Introduction

As basically every office worker today has a computer on his or her desktop, global and extensive use of computers for telecooperation is a vision that is - from an infrastructure point of view - just around the corner. In a recent survey from the UK Institute of Management conducted by Bain et al., 45% of the companies participating in the survey report already using Groupware tools. But the development of telecooperation applications turned out to be tedious and time consuming, the development project is risky and a success is uncertain. The reason for these problems are twofold. First, telecooperation applications are constructed in an system integration effort from a number of different systems, services and mechanisms that support people to interact, i.e., to exchange information, share resources and achieve mutual awareness. Second, telecooperation applications are - in contrast to many other applications - developed to support people working together harmoniously, i.e., to structure and coordinate their cooperation and resolve conflicts.

Elements of a Telecooperation System

Subsystems and services that have to be integrated to build a telecooperation system can be identified straight away by analysing its purpose. Telecooperation systems are systems that support teams of people to cooperate. [14] defines cooperation as coordinated communication; a telecooperation system thus deals with communication aspects and coordination policies on top of communication mechanisms.

Communication in a telecooperation system may be based on three different mechanism:

• multimedia communication as the most natural form of human-human communication based on the establishment of transient audio and/or video streams between cooperation partners. Examples communication mechanisms include low quality telephony tools for the Internet as well as high quality multipoint multimedia conferencing systems suitable for medical applications;

• asynchronous data sharing in the form of remote access to persistent data concurrently but usually asynchronously used in a heterogeneous team. Examples are shared file systems and database, shared objects and services, but also simple WWW and mail based communication forms;
1. Technische Aspekte und Modellierung von Telekooperationssystemen

- **tight coupling computer conferencing** offering a more synchronous way of a data sharing type of communication and providing strong awareness of other cooperation partners. Most systems developed by CSCW research as for example shared editing systems and application sharing are mechanisms for computer conferencing style cooperation.

Coordination takes place as a collection of activities, starting from identifying goals, mapping goals to activities, selecting actors and managing interdependencies [11]. These activities are performed whenever a group of people work together - no matter whether they cooperate in a computer supported way or not. Coordination is a part of every social behaviour and performed according to 'group culture', to team and task specific policies which are in turn implemented as coordination protocols. Every group of people or team either agrees on a predefined coordination policy and protocol, or develops a coordination policy and the related coordination protocol during an ongoing cooperation. An examples for a common social coordination protocol is turn taking in conversation which is a priori known by all participants of the conversation and adjusted to particular cooperation situations (e.g., heavy discussion, predominant participants). All coordination heavily interferes with the team process and coordination breakdowns can easily lead to frustration and lack of interest in further cooperation. These observations are particularly true for additional technical, computer supported coordination that augments or supports social coordination policies. Whenever technical coordination is provided, it has to cooperate and provide space for the social coordination.

Communication mechanism are specialised on means for team communication and interaction. However, only very little support for their coordinated use is included in these systems. The rules and processes for coordinated use of a communication mechanism have to be implied by an extra coordination layer on top of the communication mechanism. A coordination layer performs coordination according to a coordination policy. The policy finally defines who in the team is allowed to do what and when with a communication mechanism, thus defines how the team cooperates and, using Mallones [11] definition of cooperation, "harmonically works together". A Coordination layer may for example define issues of session control or floor control using concepts like an access token or a coordinating chair. Coordination for a multimedia communication channel for example is required when the social turn-taking coordination protocol fails due to a long delay on the multimedia channel.

Communication mechanisms and coordination policies are orthogonal concepts [3]. A communication mechanism can be combined with a number of different coordination policies; each combination of communication mechanism and coordination policy defines a different cooperation