

UK-China Science Bridges: R&D on 4G Wireless Mobile Communications (UC4G)

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Outline

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I. Background of Science Bridges Projects

- The Research Councils UK wish to enhance linkages with **China, USA, and India** to
 - Accelerate the deployment of research knowledge
 - Deepen and strengthen current research links
 - Enable the acquisition of new skills and **encourage wealth creation through improving the transfer of research and expertise from the research base to businesses and other users** by building science and innovation bridges with world-class universities and high-tech businesses.
- **Science Bridge funding is not available to support additional fundamental research although research necessary to develop knowledge from research into products or services can be included e.g. exploring routes to scale-up.**
- Each country: up to a total value of £4 million over three years.
- Four UK-China, three UK-India and three UK-US collaborations were awarded funding in 2008.

Science Bridges Awards in 2008

<http://www.rcuk.ac.uk/news/090130.htm>

■ **UK-China:**

- UK-China Science Bridge in Sustainable Energy and Built Environment
- **UK-China Science Bridges: R&D on 4G Wireless Mobile Communications (UC4G)**
- Water availability and quality: natural environments, domestic use and food production
- Science Bridges: Bradford-China Programme for Pharmaceutical Sciences and Medical Technology

■ **UK-US:**

- Harnessing Materials for Energy
- Stanford-Scotland Photonics Innovation Collaboration
- Innovative Technology for healthcare delivery

■ **UK-India:**

- Bioenergy: Technology and Business Solutions for the UK
- Sustainable Indo-UK Agricultural Initiative
- Biopharm 2020: Entrepreneurial Opportunities for Indian/UK Scientists in the Pharmaceutical and Biotechnology Industries

II. Overview of the UK-China Science Bridges Project on 4G (UC4G)

- **Duration:** 3 years (01/06/2009-31/05/2012)
- **Value:** £1,174,258 (fEC) or £939,623 (RC contribution)
- **Motivation:** Why 4G wireless communications?
 - Digital Economy has been identified as one of the four priority research themes to respond to the challenges facing UK society and the economy.
 - As the key enabler for Digital Economy, ICT plays an indispensable role in modern society.
 - It is extremely important to ensure that the profile and global influence of the UK is sustained in *Wireless Communications*, which is *a*, perhaps *the*, critical element in future global ICT strategy.
 - China is an ambitious and increasingly significant country in the development of wireless technologies, especially in 3G, 4G, and beyond 4G.
 - Huge potential market: the world's largest mobile subscriber population
 - Strong support from the government, industry, and Chinese universities

i. Aims and Objectives

- To become fully connected with top universities and telecom companies in 4G R&D in China.
- To build on the existing substantive collaboration among key UK-China partners and further strengthen and broaden current research links.
- To create, initially, a UK-China panel within Mobile VCE and, ultimately, a **UK-China Joint R&D Centre for Future Wireless Communication Networks**, enabling long-term sustainable collaboration between the UK and China by supporting collaborative research, mutual visits, exchange of researchers, and rapid technology transfer and commercialisation.

ii. Collaboration Consortium

■ China consortium:

Academic Partners (in alphabetic order)	<ol style="list-style-type: none">1) Beijing University of Posts and Telecommunications (BUPT): Prof. Ping Zhang & Prof. Xiaofeng Tao2) Huazhong University of Science and Technology (HUST): Prof. Xiaohu Ge3) Shandong University (SDU): Prof. Dongfeng Yuan4) Shanghai Jiaotong University (SJTU): Prof. Youyun Xu5) Southeast University (SEU): Prof. Xiaohu You6) Tsinghua University (THU): Prof. Zhisheng Niu & Prof. Zhigang Cao7) Xidian University (XDU): Prof. Jiandong Li and Prof. Hailin Zhang
Industrial Partners	<ol style="list-style-type: none">1) Shanghai Research Centre for Wireless Communications (SHRCWC): Prof. Songlin Feng2) Huawei Technologies Co., Ltd.: Mr Jun Shu3) ZTE: Mr Tao Zhang4) China Mobile: Mr Chunfeng Cui5) Jushri Wireless Technologies, Inc.: Prof. Zhiyong Bu6) China Academy of Telecommunication Research (CATR) : Prof. Guili He and Prof. Denian Shi

Collaboration Consortium — Cont.

■ UK consortium:

Academic Partners	<ol style="list-style-type: none">1) Heriot-Watt University (HWU): Dr Cheng-Xiang Wang2) University of Edinburgh (UoE): Prof. Peter Grant & Dr Harald Haas3) University of Bristol: Prof. Joe McGeehan & Mark Beach4) University of Southampton: Prof. Lajos Hanzo5) University of Bedfordshire: Prof. Jie Zhang6) University College London (UCL): Dr Yang Yang
Industrial Partners	<ol style="list-style-type: none">1) Mobile VCE: Dr Walter Tuttlebee2) 15 industrial members of Mobile VCE: Alcatel-Lucent, BBC, BT, Fujitsu, Huawei Technologies, Hutchison 3G, NEC, Nokia Siemens Networks, Nortel, Orange Labs, Samsung, Thales, Toshiba, Turner, Vodafone
Associate Members	<ol style="list-style-type: none">1) King's College London: Prof. Hamid Aghvami2) Univ. of York: Prof. Alister G. Burr3) Univ. of Strathclyde: Dr Ian Glover and Prof. Ivan Andonovic4) University of Surrey: Prof. Zhili Sun & Prof. Rahim Tafazolli

iii. Work Packages and Work Plan

■ Six work packages (WPs):

- **WP1:** A delegation of 20 UK researchers visit Chinese partners, including a workshop.
- **WP2:** Exchange of 30 researchers between UK and Chinese universities
- **WP3:** Joint-organisation of two four-day international workshops
- **WP4:** Prototype development and test of 4G wireless mobile communication technologies
- **WP5:** Direct commercialisation of mature 4G technologies and building trial 4G wireless communication networks by industrial partners
- **WP6:** A delegation of 25 Chinese researchers visit UK partners (a three-day project workshop)

WP1: Visit to China (01/06/2009—31/08/2009, 3 months)

■ Objective:

- To promote knowledge exchange in 4G among Chinese and UK consortium members and further strengthen and broaden current collaboration links.

■ Deliverables (D1):

- a project website for efficient dissemination and sharing of information;
- travel itinerary of the 16-day China trip, schedules and presentation slides of the workshop;
- a summary report addressing collaboration opportunities and areas among UK and Chinese partners, and experience and lessons of Beijing Olympics 2008 in choosing advanced wireless technologies;
- a full collaboration agreement (**required by the EPSRC**) between all UK and Chinese consortium members.

■ Milestone (M1):

- UK and Chinese partners get to know each other and a collaboration agreement is in place.

Detail Travel Itinerary of WP1

- **UK delegation: 20+ people**
- **Visited Chinese universities and companies**
 - **27 July:** WiCO; Jushri; Reception hosted by British Consulate General Shanghai
 - **28 July:** Huawei Shanghai, Shanghai Jiaotong University
 - **29 July:** Southeast University
 - **30 July:** Hua Zhong University of Science & Technology
 - **31 July:** Xidian University
 - **3 Aug.:** Shangdong University
- **4-6 Aug.: Beijing workshop (Tsinghua University)**
- **Chinese universities and companies to be visited**
 - **6 Aug.:** Beijing University of Posts and Telecommunications
 - **7 Aug.:** China Mobile; China Academy of Telecommunications Research

WP2: Staff Exchange (01/09/2009—30/11/2010, 15 months)

■ **Objective:**

- To further intensify the existing R&D links, explore new links, and ensure high-quality, long-term, and sustainable research collaborations between the UK and China.

■ **Deliverables (D2):**

- formation of UK-China collaborating partnerships and short-term visiting fellowship (up to 3 months) opportunities for UK & Chinese researchers;
- 30 reports detailing key 4G technologies to be possibly prototyped, tested, and commercialised;
- joint publications, posters, joint project applications, IPR applications, and 4G standard proposals;
- creation of a UK-China panel within Mobile VCE.

■ **Milestone (M2):**

- Full interaction of UK and Chinese academic consortium members.

WP3: International Workshops

(01/12/2009—31/05/2011, 18 months)

■ **Objective:**

- To disseminate the joint findings, share knowledge among wider community, involve industry leaders with invited talks to shape the R&D focus, and explore new business models.

■ **Deliverables (D3):**

- two workshops and proceedings;
- joint publications and posters in workshops.

■ **Milestone (M3):**

- Raise wider awareness of UK-China collaboration activities and publicise the outcomes.

WP4: Prototype Development

(01/06/2010—28/02/2012, 21 months)

■ **Objective:**

- To develop prototypes and test/verify findings using wireless testbeds and to facilitate proof of concept, technology transfer, and commercialisation.

■ **Deliverables (D4):**

- 4G wireless communication technology prototype;
- IPR applications;
- reports and posters regarding the verification results of developed 4G technologies using the wireless testbeds.

■ **Milestone (M4):**

- Prototype development and verification of 4G wireless technologies.

WP5: Commercialisation and Building 4G Trial Networks (01/12/2010—31/05/2012, 18 months)

■ **Objective:**

- To commercialise mature 4G wireless technologies to real products, build trial 4G networks, and impact positively the UK and Chinese economy.

■ **Deliverables (D5):**

- new 4G wireless technology products;
- trial 4G networks in the UK and China.

WP6: Visit to the UK and Final Project Workshop (01/03/2012—30/05/2012, 3 months)

■ **Objective:**

- To share main findings and collaboration outcomes, and identify new collaboration opportunities and follow-up activities with the wider community in the UK and China.

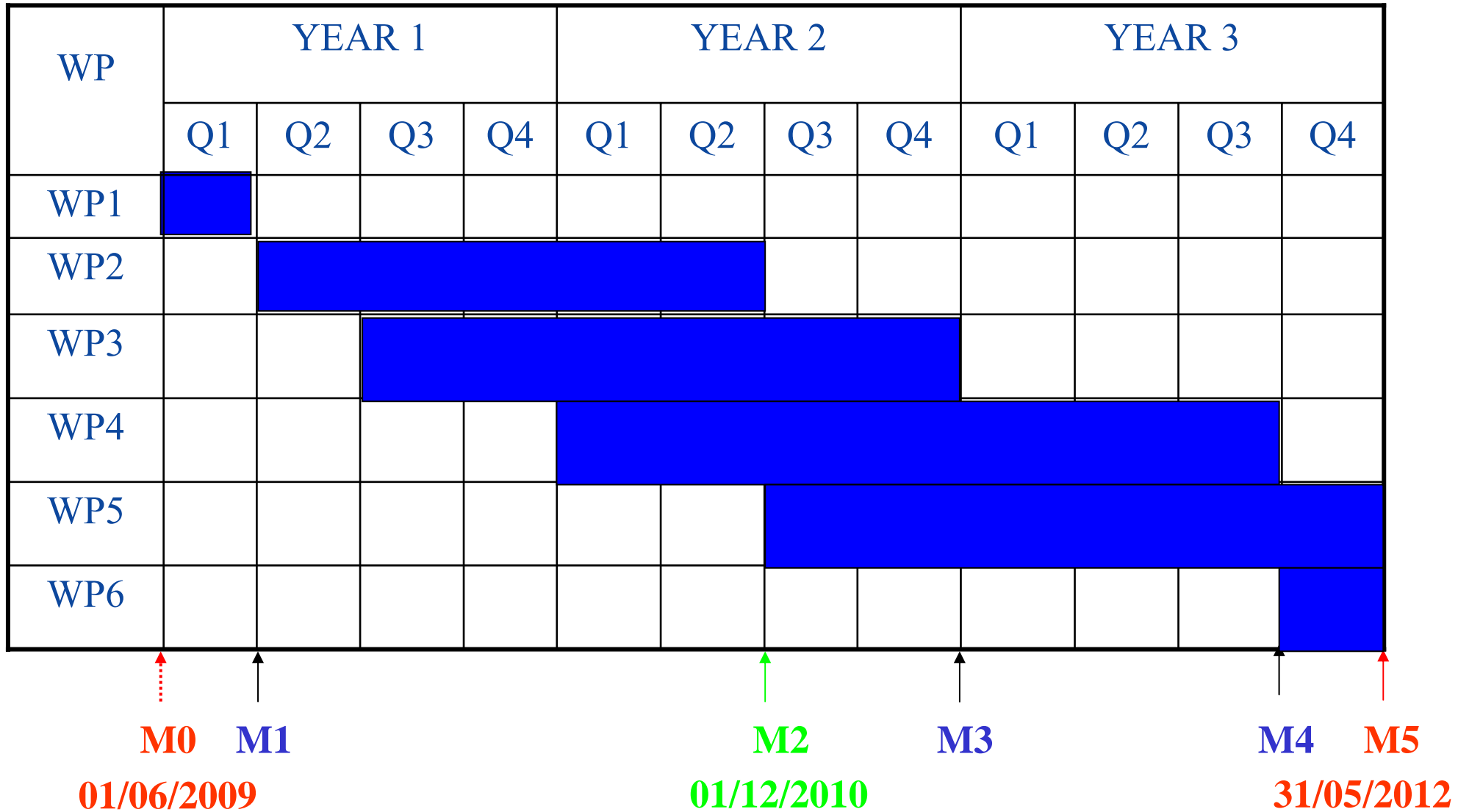
■ **Deliverables (D6):**

- a final project report summarising the collaboration outcomes and identifying follow-up activities;
- establishment of a **UK-China Joint R&D Centre for Future Wireless Communication Networks**.

■ **Milestone (M5):**

- New products of 4G wireless communication technologies and creation of a UK-China R&D Centre in 4G wireless mobile communications.

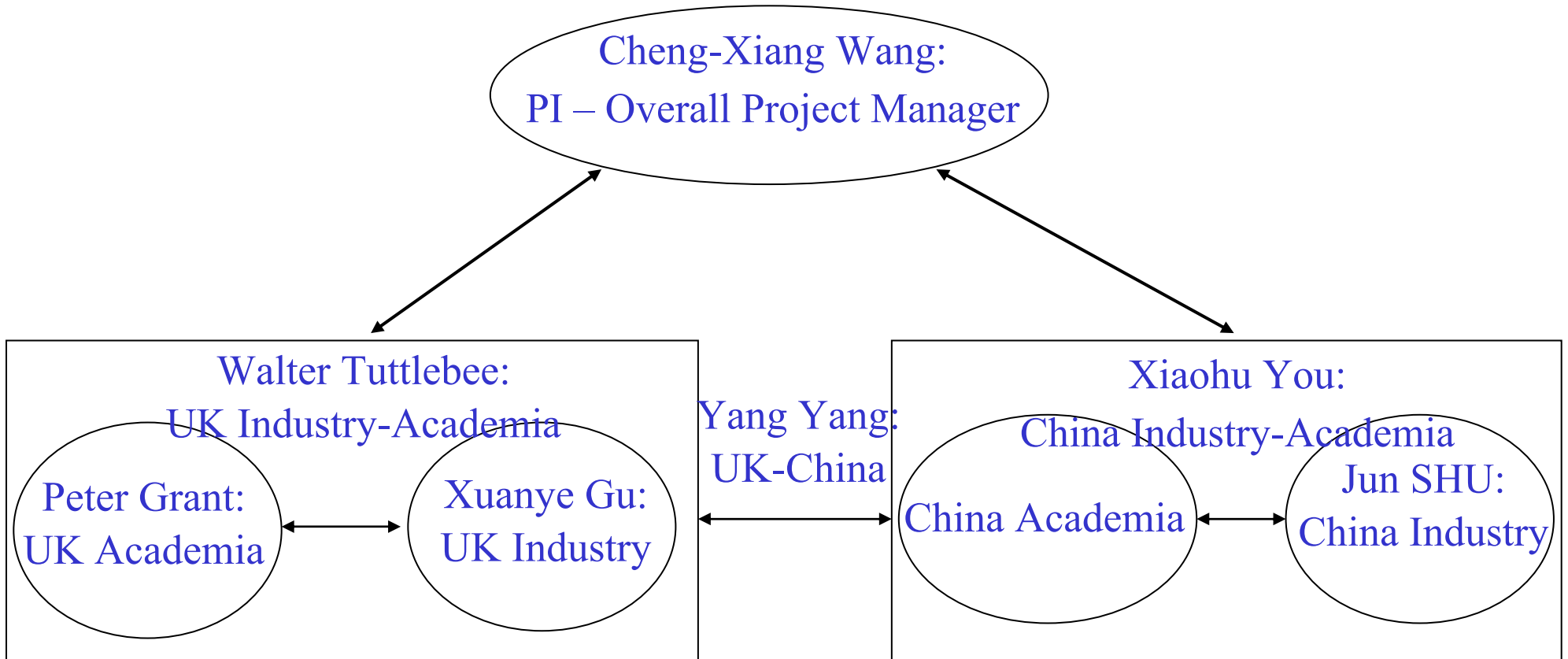
Work Plan



iv. Project Management

- Project Management Committee (7 people):
 - Dr Cheng-Xiang Wang (Heriot-Watt University): PI - overall project manager, with the assistance of the Network Manager (postdoc)
 - Dr Walter Tuttlebee (Mobile VCE): UK industry-academia liaison officer
 - Prof. Peter Grant (University of Edinburgh): UK consortium academic representative
 - Dr Xuanye Gu (BT): UK consortium industrial representative
 - Dr Yang Yang (University College London): UK-China liaison officer
 - Prof. Xiaohu You (Southeast University): China consortium academic representative, China consortium industry-academia liaison officer
 - Mr Jun Shu (Huawei Technologies Co., Ltd.): China consortium industrial representative

Project Management Committee Structure



Project Management Committee

- The 5 UK PMC members will meet 3 times per year to
 - Monitor project progress
 - Evaluate and control risks at each milestone
 - Suggest measures to cope with unexpected deviation
 - Make key decisions
 - Resolve disputes

- Multiparty video/telephone conference calls will be arranged to involve Chinese PMC members.

v. Project Progress

- **5-26 April 2009:** Cheng-Xiang Wang (CXW) visited China at HWU budget.
 - Attended 2 receptions (Shanghai, 07/04; Beijing, 09/04) hosted by The First Minister of Scotland (Mr Alex Salmond) and The Scottish Cabinet Secretary for Education and Lifelong Learning (Ms Fiona Hislop), with Prof. Andy Walker (Vice Principal, HWU);
 - Some Chinese partners (WiCo, Jushri, SJTU, SEU, BUPT, THU, CATR) attended the Scottish Government Receptions and meetings.
 - CXW visited WiCo, SJTU, BUPT, HUST, and SDU.
- **8 May 2009:** project kick-off meeting held at Heriot-Watt Univ.
- **20 May 2009:** Chinese academic partners applied leverage funding from MOST.
- **29 June 2009:** 1st PMC teleconference meeting held to comment on workshop slides
- **6 July 2009:** Network Manager (Postdoctoral RA) Dr Xuemin Hong appointed
- Project temporary website: <http://www.eps.hw.ac.uk/~cw46/UK-ChinaBridge4G.html>
- **25 July-9 Aug. 2009:** Mission to China ongoing (21 UK delegation members)
- Agreement (after several rounds of feedback) to be signed

III. Discussions and Summary

- **Common ground of the 4G R&D activities in the UK and China**
 - Recognise the relative strengths of 4G R&D in the UK and China
 - Desire more research collaboration
- **Strength of the UK**
 - World-class research conducted by small groups with strong expertise
 - Integrated R&D network and management experience (e.g., Mobile-VCE)
 - Strong global influence (e.g., IET) and innovative ideas (e.g., green radio)
- **Strength of China**
 - Strong government supports to both the academia and industry
 - Well structured large research team with close collaboration and comprehensive coverage of 4G topics
 - Huge intellectual bank for rapid and cost-effective R&D
 - Strong drive for testbed and prototype development

Identified Benefits to Project Partners

- **UK academia**
 - Access to a huge intellectual bank to empower quality research
 - Access to the state-of-the-art hardware resources for rapid proof-of-concepts
- **China academia**
 - Access to world-class 4G expertise to drive research excellence
 - Raise global awareness and international influence
- **UK industry**
 - Cost-effective strategic research
 - Gateway to the huge consumer market in China
- **China industry**
 - Cost-effective strategic research
 - Gateway to the western market

Overview of WP2 Collaboration Initiatives

UK	CN		HWU	BT	<u>UoE</u>	Bristol	<u>St.C.</u>	Surrey	UCL	York	KCL	Swansea
2	0	Charnel	0		0							
6	4	CR	0	0	0	0X	X		0X		X	0
6	2	MIMO	0		0X	0	X		0	0	0	
6	5	<u>CoMP</u>	0X	0	0X	0		X	0X	0	X	
4	1	RRM	0		0X				0		0	
3	2	<u>CroLay</u>	0		X		0X		0			
2	0	<u>Multicell</u>					0				0	
2	1	SON			0		0				X	
1	1	Traffic			X			0				
2	0	Backhaul					0		0			
2	0	Routing						0				0
1	0	Security						0				
0	3	<u>SpeNet</u>	X			X				X		
1	1	BAN				0			X			
1	0	<u>VehNet</u>	0									
2	0	WSN					0					0
1	1	Green		X							0	
1	3	<u>Testbed</u>	0	X			X			X		
			<u>BUPT</u>	<u>CART</u>	<u>HUST</u>	<u>Jushu</u>	<u>SDU</u>	<u>SEU</u>	<u>SHJT</u>	<u>WiCO</u>	<u>XDU</u>	

Observations on WP2 Initiatives

- **High common interest in PHY access technologies**
 - Cognitive radio
 - MIMO
 - CoMP (coordinated multi-point) or cooperative communications
- **UK complement Chinese research interests on**
 - Channel modelling
 - MAC and above
- **China complement UK research interests on**
 - Testbed and prototyping
 - Special networks (e.g., high speed train coverage and emergency networks)
- **Some resonance on visionary concepts such as “green radio”**

Detail Program of WP2

- CFP guideline defining the application procedure and evaluation criteria
- A two-page technical proposal plus CV or relevant publication list are sufficient. The PMC will design a simple form to help this.
- **General procedure**
 - Partners submit maximum 4 brief research proposals on different sub-topics.
 - PMC collects all proposals and selects the best
- **Flexibility**
 - Time arrangement: e.g., 3 months can be divided to 2+1 months
 - Seek local match funding to further support exchange of researchers

Scottish Government Reception in Shanghai



Left to right:

Dr. Cheng-Xiang Wang, Professor Andy Walker,
First Minister Alex Salmond and Zhongyi Wang



Left to right:

Dr. Cheng-Xiang Wang, Professor Andy Walker,
Education Secretary Fiona Hyslop

WP1 Snapshots

WiCO, 27 July



Jushri, 27 July



WP1 Snapshots

Reception hosted by British General-
Consulate Shanghai, 27 July



Huawei, 28 July



WP1 Snapshots

Shanghai Jiao Tong University, 28 July

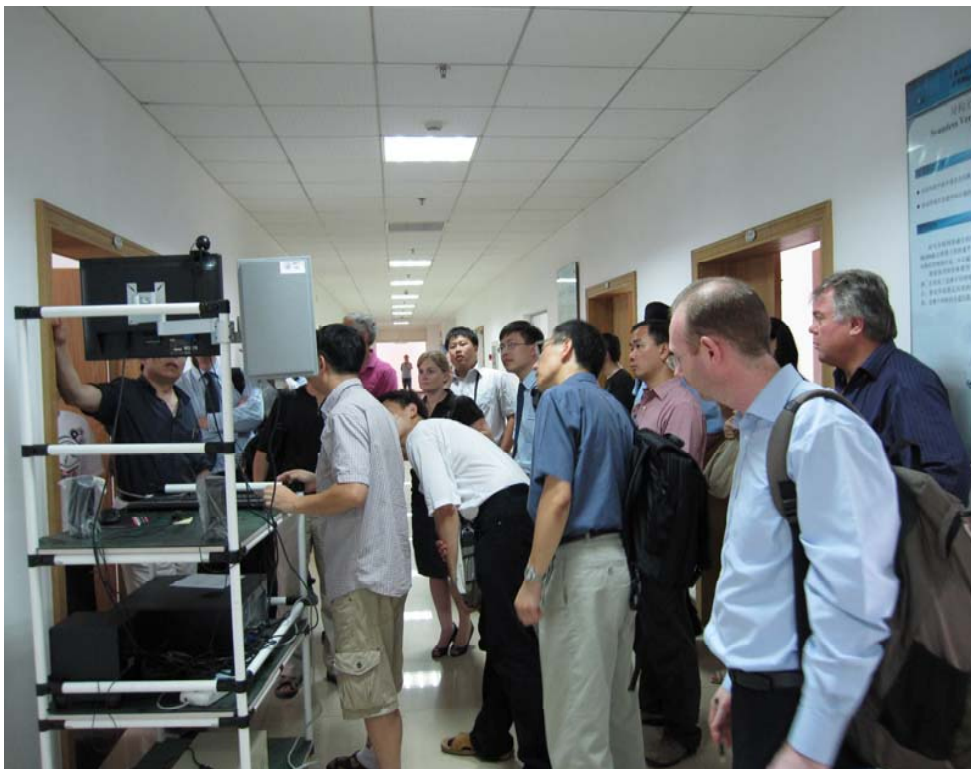


Southeast University, 29 July



WP1 Snapshots

HUST, 30 July



Xidian University, 31 July



WP1 Snapshots

Shandong Univ., 3 Aug.



Summary

- Partners are keen to collaborate.
- Common interests
- Differences
- Imbalanced support from UK/China governments
- Challenges ahead
- How to ensure long-term sustainable collaboration via further funding from governments, EU, and industry is a real challenge.