recorded multimodal stream of communicative signals. Content processing includes summarization, named entity extraction, topic classification and detection of key highlights.

The following steps are performed to get the minutes of a past meeting:

1. The user requests to browse the minutes of a past meeting.

2a. The system asks the user to specify the meeting date.
3a. The user enters the meeting date.

Exception: There is no data available for the specified meeting. The system informs the user, that no data is available for the specified meeting.

or alternatively

2b. The system asks the user for key words, a participant's name or the meeting place.
3b.1. The user specifies search keys.

Exception: No meeting matches the specified keys. The system informs the user, that no meeting matching the keys has been found.

3b.2. The system provides a list of meetings matching the specified key words.
3b.3. The user chooses a meeting from the list.

or alternatively

2c. The system provides a list of all available meetings respectively minutes.

Exception: The list is empty. The system informs the user that no minutes are available.

3c. The user chooses an item from the list.

4. The system checks if the user's profile allows access to the minutes.

Exception: The user's profile does not allow access to the minutes. The system informs the user that he/she is not authorised to access the minutes.

5. The system determines the preferred output form, format and device from the user profile.

Exception: No preferred output form, format and device are specified in the user profile.
Alternatives:
a) Default settings are used.
b) The user is asked to specify form, format and output device

6. The minutes are converted into the desired form and format.

   Exception: The minutes cannot be converted into the desired format.
   Alternatives:
   a) The default format is used.
   b) The user is asked to specify another form or format.

7. The minutes are made available on the desired output device.

Postconditions:

- The minutes of the specified meeting are provided.

3.2.7 Use Case BrowsePastLecture

Preconditions:

- The user is identified by the system.
- The lecture to be browsed is over.

Description:

A user wants to browse through a past lecture. He/she asks the system to give him material of the lecture. Relevant data are an audio/video stream of the lecture, the material (slides) presented, a summary of the topics discussed and possibly a list of participants.

The system asks the user for the date and title of the lecture he/she wants to browse. If the user does not know the date but the topic of the lecture he/she can ask the system to give him a list of all lectures that have covered that topic. Alternatively, the user can browse through a list of all available lectures and material. What kind of material is accessible by a user is controlled by user profiles.

While browsing the material of the lecture, the system assists the user to quickly find the relevant information by letting him search the material for key words.

This service is important to the lecturer as he/she can review and improve his/her presentations. Members of the audience can use this feature to recapitulate a specific topic in a past lecture. It also helps a listener to prove his/her point in case he/she thinks there is a discrepancy between the current lecture and what has been said in a previous lecture.

For providing the requested data there are three possibilities depending on where the user is located when requesting data.

4. Online browsing: The user is located within a CHIL environment (i.e. the lecture room). The data he/she requests is located on the CHIL server and provided in the desired form and format to the user's preferred device (i.e. notebook, PDA). Audio and video are provided as streams.
5. Offline browsing: The user is not located within a CHIL environment. The data he/she wants to browse has been copied to his/her local machine before. The user can browse the data offline.

6. "Offline" browsing with network access: The user is not located within a CHIL environment and the required data is not stored on his/her local machine. He/she connects to the CHIL system through network and browses or downloads the required data.

The following steps are performed to browse lecture data:

1. The user requests access to material of a past lecture.

2a. The system asks the user to specify lecture title and date.
3a. The user enters date and lecture title.

Exception: There is no data available for the specified lecture. The system informs the user, that no data is available for the specified lecture.

or alternatively

2b. The system asks the user for key words.
3b.1. The user specifies key words.

Exception: No lecture matches the specified key words. The system informs the user, that no lecture matching the key words has been found.

3b.2. The system provides a list of lectures matching the specified key words.
3b.3. The user chooses a lecture from the list.

or alternatively

2c. The system provides a list of all available lectures.

Exception: The list is empty. The system informs the user that no lectures are available.

3c. The user chooses a lecture from the list.

4. The system provides a list of all available material of the selected lecture.
5. The user chooses one or more items from the list.
6. The system checks if the user's profile allows access to the requested data.

   Exception: The user's profile does not allow access to the requested material. The system informs the user that he/she is not authorised to access the requested data.

7. The system determines the preferred output form, format and device from the user profile.

   Exception: No preferred output form, format and device are specified in the user profile.
   Alternatives:
   a) Default settings are used.
   b) The user is asked to specify form, format and output device.

8. The material is converted into the desired form and format.

   Exception: The material cannot be converted into the desired form or format.
   Alternatives:
   a) The default format is used.
   b) The user is asked to specify another form or format.

9. The material is made available for browsing on the desired output device.

Postconditions:

- The user is given access to the available recording and material (slides, etc.) of the requested lecture.

3.2.8 Use Case BrowseSummaryOfCurrentLecture

Preconditions:

- The user is listener
- The user is identified by the system
- The user is in the "lecture scenario"
- The lecture is in progress

Description:

A user arrived late to the lecture and wants to be updated on what he/she has missed so far. He/she asks the system to give him a summary of the past topics. The summary can be an audio/video stream containing the highlights of the lecture or a text document summarizing the main points.

The user wants to know from the system if a topic of interest has already been discussed. If this is the case the system lets him browse the lecture for the relevant passage in the recorded audio/video stream.

The following steps are performed to get a summary of the lecture:

1. The user requests a summary of the current lecture.
2. The system checks if the user's profile allows access to the summary.

   Exception: The user's profile does not allow access to the summary. The system informs the user that he/she is not authorised to access the summary.
3. The system generates a summary of the lecture (unless an up-to-date summary is already available due to several contemporary requests).

   Exception: No summary can be generated. The system informs the user, that no summary of the current lecture could be generated.
4. The system determines the preferred output form, format and device from the user profile.

   Exception: No preferred output form, format and device are specified in the user profile.
   Alternatives:
   a) Default settings are used.
   b) The user is asked to specify form, format and output device.

5. The summary is converted into the desired form and format.

   Exception: The summary cannot be converted into the desired form or format.
   Alternatives:
   a) The default format is used.
   b) The user is asked to specify another form or format.

6. The summary is made available on the desired output device.

Postconditions:

- The user is given a summary of the lecture.

3.2.9 Use Case BrowseSummaryOfPastLecture

Preconditions:

- The user is identified by the system
- The lecture to be browsed is over
- The user is in the "lecture scenario"

Description:

A user wants to browse the summary of a past lecture. The summary can be an audio/video stream containing the highlights of the lecture or a text document summarizing the main points.

The system asks the user for the date and title of the lecture he/she wants to browse the summary. If the user does not know the date but the topic of the lecture he/she can ask the system to give him a list of all lectures that have covered that topic. Alternatively, the user can browse through a list of all summarized lectures.

The following steps are performed to browse the summary of a past lecture:

1. The user requests access to the summary of a past lecture.

2a. The system asks the user to specify lecture title and date.
3a. The user enters date and lecture title.

   Exception: There is no summary available for the specified lecture. The system informs the user, that no summary is available for the specified lecture.

or alternatively

2b. The system asks the user for key words.
3b.1. The user specifies key words.

   Exception: No lecture matches the specified key words. The system informs the user, that no lecture matching the key words has been found.

3b.2. The system provides a list of lectures matching the specified key words.
3b.3. The user chooses a lecture from the list.

or alternatively

2c. The system provides a list of all available summaries.

Exception: The list is empty. The system informs the user that no summaries are available.

3c. The user chooses a lecture from the list.

4. The system checks if the user's profile allows access to the requested summary.

Exception: The user's profile does not allow access to the requested summary. The system informs the user that he/she is not authorised to access the requested summary.

5. The system determines the preferred output form, format and device from the user profile.

Exception: No preferred output form, format and device are specified in the user profile.
Alternatives:
a) Default settings are used.
b) The user is asked to specify form, format and output device.

6. The material is converted into the desired form and format.

Exception: The material cannot be converted into the desired form or format.
Alternatives:
a) The default format is used.
b) The user is asked to specify another form or format.

7. The material is made available for browsing on the desired output device.

Postconditions:

- The user is given a summary of the requested lecture.

3.2.10 Use Case ConfigureSystem

Preconditions:

- The user is system administrator.

Description:

The CHIL system administrator wants to configure the CHIL system, e.g. customise the system, update the software or integrate new hardware components.

Postconditions:

- The system configuration has been changed

3.2.11 Use Case ConfigureUserProfiles

Preconditions:

- The user is identified by the system.

Description:

A user wants to change his/her profile settings. The profiles are user-, role- and scenario-specific. Through the profile settings, the user can activate automatic subscription of specific services by default. Furthermore, the system allows him to configure the CHIL services to his/her needs, e.g. he/she can subscribe to notifications for certain events and can specify the way he/she prefers to be notified.

Examples:

1. A listener within the lecture scenario wants to be notified when a special topic he/she is interested in is discussed. He/she wants to be notified through a message on his/her PDA.
2. The lecturer wants to be notified when the general attention drops or when large parts of the audience look perplexed. He/she prefers to be notified by a short beep of his/her notebook.
3. The lecturer wants to be notified when a participant intends to ask a question.
4. The lecturer wants to be informed when the lecture time is about to run out. He/she wishes to be notified by targeted audio.

The services and options available to a user depend on his/her role, e.g. a listener cannot access the Attention Cockpit settings.

Three types of services can be distinguished: Notification services, assistance services and data providing services.

For different scenarios and roles, the user specifies

- which notifications he/she is interested in by default,
- how he/she prefers to be notified
  (e.g. by targeted audio, notice on his/her notebook or a short beep),
- service specific settings like a threshold value for the Attention Cockpit,
- what kind of documents of a data providing service he/she is interested in,
- the preferred form of data provision (i.e. audio, video, text),
- the preferred format for audio, video, text (e.g. mp3, mpeg4, pdf),
- the preferred output component (e.g. notebook, PDA).

The following steps are performed to change user profile settings:

1. The user requests access to the service settings.
2. The system checks if the user is authorised to make changes in the service settings.

Exception: The user's profile does not allow access to the service settings setup. The system informs the user that he/she is not authorised to access the service settings setup.

3. The system gives the user access to parts of the settings according to his/her profile.
4. The user makes changes to parts of the settings.
5. The changes are stored and the user profile is updated.

Postconditions:

- The user profile settings have been changed

3.2.12 Use Case DemandAssistanceInContactingPeople

Preconditions:

- The user is either in the "meeting scenario" or in the "lecture scenario".

Description:

A user wants to contact somebody. The system assists the user in connecting the appropriate people at the appropriate moment using appropriate media. It frees the user from managing contact addresses and deciding on the most appropriate media and time for communication. It emulates the ability of a human assistant.

3.2.13 Use Case DemandAssistanceInSchedulingMeeting

Preconditions:

- The user is either in the "meeting scenario" or in the "lecture scenario".

Description:

The user wants to schedule the next meeting or lecture. The system assists the participants in this task by considering the dates of each participant and the availability of an appropriate room. If the participants agree on a date, the room is automatically reserved and the date is entered into the participant's schedule.

3.2.14 Use Case ManageUserProfiles

Preconditions:

- The user is system administrator.

Description:

The CHIL system administrator wants to manage user profiles, e.g. create a new user, delete a user or change a user's privileges.

Postconditions:

- The profiles have been managed

3.2.15 Use Case NotificationAboutAttentionLoss

Preconditions:

- The user is in the "lecture scenario".
- The user is lecturer.
- The user wants to be notified about a decrease of attention (general or of selected participants).
- Attention drops below a specified threshold.

Description:

A user (i.e. the lecturer) has requested notification about a lack of attention in the audience. The system has recognised that attention dropped below a defined threshold. The system informs the user about the lack of attention in a way according to the settings in his/her profile.

The Attention Cockpit service provides information about the level of attention in the audience. The user can specify in the service settings if he/she is interested in the average attention level or the attention of selected participants. This service allows the user to react on decreasing attention, e.g. by concluding with his/her current topic and showing a fancy audio-visual presentation.

The following steps are performed to notify the user about a lack of attention:

1. The system recognises that the attention has dropped.
2. The profile of the lecturer tells the system that he/she wants to be notified about an attention loss.
3. The system determines the preferred way of notification from the user profile.

   Exception: No preferred way of notification is specified in the user profile. The system uses default settings.
4. The user is notified in the preferred manner.

Postconditions:

- The user is informed about the decrease of attention.

3.2.16 Use Case NotificationAboutDeviationFromGoals

Preconditions:

- The user is in the "meeting scenario".
- The user has requested notification about deviations from reaching the intended goals.
- The goals of the meeting were defined and are available to the system.
- The current discussion is a digression from the goals.

Description:

A user has requested notification about deviations from the intended goals of the meeting he/she is attending. The system has recognised a significant deviation of the current activity from the goals. The system informs the user about the deviation in the way he/she specified in his/her profile. This service helps the participants within a meeting to stick to the goals of the meeting. If the participants appear to digress too much from the goals, the participants are suggested to return to the essential topics or to move on to the next item.

The following steps are performed to notify the user about a deviation from the intended goals:

1. The system recognises the current topic of the meeting.
2. The profile of the user tells the system that he/she wants to be notified about deviations from the goals.
3. The system recognises that the current discussion is not relevant for reaching the goals.
4. The system determines the preferred way of notification from the user profile.

   Exception: No preferred way of notification is specified in the user profile. The system uses default settings.
5. The user is notified in the preferred manner.

Postconditions:

- The user is informed about the deviation from the intended goals.

This Use Case refines Use Case NotificationAboutDeviationFromSchedule.

3.2.17 Use Case NotificationAboutDeviationFromSchedule

Preconditions:

- The user is in the "meeting scenario".
- The user has requested notification about deviations from the agenda.
- An agenda is available.
- The meeting is behind schedule or the current discussion is not part of the agenda.

Description:

A user has requested notification about deviations from the agenda of the meeting he/she is attending. The system has recognised a significant deviation of the current activity from the agenda. The system informs the user about the deviation in the way he/she specified in his/her profile. This service helps the participants within a meeting to keep track of the agenda and to stick to the goals of the meeting. If the participants appear to deviate too much from the topics of the agenda or they are behind schedule, the participants are suggested to return to the essential topics or to move on to the next item.

Postconditions:

- The user is informed about the deviation from the agenda.

3.2.18 Use Case NotificationAboutDeviationFromTimeSchedule

Preconditions:

- The user is in the "meeting scenario".
- The user has requested notification about being behind schedule.
- An agenda is available.
- The meeting is behind schedule.

Description:

A user has requested notification about deviations from the time schedule of the meeting he/she is attending. The system has recognised that the meeting is behind schedule. The system informs the user about the delay in the way he/she specified in his/her profile. This service helps the participants within a meeting to keep track of the agenda.

The following steps are performed to notify the user about a deviation from the time schedule:

1. The system recognises the current topic of the meeting.
2. The profile of the user tells the system that he/she wants to be notified about deviations from the time schedule.
3. The system recognises that the meeting is behind schedule.
4. The system determines the preferred way of notification from the user profile.

   Exception: No preferred way of notification is specified in the user profile. The system uses default settings.
5. The user is notified in the preferred manner.

Postconditions:

- The user is informed about the meeting being behind schedule.

This Use case refines Use Case NotificationAboutDeviationFromSchedule.

3.2.19 Use Case NotificationAboutQuestionDemand

Preconditions:

- The user is in the "lecture scenario".
- The user is lecturer.
- The user has requested notification about question demand.
- A listener has clearly indicated that he/she intends to ask a question, e.g. by raising his/her hand.

Description:

A user (i.e. the lecturer) has requested notification about a question demand. The system recognises that a participant wants to ask a question. The system informs the user about the question demand in a way according to the settings in his/her profile.

The following steps are performed to notify the user about a question demand:

1. The system recognises the question demand of a listener.
2. The profile of the lecturer tells the system that he/she wants to be notified about a question demand.
3. The system determines the preferred way of notification from the user profile.

   Exception: No preferred way of notification is specified in the user profile. The system uses default settings.
4. The user is notified in the preferred manner.

Postconditions:

- The user is informed about the question demand.

3.2.20 Use Case NotificationAboutRoleChange

Preconditions:

- The user is either in the "lecture scenario" or in the “meeting scenario”.
- The user is identified by the system.
- The user has requested notification about change of his/her or another participant’s role.
- The role of the user or a participant has changed.

Description:

A user has requested notification about a role change, either his/her own or that of another participant. The system recognises that a role change has occurred and informs the user about the role change in a way according to the settings in his/her profile.

The following steps are performed to notify the user about a role change:

1. The system recognises a role change.
2. The profile of the user tells the system that he/she wants to be notified about the change of a particular participant's role.
3. The system determines the preferred way of notification from the user profile.

   Exception: No preferred way of notification is specified in the user profile. The system uses default settings.
4. The user is notified in the preferred manner.

Postconditions:

- The user is informed that his/her or another participant’s role has changed.

3.2.21 Use Case NotificationAboutScenarioStateChange

Preconditions:

- The user is either in the "lecture scenario" or in the “meeting scenario”.
- The user is identified by the system.
- The user has requested notification about change of state in the current scenario.
- The state within the scenario has changed.

Description:

A user has requested notification about a change of state within the current scenario. The system recognises that the state has changed and informs the user about the change in a way according to the settings in his/her profile. Furthermore, notification can be limited to a certain state change. For example, the user wants to be notified, when the current discussion is finished or when the participants begin to schedule the next meeting.

The following steps are performed to notify the user about a state change:

1. The system recognises a state change.
2. The profile of the user tells the system that he/she wants to be notified about this state change.
3. The system determines the preferred way of notification from the user profile.

   Exception: No preferred way of notification is specified in the user profile. The system uses default settings.
4. The user is notified in the preferred manner.

Postconditions:

- The user is informed that a state change has occurred.

3.2.22 Use Case NotificationAboutTimeLimit

Preconditions:

- The user is in the "lecture scenario".
- The user is lecturer.
- The user has requested notification about time limit.
- The lecture time has almost expired.

Description:

A user (i.e. the lecturer) has requested notification about the lecture time running short. The system recognises that the lecture time is almost up and informs the user about this in a way according to the settings in his/her profile.

The user can specify in the service settings when he/she wants to be informed about time running out (e.g. 2 minutes before scheduled end of presentation) and how he/she prefers to be informed about it. Possible means are a notice on his/her notebook or targeted audio.

The following steps are performed to notify the user about the time running short:

1. The profile of the lecturer tells the system that he/she wants to be notified about a question demand.
2. The system determines when the user wants to be notified.
3. The system recognises that is has to notify the lecturer now.
4. The system determines the preferred way of notification from the user profile.

   Exception: No preferred way of notification is specified in the user profile. The system uses default settings.
5. The user is notified in the preferred manner.

Postconditions:

- The user is informed that time is about to run out.

3.2.23 Use Case NotificationAboutTopicOfInterest

Preconditions:

- The user is in the "lecture scenario".
- The user is listener.
- The user has requested notification about his/her topic(s) of interest.
- The lecturer talks about one of the user's topic(s) of interest.

Description:

A user (a listener) has requested notification about his/her topic of interest being discussed now in the presentation. He/she specified a list of topics that interest him in the current lecture. The system recognises that the subject of the lecture changes to one of the topics on the list. The system informs the user, that one of his/her topics of interest is covered now. The way of notification depends on the settings in his/her user profile. While none of his/her topics of interest is currently addressed, the user can focus on other activities.

The following steps are performed to notify the user about one of his/her topics of interest being covered now:

1. The system recognises the current topic of the presentation.
2. The profile of the user tells the system that he/she wants to be notified when a topic of interest is addressed.

   Exception: The user did not specify a list of topics of interest.
3. The system recognises that the current topic is on the user's list of topics of interest.
4. The system determines the preferred way of notification from the user profile.

   Exception: No preferred way of notification is specified in the user profile. The system uses default settings.
5. The user is notified in the preferred manner.

Postconditions:

- The user is informed that one of his/her topics of interest is discussed now.

3.2.24 Use Case PersonalDeviceIntegration

Preconditions:

- The user is either in the "lecture scenario" or in the "meeting scenario".
- The user starts a personal device.

Description:

A user in the CHIL meeting or lecture room wants to use his/her personal device (PDA or notebook). He/she starts the device and connects to the CHIL system. If required the CHIL client software is automatically installed on the user's personal device and started.

Postconditions:

- The user's personal device is integrated into the CHIL system.

Postconditions:

- The user is identified by the system.

3.2.25 Use Case PersonalNotifications

Preconditions:

- The user is either in the "lecture scenario" or in the "meeting scenario".
- The user has requested notification about personal matters.
- There is news concerning a personal matter.

Description:

A user wants to be notified when there is news about a personal matter. For example he/she wants to be notified if the flight or train he/she has booked is in time. Or he/she wants to be notified when the taxi he/she ordered is arriving. The system may obtain relevant information about a specific personal matter through web services.

The following steps are performed to notify the user about personal news:

1. The profile of the lecturer tells the system that he/she wants to be notified about news in a certain matter.
2. The system recognises that there is news in this matter.
3. The system determines the preferred way of notification from the user profile.

   Exception: No preferred way of notification is specified in the user profile. The system uses default settings.
4. The user is notified in the preferred manner.

Postconditions:

- The user is informed about news concerning a personal matter

3.2.26 Use Case UserIdentification

Preconditions:

- The user enters the room.
- The user enters either the "meeting scenario" or the "lecture scenario".

Description:

A user enters the CHIL meeting or lecture room and wants to be identified by the system. In order to be recognisable by the system relevant data must be available *a priori* to the system, e.g. from a previous meeting.

If the user could not be identified by the system he/she is classified as unknown or guest.

4 Requirements for the Architecture

4.1 Requirements Overview

Table 4-1: Summary of Requirements

Code	Description	Importance/ Priority
R1	Transparent Distributed Communications	High
R2	Subscriptions	High
R3	Polling	High
R4	Synchronised Global Timing	High
R5	Perceptual Components Simulation	High
R6	Support for Heterogeneous Sensors and Perceptual Components	Medium
R7	Situation Interpretation	Medium
R8	Storage	Medium
R9	Situation Tagging	Medium
R10	Direct Access to Raw (Sensor) Data	High
R11	Raw data Storage	High
R12	Integration with 3rd party entities	High
R13	Directory Services	Medium
R14	Life supervision	High
R15	User front-end integration	High
R16	Scenario detection	High
R17	Dynamic role assignment	High
R18	Service handling	High
R19	Profiling	High
R20	Real time assembly and correlation of inputs	High
R21	Heterogeneous Operating Systems Support	Low
R22	Multi User Front-End Support	Medium
R23	Failure Resilience	Low

Code	Description	Importance/ Priority
R24	Multiple Data Formats	Medium
R25	System Management	High
R26	System Configuration	High
R27	System Instrumentation	High
R28	Resource control	Medium
R29	Access security	Medium
R30	Automatic Client Setup	Medium

4.2 Detailed requirement description

R1: Transparent Distributed Communications

Description	Distributed Entities must be able to communicate with each other, towards exchanging transferring data and/or initiating remote operations. Communication should be transparent to underlying physical networking and component types.
Rationale	Realising the scenarios requires data exchange between various (types of available) components.
Example(s)	Service-Perceptual Component Communication: Allow the Service to query a perceptual component.

R2: Subscriptions

Description	Distributed entities may allow subscription by other entities for notification of events.
Rationale	Allow entities to continually be notified about changes in the environment, context, and generally other components status.
Example(s)	Service entity subscribes to a “lecturer up” event to be notified when a person approaches the speaker area. Service or context entity subscribes to a perceptual component tracking a person location, to continually update the information about a person position.

R3: Polling

Description	Components may allow polling to provide access to the information they expose (i.e. data attributes).
Rationale	Access/determine the state of a component at any arbitrary time instant. Selectively minimise number of subscriptions and the corresponding network & processing overhead, through a mode alternative to subscriptions.
Example(s)	A service entity (e.g. Memory Jog) queries a person-tracking component about the location of the speaker/lecturer. Service entities query access past topics through querying the summarisation components.

R4: Synchronised Global Timing

Description	Data at all levels are labelled with a global time stamp from common network timeserver with a precision of 10 milliseconds.
Rationale	Allow distributed entities to prioritise, sequence, process, and disambiguate timing relationships of events and related information based on a global timing mechanism. *Key requirements to solve the "when" problem.*
Example(s)	A service entity receiving person tracking and identification events must be able of resolving their timing relationship. Topic Tracking and Summarisation components should timestamp information consistently with the timing of ASR components.

R5: Perceptual Components Simulation

Description	Allow Perceptual Components to be replaced by entities providing similar simulated inputs/outputs.
Rationale	Exploit the architecture to develop or demonstrate environment even in the case of missing or malfunctioning technology components.
Example(s)	In the absence (or poor performance) of a Person-ID component, allow an emulator to be plugged in the architecture (e.g. an entity returning an ID by clicking a button on a GUI).

R6: Support for Heterogeneous Sensors and Perceptual Components

Description	The architecture should be able to employ heterogeneous sensors and perceptual components in terms of sensor type and functionality.
Rationale	The configuration of sensors and perceptual components may differ at different sites. This minimise the effort required to adapt sensors and components of the same type for use within the architecture.
Example(s)	Microphones, microphone–array, wide angle Camera, panoramic camera, different vendors etc.

R7: Situation Interpretation

Description	The architecture should comprise perceptual components that interpret situation, mapping the current situation to tasks and actions.
Rationale	Provide processes interpreting situations according to needed service.
Example(s)	Some perception components may provide correlation of perceptual input to respond to the question: "*Who is the speaker*?" This information will be available to other entities.

R8: Storage

Description	Provide generalised, structured mechanisms for storing situation information.
Rationale	Allow for post processing, non real time processing of situation information for use by service entities.
Example(s)	Answering to questions concerning 'when' requires access to past situation information.

R9: Situation Tagging

Description	Provide generalised structured mechanisms for tagging situations.
Rationale	Service entities should access tagged situations.
Example(s)	Answering to questions concerning 'when' requires access to "tagged" situation information.

R10: Direct Access to Raw (Sensor) Data

Description	Entities should be able to access raw sensor data
Rationale	Several Components require access to the same stream(s). Low level processing should not be solely done by sensor controllers/Wrappers, but also by other components. Permits communicating pointers instead of data.
Example(s)	Allow raw camera input to be available (for processing) to two distinct components (a Person Tracker and a FaceID component).

R11: Raw data Storage

Description	Provide generalised structured mechanisms for storing of raw data. It should be possible to disable and enable this functionality.
Rationale	Allow for post processing, non real time processing and (possibly) tagging of raw data.
Example(s)	Automatic summarisation requires access to raw data streams.

R12: Integration with 3rd party entities (software)

Description	The architecture should allow incorporation of third party components.
Rationale	Allow proprietary components to be used to provide for additional functionality.
Example(s)	Integrate 3rd party IR systems (to support participants questions, provision of pertinent information). Use X+V browser as a multimodal user interface.

R13: Directory Services

Description	Provide a directory facility for configurable and dynamic location and binding to resources and distributed entities.
Rationale	Allow entities to start/join and stop/abandon the CHIL environment. Minimise effort for configuration and facilitate portability.
Example(s)	Provide a directory facility for configurable locating and binding to resources and distributed entities. Provide a directory facility for dynamical locating and binding to resources and distributed entities.

R14: Life supervision

Description	Provide the possibility to supervise the operational availability of integrated components.
Rationale	Supervision of components being “alive” and reaction to errors.
Example(s)	Provide the possibility for lifetime supervision registration. Provide trouble handling of disturbances.

R15: User front-end integration

Description	Provide front-end integration for the devices/applications of the users as soon as these are available.
Rationale	The system should detect any new arriving device connected to the system and integrate this device into the system.
Example(s)	The system notices a user front-end in the meeting room and integrates it into the system-network (OS independently). An assignment user/terminal should be provided.

R16: Scenario detection

Description	Provide automatic recognition of the situation model.
Rationale	The system should know which of the possible CHIL-scenarios is taking place.
Example(s)	Decide if we are in the “Lecture Meeting” or in a “Small Group Meeting”. If we are in a “Lecture Meeting”: Are we in the “Lecture Stage” or in the “Question Stage”.

R17: Dynamic role assignment

Description	Provide automatic role detection within a particular scenario.
Rationale	The role of a user can change within the scenario dynamically.
Example(s)	Any user can be of type “lecturer”, “listener” or “participant” (especially at the beginning when the role is unknown).

R18: Service handling

Description	Allow any user accordant to his/her profiles the subscription, configuration, suspension, etc. of services.
Rationale	Any user is an individual in the scenario.
Example(s)	A particular user wants to get information from the “Attention Cockpit” if and only if he/she is in the “Lecture Meeting” scenario and his role is “Lecturer”.

R19: Profiling

Description	Provide at least one “profile” per user with specific entries: user-, role- and scenario-specific.
Rationale	The system should know the favourite services settings of each user in different situations.
Example(s)	According to the profiles an automatic subscription to special services can be performed.

R20: Real time assembly and correlation of inputs

Description	Allow raw sensor information and other sensors data to be collected, in real time.
Rationale	Technology components, sensor controller and other distributed entities within CHIL run on different OS platforms. Moreover, this will also facilitate migration towards tackling with failure and supporting autonomic functionality.
Example(s)	Recognise Speaker in real time, and provide pertinent info asap.

R21: Heterogeneous Operating Systems Support

Description	The architecture should cater for the integration of distributed components that run on different systems.
Rationale	Technology components, sensor controller and other distributed entities within CHIL run on different OS platforms. Moreover, this will also facilitate migration towards tackling with failure and supporting autonomic functionality.
Example(s)	NIST controller runs under Linux. Other components run on Windows.

R22: Multi User Front-End Support

Description	The architecture should support multiple terminal devices.
Rationale	Participants should have the option of using more than one terminal type.
Example(s)	The memory jog should be run on a laptop, as well as also on a PDA (possibly with more limited functionality).

R23: Failure Resilience

Description	Components should resist (hardware) failures on the hosting machines.
Rationale	Be able to provide services even if a hosting machine fails.
Example(s)	On the occasion of a failure of the machine hosting the MM-Array ASR component, allow for its migration to another host.

R24: Multiple Data formats

Description	Be able to cope with a variety of data/media formats trough appropriate recognition, conversion, handling.
Rationale	Increase the scope of the system's operation.
Example(s)	Deal with compressed and uncompressed video, greyscale and coloured (RGB) in the scope of person ID and person tracking components. Provide support for different audio files.

R25: System Management

Description	Software components that make up the CHIL software environment should behave similarly regarding their runtime behaviour.
Rationale	Standardise the system's behaviour.
Example(s)	Provide support for platform- and language independent system shutdown. Provide an entity functional testing tool.

R26: System Configuration

Description	The CHIL software environment's components should provide standardized configuration interfaces. Moreover, components should exhibit their runtime behaviour for logging and tracing applications (e.g. start up, shut down, error detection and process logging).
Rationale	Define language- and platform independent configuration interfaces.
Example(s)	Provide a configuration tool. Provide process logging and tracing.

R27: System Instrumentation

Description	Software components that make up the CHIL software environment should expose instrumentation interfaces that facilitate performance monitoring of components.
Rationale	Provide management instrumentation interfaces.
Example(s)	Provide information about the throughput of processed image data.

R28: Resource control

Description	Defines mechanisms for acquiring control over resources and their input/output data.
Rationale	Manage allocation and control of resources. Ensure exclusivity of access to resource control APIs.
Example(s)	Define *read*, *write*, *execute*, and *monitor* APIs on resources. The following applies: N clients can subscribe to *reading* input stream in parallel. Only single client can *write* to the output resource. Only a single client can *execute* resource controls (if provided). N clients can *monitor* resource status in parallel. Part of resource control mechanisms is e.g. implementing queues over *execute* and *write* APIs to handle operation exclusivity and notifications when the owner of the resource changes. (The Access security requirement extends these mechanisms by incorporating security policies over it.)

R29: Access security

Description	Define security mechanisms to guard access to resources and their input/output data.
Rationale	Manage resource access rights and clients capabilities to implement desired security policies.
Example(s)	Each resource maintains the access right table that lists clients (principals) who has capabilities to *read*, *write*, *execute*, and *monitor* the resource. E.g., only clients with “admin” privileges can read the video stream from a surveillance camera.

R30: Automatic Client Setup

Description	Provide automatic client setup for “CHIL-application” within user’s login to the system.
Rationale	Standardise the system’s behaviour.
Example(s)	Provide an automatic Setup tool (e.g. via “Java Web Start”).

5 Requirements for External Interfaces

5.1 User Interface

Communication with users will be handled through a PDA (or Laptop) front-end, connected via Wireless LAN. Initial input modalities will be speech commands, typing and clicking on a graphical user interface. Output will be given trough the GUI or where appropriate via synthesized (targeted) speech. As for communication with other parties, this can be achieved either through talking to another person's Connector (via LAN) or through traditional channels such as email, phone calls or SMS, that the Connector will initiate and accept.

The front-end will connect to the room infrastructure via WLAN to obtain the appropriate context setting (based on activity in the room, etc.). The front end will also combine the given context information with user preferences that it has learned. It will signal incoming calls to the user as appropriate. This could be either by just connecting the user, giving audio signals or by blinking lights etc.

5.2 External Systems

The Connector Service may have additional requirements to connect to external systems. These requirements are subject to the exact specification of the Connector Service.

6 Quality Requirements

6.1 Criticality

The criticality of the CHIL system can be rated low. The loss of operational availability or malfunction of the system does not cause harm to human beings.

6.2 Data Protection / Ensuring Anonymity

To help identifying participants with respect to their ability to provide a representative data set, as well as the evaluation of the data set itself, we will collect a "Participant Form" from each participant. Representative information fields for a participant include the minimum relevant information such as: Last Name, First Name, Middle Initials, Gender, Date of Birth, e-mail, telephone number, area of birth, area of longer residence, area of residence during primary school, native language (father's, mother's), accent, education, etc.

To ensure privacy of the participants, data will be coded in such a way that no identification of participants is possible. Scientific results based on this data will be published without revealing the identity or affiliation of the individuals involved.

To ensure that the individuals or their affiliations cannot be identified, names of participants and any personal data will be removed from the transcripts and the recorded data before the data collection group releases them to other parties. The speakers will be assigned randomly generated codes that will allow only features and extracted parameters to be retrieved.

7 Ancillary Conditions

The CHIL system shall work in an office environment both in daylight and artificial light.

The CHIL system shall not be disturbed by normal office noise.

The CHIL system should work in real time and communicate with external devices in a wireless mode.

8 Annex

8.1 References

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8.2 Table list

8.3 Figure list