

# Secure and Dynamic Coordination of Heterogeneous Smart Spaces

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## INTRODUCTION

Recent advances of ubiquitous technology enable development of smart rooms and spaces in several research organizations. Generally, smart rooms and spaces are equipped with sensors, appliances, and computer controlled actuators. Also there might be a middleware or software for controlling these smart rooms.

Nagoya University has developed a middleware named “cogma”[1] and constructed a smart room named “cogma room”. “cogma” can be used as a tool to support everyday life in the ubiquitous computing. Ritsumeikan University and Uchida Yoko Co Ltd. have developed a smart space and a control software named “UnitedSpaces”[2]. Like the initial stage of the internet, this kind of smart rooms should be interconnected each other(Figure.1). However, our middleware are based on completely different concepts. So it is not possible to directory connect and cooperate each other. In 2006, we started a joint research project to overcome several difficulties related to federation of the smart rooms and users.

## CURRENT STATUS OF SMART ROOM COORDINATION

We have developed solutions for each of problems in the heterogeneous coordination of smart spaces.

### Heterogeneity

Different smart rooms may have their own design concept. So it is not easy to standardize a protocol for coordination between heterogeneous smart rooms. In the current status, we employ simple “RESTful” Web service interface described by WADL[3] for smart room services.

### Secure Communication

By employing REST interface, we just use “https” as a secure transport protocol. In the smart room environment, it is not easy to specify the authorization on each user. We employ a “ticket” based authorization. In this scheme, the manager issues a ticket for the guest user. Current ticket is defined as a XML format with digest signature.

### NAT problems

We have developed a smart virtual network technology named “PeerPool”. By using PeerPool, user can add a direct connection between private networks using dual-NAT.

### Simple Configuration

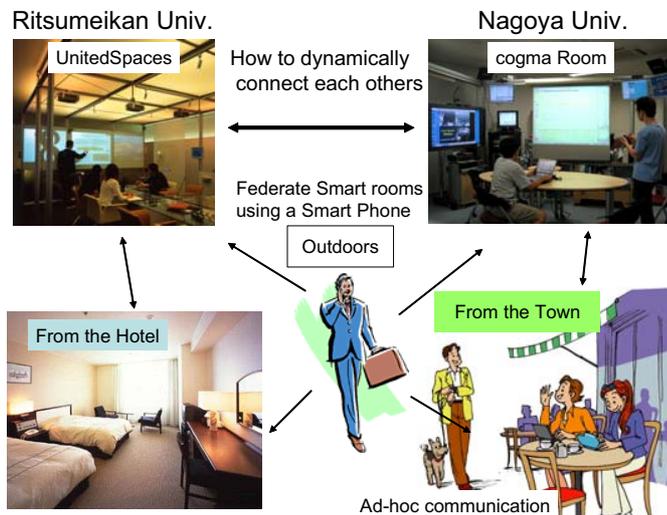
It is not easy to configure the several technologies. We introduce a “Instant messenger” based smart interface for smart room coordination named “NUE”.

## ACKNOWLEDGMENTS

This project is supported by SCOPE (061106004) (strategic Information and Communications R&D Promotion Programme) from the Ministry of Internal Affairs and Communications(MIC), Japan.

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**Figure 1. Secure and Dynamic Coordination of Heterogeneous Smart Spaces.**