Centre for Communication Systems Research (CCSR)

UK-China Science Bridge

Professor Zhili Sun

26 July – 24 August 2009

The Centres within the Faculty

FACULTY OF ENGINEERING & PHYSICAL SCIENCES	
DISCIPLINES	RESEARCH CENTRES
Electronic Engineering Mech/Aero Engineering Civil Engineering Chemical Engineering Physics Applied Maths Computing	Communication Systems Research (CCSR) Advanced Technology Institute (ATI) Vision Speech & Signal Processing (CVSSP) Surrey Space Centre (SSC) Surrey Materials Institute (SMI) Centre for Environmental Strategy (CES) Fluid Systems Research Centre (FSRC) Centre for Nuclear & Radiation Physics (CNRP) Mathematics – Dynamics Computing – Security & Software

CENTRE FOR COMMUNICATION SYSTEMS RESEARCH

- Academic/support staff – 20
- PG Research Fellows – 45
- PhD students – 90
- Research Annual Turnover - £4m
- Research Portfolio - £10m
- MSc's – Mobile, Satellite, Networks – 80 students year

Centre for Communication Systems Research
At the centre of world-wide research

❖ **Largest academic communications research group in Europe** (£10m current research portfolio)

❖ **Largest recipient of EU IST research funds** FP6 (25 projects) - £7.5m research funding.
   FP7 (7 projects)---£6m

❖ Major player in Mobile VCE in UK

❖ Wide industrial collaboration
❖ Strategic Partnerships – Vodafone, Nokia, Ericson, Thales, EADS
❖ World-Wide partners

Asia
- China (EU FP6 EC-GIN project with 4 Universities)
- Korea (ETRI and 2 Universities)
- Japan (NICT– exchange programme)

USA
- Partnership with University of California San Diego / Irvine via SET^2 UK-USA programme **in wireless**

India
- **5 ITT's – next generation networks UKIERI, INTERACT**

❖ **Driving Europe's communication programme**
  - WWRF, ASMS-TF / Technology platforms: e-mobility (chair), ISI, MIMO / Hermes partnership / 5 networks of excellence

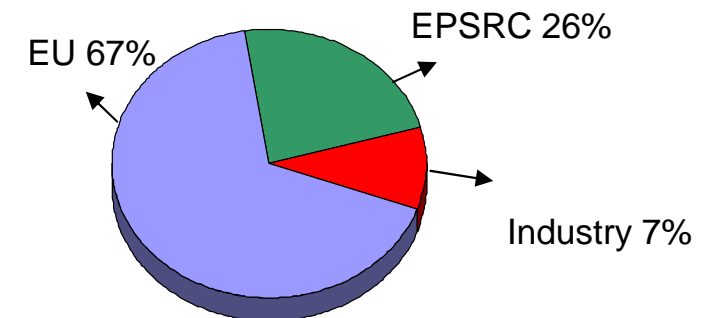I-Lab Vis-Lab Large screen immersive visualisation systems.
High-end graphics manipulation server

COVERAGE
- **Mobile/wireless**
- **Satellite/HAPS**
- **Core IP Network**
- **Applications and services**
- **Content and context**

EU

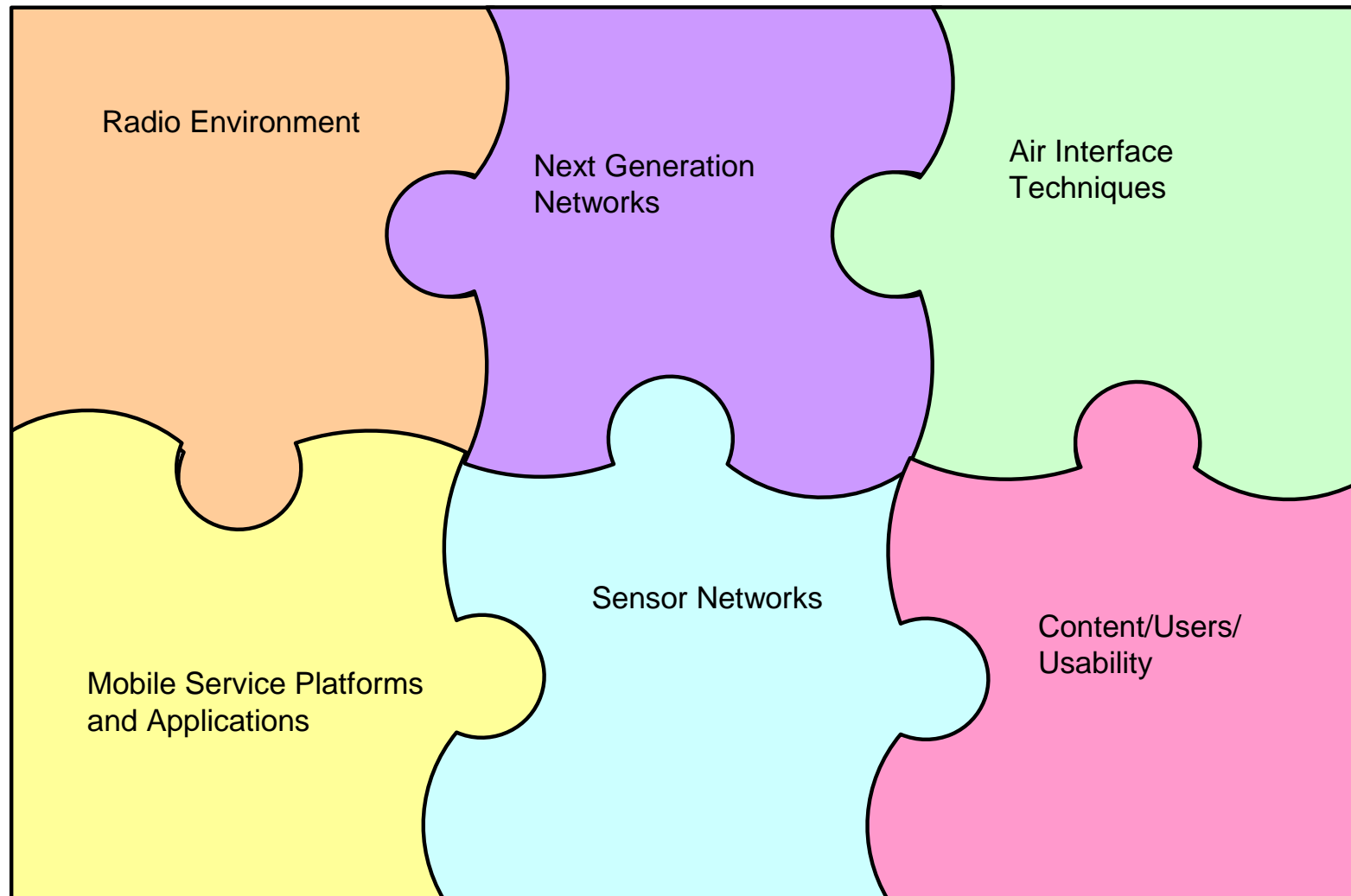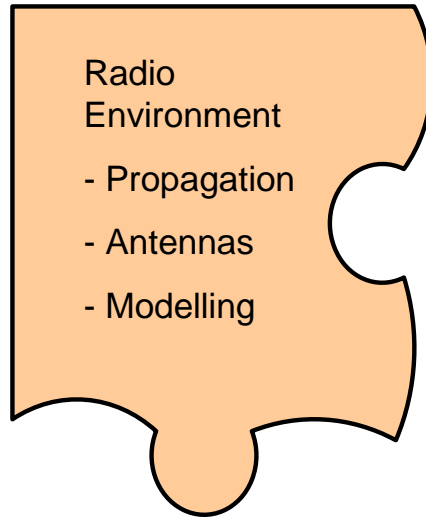**EPSRC**

Industry – worldwide

EU 67%

EPSRC 26%

Industry 7%

RESEARCH LANDSCAPE

RADIO ENVIRONMENT

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Radio Environment

- Propagation

- Antennas

- Modelling

Research Projects:

•MVCE Core 3

•INMARSAT BGAN

•EPSRC Portfolio

Research Areas:

•Wideband propagation Measurements 2-5GHz

•UWB Channel measurements/modelling

•Satellite channel measurements/modelling L-Ka band

•Satellite MIMO

•Body Area Network Characterisation

•Quadrafilar Helix Antennas

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AIR INTERFACE TECHNIQUES

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Air Interface Techniques

-Short Range

- Long Range

RESEARCH PROJECTS
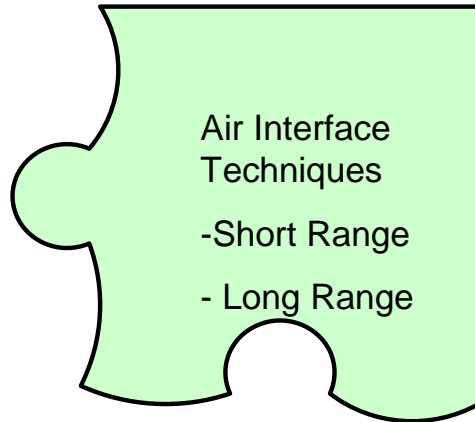
FP6	FP7	Other
WINNER I/II	ROCKET	MVCE Core 4
MAGNET BEYOND	WHERE	
4MORE		
MATRICE		
FIREWORKS		
MOWGLY		
MAESTRO		
ANASTASIA		

Research Areas:

* OFDM/OFDMA

* Adaptive modulation & coding

* Interference Cancellations

* Synchronisation

* MIMO

* Beam forming

* LTE / WiMax

* Cross Layer Optimisation

* DVB-SH; DVB-RCS + m

* Cognitive Radio

* Capacity/coverage and optimisation

* Multihop

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NEXT GENERATION NETWORKING

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Next Generation Networks
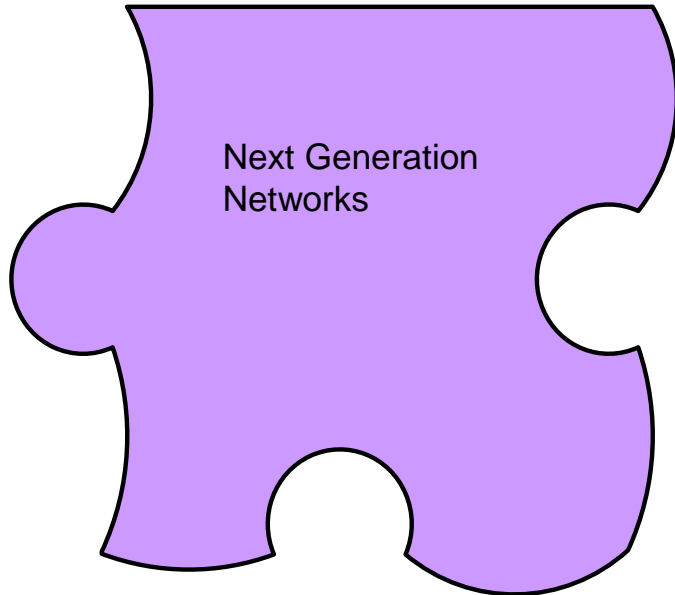
RESEARCH PROJECTS

| FP6	FP7	Other
AMBIENT NETWORKS 1 / 2	4WARD	MVCE Core 4/EPSRC
EVOLUTE	SMARTNET	
DISCREET	PREDRIVE	
BGAN	E3	
SATLIFE		
SATSIX		
EUROFGI		

Research Areas:

* Adhoc/Mesh networking

* QoS ranking

* Network Composition

* Multicast

* Context transfer

* Micro/macro mobility

* IPV6 on satellite

* Network Virtualisation

* Future generation internet

* Cross layer optimisation

*CAC & scheduling

* Dynamic spectrum allocation

*DVB/Mobile inter working

*RRM for SDMB

* Handover & security

* Security protocols

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MOBILE SERVICE PLATFORM & APPLICATIONS

Mobile Service Platforms and Applications
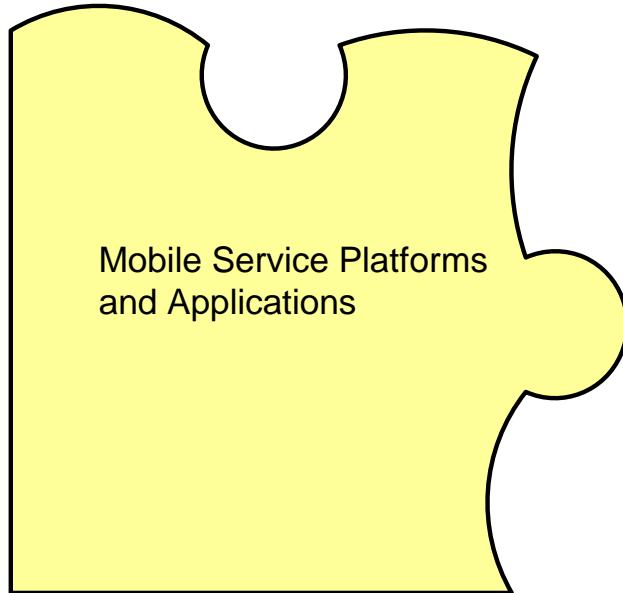
RESEARCH PROJECTS

FP6	FP7	Other
SPICE	MCiudad	MVCE Core 4/TSB - Ubiquitous
MOBILIFE		EPSRC Portfolio
ORACLE		

Research Areas:

* Distributed user interfaces

* Distributed user equipment

* Service & Device discovery

* Context description & reasoning

* IMS & platform implementation

* Group management services

SENSOR NETWORKS

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Sensor
Networks

RESEARCH PROJECTS
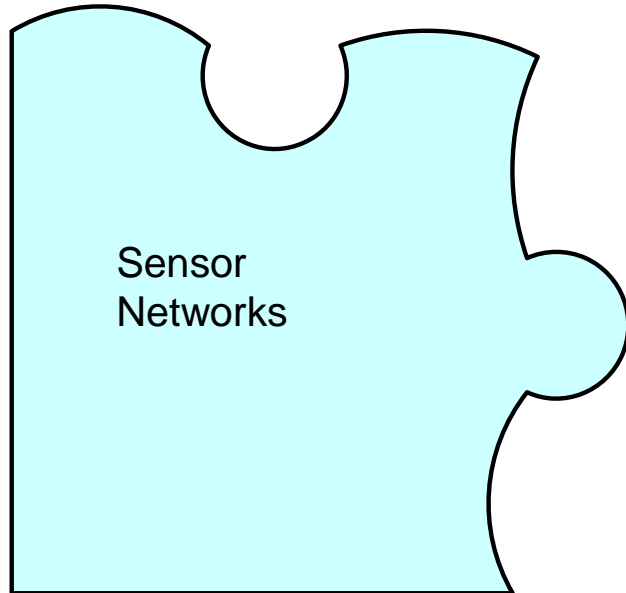
FP6	FP7	Other
E-Sense	Sensei	EPSRC Portfolio
Portfolio		
Mobilife		
Oracle		

Research Areas:

* Sensing techniques

* Sensor networks

* Information classification

* Context definition

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CONTENT / USERS / USABILITY

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Content/Users/
Usability

I-Lab
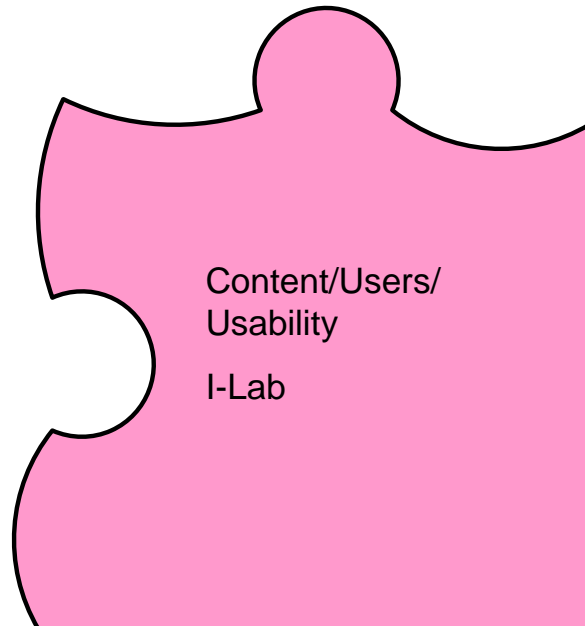
RESEARCH PROJECTS

FP6	**FP7**	**Other**
VISNET 1 / 2		EPSRC Portfolio
Mobilife		Thales Embedded Lab

Research Areas:

* Video / Audio processing

* 3D Video / Audio

* User experience

* Multimodality interfaces

* Dynamic desktop (Virtual Offices)

* Immersive environments

* e-health – Guardian Angel

* Assisted Living

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Radio Measurement Facilities

- Elektrobit Propsound Wideband channel sounder 64x32 branches, 2GHz and 5GHz bands.
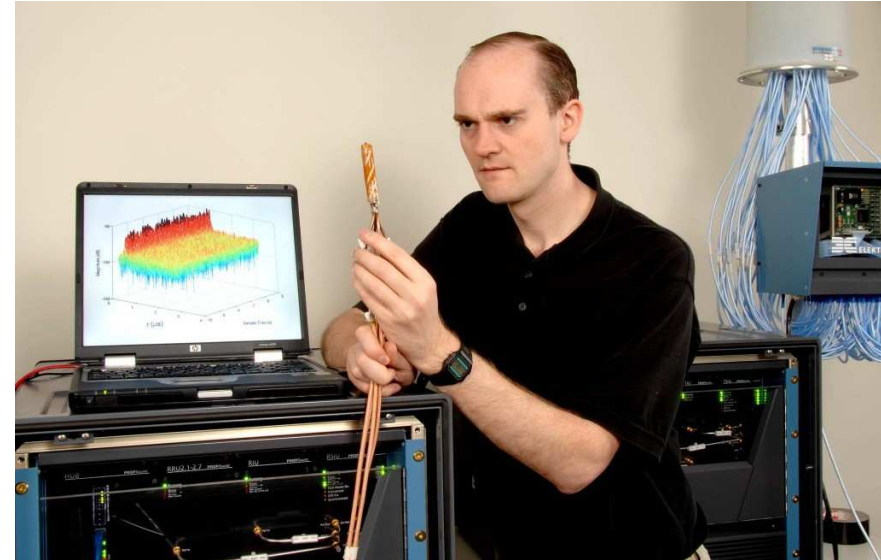
- Mobile RF Lab equipped to test up to 20GHz and beyond. Channel emulators also available.

- Anechoic chamber for mobile terminal measurements. Suited for 400MHz-60GHz.

UniS Campus-wide Wireless Testbed - Network Structure

Ad-hoc cloud

AP - Access Point

APC - Access Point controllers

CISCO 4500/7xxx

10BaseT 100BaseFX

SWR Terminal emulator

video Server & media archive

data Server

FX

CISCO 7507

Content Server

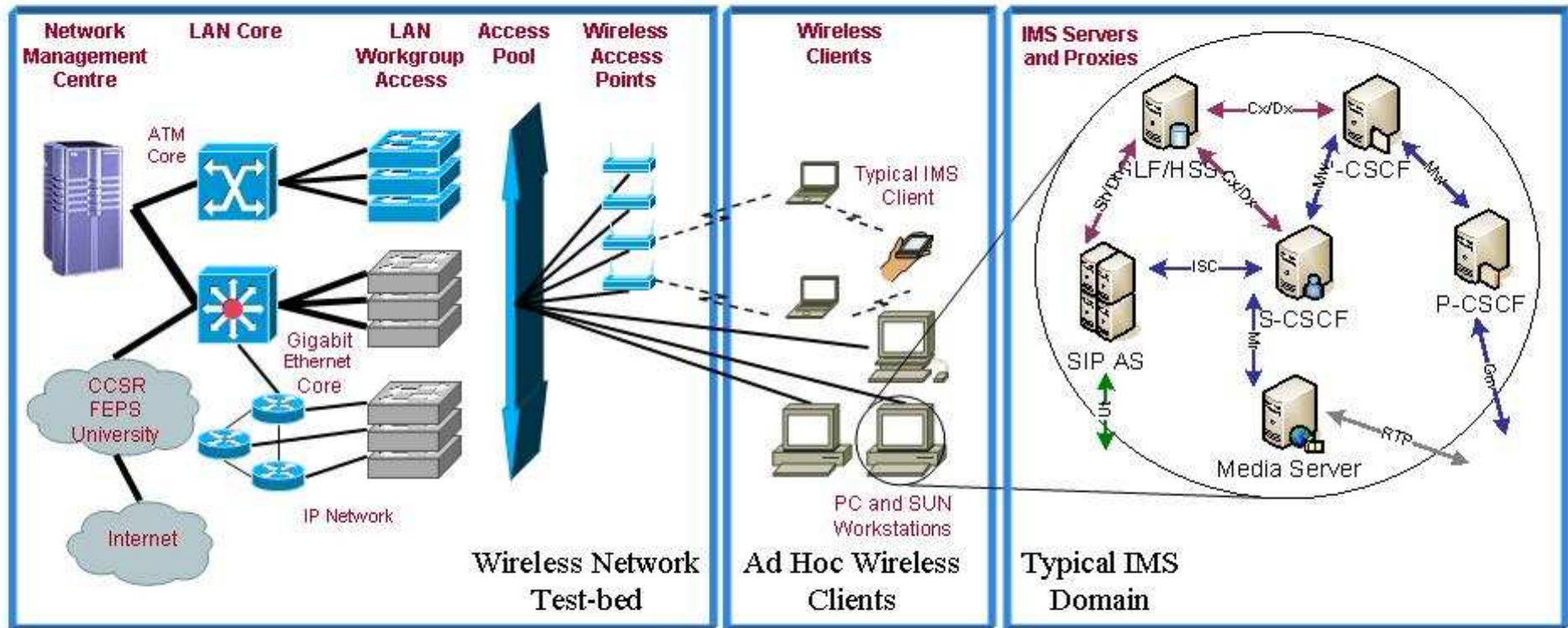experim-entation router

Local LAN/ INTERNET

The SUN E10000 server will support :
- Mobility Server (MSCP func. i.e. home & visitor location servers)
- object store for
  ⇨ mobility-server objects
  ⇨ node-server objects
  ⇨ switch-server objects
- network management software
- multimedia traffic monitoring station & data collection point
- mobile client proxy implementation
- Streaming video server
- multimedia conversions
- wireless gateway server
- H320 to H323 gateway

OC12

Primary switch (Fore ASX1000)

CISCO 7507

fixed terminals for H323 video-conf. & E10000 clients.

access switch CISCO Catalyst 5505 Primary LANE server

SWR BaseStation emulator

FastEthernet 100BaseT 100BaseFX

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The IMS ++ testbed at Surrey
IMS++ in the WNT
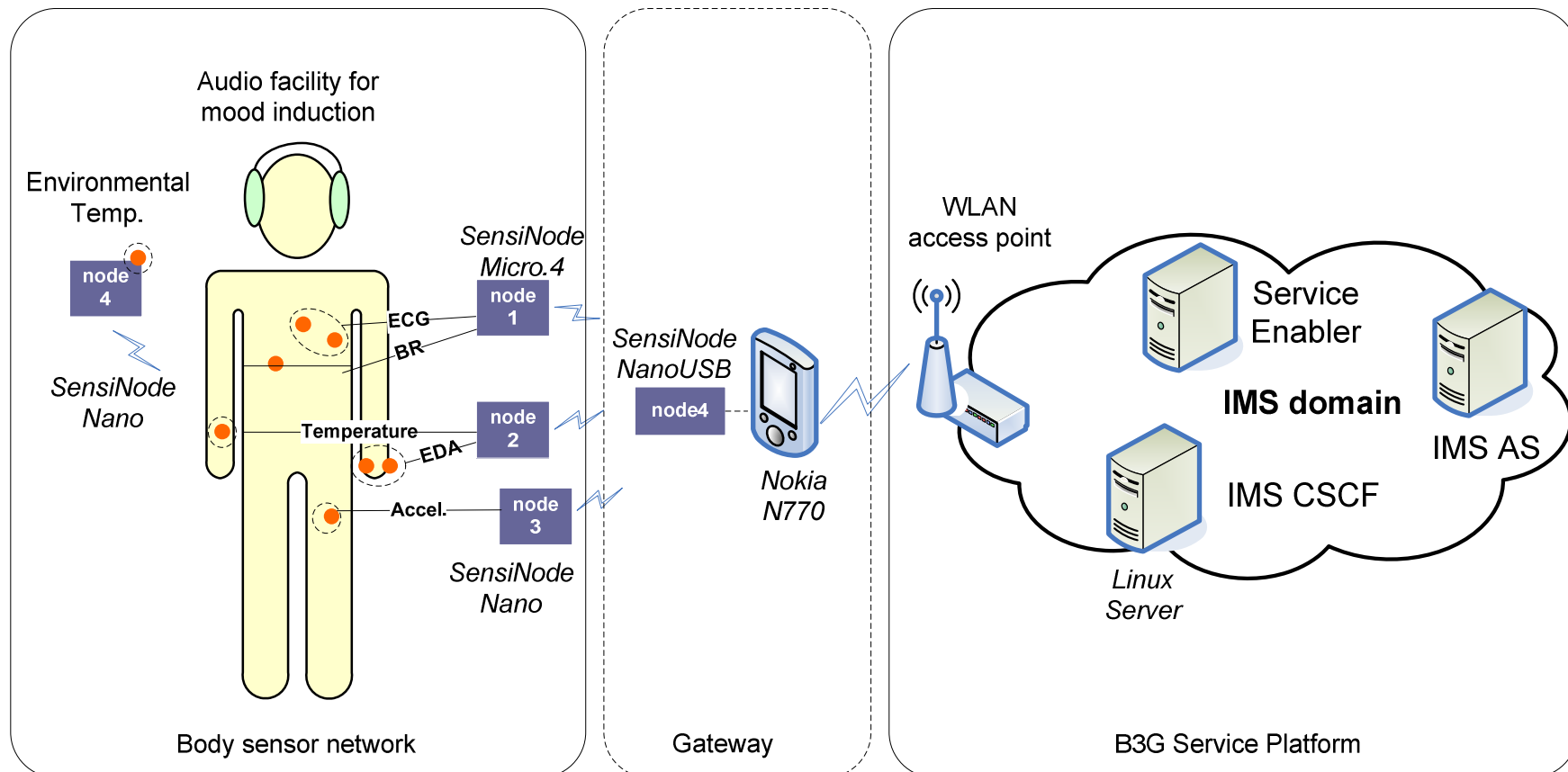

- Connected to the Surrey Wireless Network Testbed
- Large range of experimental setup options
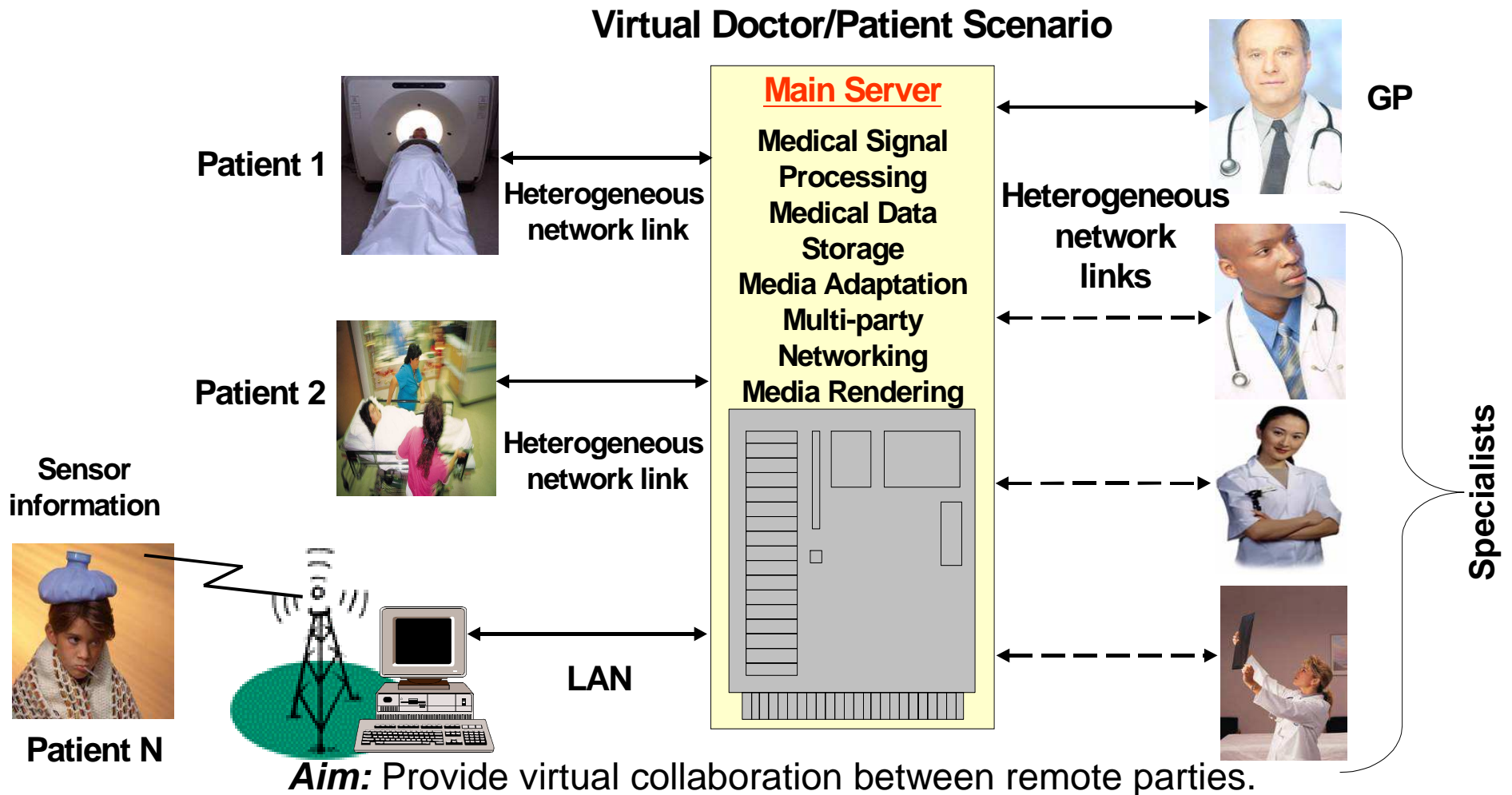
Context gateway and context service enablers
Current test bed example – "mood" demonstrator

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Body sensor network

Audio facility for mood induction

Environmental Temp.

node 4

SensiNode Nano

SensiNode Micro.4

node 1

ECG
BR

Temperature

node 2

EDA

Accel.

node 3

SensiNode Nano

Gateway

SensiNode NanoUSB

node4

Nokia N770

B3G Service Platform

WLAN access point

Service Enabler

IMS domain

IMS CSCF

IMS AS

Linux Server

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E-Health: Guardian Angel

Virtual Doctor/Patient Scenario

Patient 1

Patient 2

Sensor information

Patient N

Heterogeneous network link

Heterogeneous network link

LAN

Main Server

Medical Signal Processing
Medical Data Storage
Media Adaptation
Multi-party Networking
Media Rendering

GP

Heterogeneous network links

Specialists

Aim: Provide virtual collaboration between remote parties.

Applications: e-Teaching/Training, e-Commerce/Business, e-Health, virtual meeting room, collaborative working, etc.

I-Lab Facilities

- **VisLab**:
    - Active stereo, rear projected display (7.5x2.5m)
    - 340 speaker WFS 3D audio
    - Motion capture/tracking
    - State-of-the-art Sun Microsystems Visual Grid Graphics System
- **Multimedia & Wireless Lab**: Generating new forms of multimedia and interface to fixed and wireless networks
- **Campus wide 500Mb/s broadband access network (BluWAN)** Web browsing, Voice and video over IP, HDTV etc. applications (being installed)
- **Virtual Collaboration Desk**

I-Lab Audio-Visual Studio

An acoustically insulated, flexible experiment space for developing and testing algorithms:

✓ Microphone array signal processing (source localisation and separation)
✓ Subjective listening tests with multichannel reproduction systems such as binaural, stereo, 5.1 (up to 24 channels).
✓ Human-computer interaction.
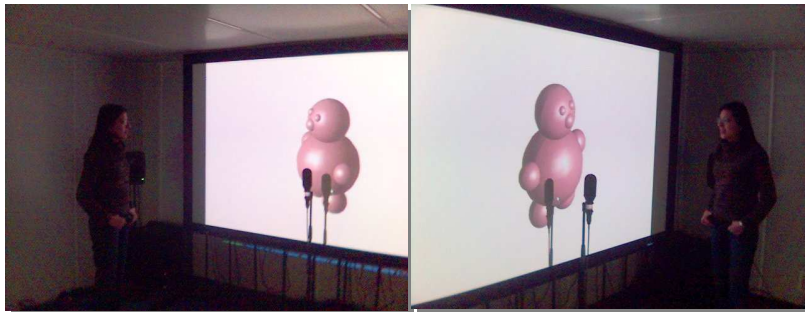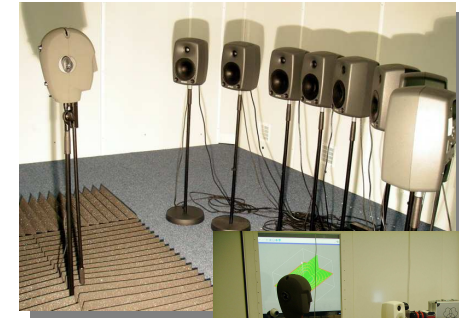
Visual system:
▪ Low-noise HD projector
▪ Acoustically transparent projection screen
▪ Digiclops range cameras
▪ HD and standard SONY camcorders
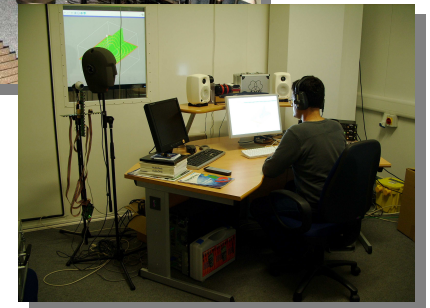
Loudspeakers:
▪ 24 x Genelec bi-amplified speakers
▪ 2 x Genelec subwoofers

Microphones/Microphone arrays:
▪ 64-channel Mark III NIST microphone array
▪ Neumann KU 100 dummy head
▪ Soundfield SPS422B microphone system
▪ DPA omnidirectional standard microphone
▪ AKG vocal microphone
▪ 8 x DPA miniature microphones

Interfaces:
▪ Apple Quad-core Mac Pro workstation,
▪ Phantom Power supplies
▪ 3 X MOTU multichannel sound cards

Topic for collaboration research

Topic for collaboration research (1/4)

❖ **Radio Environment**
- ❑ Satellite MIMO
- ❑ Handheld QFH antennas
- ❑ UWB indoor modelling
- ❑ Body area characterisation

❖ **Satellite Communications**
- ❑ OFDM over satellite / WiMax / LTE Channel estimation/synchronisation
- ❑ Spectrum sharing between satellite and terrestrial
- ❑ Interference cancellation
- ❑ RRM and handover in DVB-RCS (+m)
- ❑ End-to-end security in satellite-sensor networks
- ❑ IPv6 QoS

❖ **Spectrum and cognitive radio**
- ❑ Cognitive network approaches – RRM, architectures, sharing and scheduling
- ❑ Cognitive radio – spectrum sensing, context, learning behaviour

❖ **Next Generation Networking**

- ❏ Next Generation network architectures
- ❏ Ad-hoc/mesh networking
- ❏ Network virtualisation
- ❏ Cross-layer optimisation
- ❏ Design for energy minimisation (Green Networks)
- ❏ Self organising flexible networks

❖ **Advanced Air Interference/Receivers**

- ❏ OFDM/OFDMA – LTE WiMax
- ❏ Adaptive modulation and coding
- ❏ MIMO – synchronisation/estimation
- ❏ Beamforming
- ❏ Fundamental limits
- ❏ Cooperative communications
- ❏ Green Radios
- ❏ Advanced RRM for new radio architectures

❖ Service Platforms and applications

- ❑ IMS Platform and WTB Demonstrator
- ❑ Service and device discovery
- ❑ Context description and reasoning
- ❑ Integration of WSN into service platforms

❖ Internet of things (IoT)

- ❑ IoT impact evaluation on next generation mobile networks
- ❑ Supporting mobility and other system dynamics in the IoT
- ❑ Semantic integration of sensor information
- ❑ Service oriented IoT
- ❑ Discovery and resolution services for IoT
- ❑ Energy efficient communication for wireless sensor networks
- ❑ Internet of Things and Future Internet Architecture Convergence
- ❑ Experimental facilities

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❖ Content/Users

- ❑ 3D Video/audio processing
- ❑ User quality of experience
- ❑ Immersive environment/virtual reality
- ❑ Multimodal interfaces
- ❑ Scalable video delivery
- ❑ Audio processing for security
- ❑ Secure speech in mobile systems

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Thank you!!

Any questions?