



## Discussion Notes in 2011 UC4G London Workshop

Xuemin Hong, Cheng-Xiang Wang, and Peter Grant

**Date/time:** 11:00am-4:15pm, Wednesday 19<sup>th</sup> January 2011

**Venue:** University College London, London

**Attendees:** Dr Cheng-Xiang Wang (Heriot-Watt), Dr Xuemin Hong (Heriot-Watt), Dr Xiaoli Chu (KCL), Prof. Peter Grant (Edinburgh), Prof. Harald Haas (Edinburgh), Dr Kit Wong (UCL), Dr Kenneth Tong (UCL), Mr Yu Chen (UCL), Prof. Mark Beach (Bristol), Prof. Joe McGeehan (Bristol), Dr Tim Brown (Surrey), Mr Amar Sood (HMGCC), Mr Simon Fletcher (NEC), Sunil Vadgama (Fujitsu), and Dr Kun Yang (University of Essex)

**Discussion coordinator:** Peter Grant

### I. Testbed Development Issues

#### 1. Testbed objectives

The objective is to establish an open-access wireless testbed in the UK to demonstrate **UK's (or Europe's) beyond 4G (B4G)** technologies and concepts. This UK-based UC4G testbed can hopefully be linked with the testbeds of other UK/Chinese project partners, e.g., SWAN testbed in Shanghai Research Centre for Wireless Communications (WiCO), at a latter stage to form an integrated UC4G testbed.

#### 2. What should we demo?

**1) Demonstrate to whom?** We shall demonstrate B4G wireless technologies using the UC4G testbed to the academia and industry in the UK and China (particularly the UC4G collaboration consortium), DCKTN, UK/Chinese Embassies, and various funding bodies, such as Research councils UK (RCUK), EPSRC, Technology Strategy Board (TSB), National Science Foundation of China (NSFC), and Ministry of Science and Technology (MOST) of China. Hopefully, such demonstration will attract interests from the industry to engage with commercialisation and show value to the UK and Chinese governments to continuously fund the UK-China Bridge in wireless communications.

**2) What to demonstrate?** Two B4G wireless technology proposals on testbed demonstration have been received so far, one from the University of Edinburgh (UoE) and the other from WiCO.

UoE's proposal on Spatial Modulation (SM) is considered as mature and well-positioned. It is estimated that additional 24 man/months will be needed to get to the stage of real-world demonstration.

WiCO's proposal on Link Evaluation (LE) received some interests due to its relevance to standardisation. However, because the proposed technology is has already been used in the WiMAX standard, further clarifications need to be sought regarding whether the industry has already been trying to promote the technology to LTE/LTE-A. In addition, as WiCO is going to test this technology using its own testbed, the value of seemingly repetitive demonstration of the proposed technology in the UK-based UC4G testbed was questioned.

**It was agreed that the UK-based UC4G testbed will first demonstrate the UoE's proposal on SM.** Therefore, being able to support the SM demonstration should be used as a guideline when purchasing and setting up the UK-based UC4G testbed. After the testbed has been set up, another round of WP4 call for



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proposal will be distributed to all the project partners to seek other promising B4G wireless technologies to be verified/demonstrated in the UK-based UC4G testbed.

### 3) Testbed architecture:

- a) Number of antennas for MIMO: 4\*2
- b) Supporting OFDM with 20 MHz bandwidth
- c) Both TDD & FDD signals should be supported.
- d) Duplex vs. broadcasting: Only broadcasting nature is necessary, while no feedback channel (duplex) is required to be supported.
- e) Real-time vs. off-line processing: Off-line processing will be supported.

### 3. Testbed purchase

Two testbed solutions, one from National Instrument (NI) and the other from Lyrtech, were compared and discussed. Although these two solutions have different technical features, they are both found to meet the basic requirements for demonstrating SM. The technical advantages of the NI's solution in RF frequency range and data storage are considered useful for the SM demonstration, while the technical advantages of Lyrtech's solution in receive RF channels, baseband processing power, and duplexing are found to be less relevant.

**Risk management** is considered to be of great importance in testbed purchasing. The Lyrtech solution, without particular technical support, is considered to be very risky. On the other hand, the strong technical support from NI makes its solution much in favour. In addition, as WiCO is also developing a similar NI-based testbed in China, it is felt that a NI-based UC4G testbed will allow both sides to collaborate closely and reduce testbed development efforts. **An agreement was reached that the UK-based UC4G testbed will be based on the NI solution.**

To ensure that there is no hidden cost involved in the NI solution (e.g., interface, software, peripherals) and that the NI testbed is truly a plug-and-play system as promised, **a demonstration of the NI solution will be arranged at the University of Bristol shortly after the workshop.** People from the University of Bristol (Prof. Joe Mcgeehan and Prof. Mark Beach) and University of Surrey (Dr Tim Brown) will double-check the NI solution with their extensive experiences in hardware and testbed. Prof. Harald Hass from Edinburgh will attend the demonstration in person to make sure that the NI solution is sufficient to demonstrate the SM proposal. Dr Cheng-Xiang Wang and Dr Xuemin Hong from Heriot-Watt University will also attend the demonstration at Bristol. The final decision of purchasing the testbed equipments from NI will be made shortly after the demonstration at Bristol.

### 4. Legacy and impact of the testbed

The to-be-built UK-based UC4G testbed has its value by adding to UK's existing testbed capability, particularly in terms of allowing open access to the testbed from (a wide range of) UK/Chinese universities and companies. Such openness of the testbed can potentially generate a big impact on the UK wireless community. It is desirable to operate the testbed continuously beyond the UC4G project. The funding model to cover the maintenance cost of the testbed will be explored at a latter stage after the testbed is set up.

In terms of how the testbed demonstration can have impact on standardisation, industrial attendees shared a



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conservative view that it is very difficult to influence major standards such as 3GPP. The next 3GPP standard is Release 11, which may not have open calls for new physical layer proposals. Besides, there is no sufficient time to put up a concrete proposal for Release 11 based on results produced in the testbed. 3GPP Release 12 is still some time away, likely beyond the UC4G project period.

### 5. Channel emulators

The University of Surrey has 3 sets of TAS 4500 RF Channel Emulators purchased from Spirent Communications. Each emulator can support 2 independent dual channels of up to 3GHz. Altogether they can emulate 3x2 or 4x1 uncorrelated MIMO channels. These emulators are small-size and portable and can therefore be borrowed to Heriot-Watt University for pre-trial tests.

The University of Bristol has a powerful C8 channel emulator, which is heavily used locally and not easily portable. Instead of shipping the C8 channel emulator from Bristol to Heriot-Watt University, it may be easier to ship the UC4G testbed from Edinburgh to Bristol for testing. If the transportation of the UC4G testbed to Bristol is difficult, we may remotely access to the C8 channel emulator at WiCO for testing.

### 6. New time plan for testbed development

A brief plan was made to build the world's first SM demonstrator in four steps:

- a) simulate the performance of SM with a wide range of measured channels from Bristol;
- b) implement SM on the UC4G testbed;
- c) demonstrate the performance of SM with Bristol's C8 channel emulator;
- d) demonstrate the performance of SM in real-world scenarios (optional).

Time/Deadline	Activities
Feb 2011	<ul style="list-style-type: none"><li>• Demonstrate the NI solution at Bristol</li><li>• Make final decision and place purchasing order of the testbed</li></ul>
Apr 2011	<ul style="list-style-type: none"><li>• Set up tested hardware at Heriot-Watt University</li></ul>
July 2011	<ul style="list-style-type: none"><li>• Demonstrate a basic wireless system (e.g., 802.11x, LTE) on the testbed</li><li>• Distribute a new round of WP4 Call for Proposals for B4G wireless technologies</li><li>• Finish the performance test of SM with measured channels from Bristol</li></ul>
Dec 2011	<ul style="list-style-type: none"><li>• Implement SM in the UC4G testbed and test its performance using the borrowed channel emulator from Surrey and/or C8 channel emulator from Bristol or WiCO</li></ul>
Jan 2012	<ul style="list-style-type: none"><li>• Showcase the SM demo in a project workshop</li></ul>
June 2012	<ul style="list-style-type: none"><li>• Implement another B4G technology in the UC4G testbed</li></ul>

### 7. Budget update

As the budget for building the testbed is quite limited, it is suggested that unused budgets from other WPs should be carefully calculated and used to support the testbed initiative. Several academic attendees confirmed that the EPSRC generally allows the flexibility to adjust the budgets to a certain degree (e.g., 10%). Prof. Peter Grant suggested Dr Cheng-Xiang Wang to work out a new budget based on three categories: 1) How much budget has spent, 2) future plan of spending, and 3) how much extra budget that can be relocated to support WP4 (i.e., testbed). It is estimated that there may be some unused budget from WP1 and some surplus budgets



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from WP3 (workshops) and IPR applications. The new budget plan will be discussed in the next PMC meeting, after which a formal request will be submitted to the EPSRC for the permission of adjusting the budget.

There are some sources to apply for extra funding to further support the testbed development. Dr Cheng-Xiang Wang and Dr Xuemin Hong will find out more information about this.

### 8. Ofcom nonoperational license

Nonoperational spectrum license should be obtained from Ofcom before the testbed can make legal transmissions over the air. Desirable operating frequencies of the testbed are one at lower frequency (e.g., around 850 MHz) and one at higher frequency (e.g., around 2.4 GHz). Dr Tim Brown from Surrey commented that license applications need to be made 3 months in advance and it should be easy to get a license for the 2.4GHz band. Based on his previous experience, Ofcom is willing to discuss license issues related to academic researches.

## II. Other Issues

### 1. WP3 workshop

A 2-day WP3 workshop will be held around January 2012, preferably in London. Day 1 will showcase testbed demonstration and focus on industry-relevant activities. Day 2 will focus on topics of academic interests. Industrial partners can attend Day 1 only, if they do not have time. People from the RCUK, EPSRC, and UK/Chinese governments will be invited to attend this workshop.

### 2. Website

The project website will be re-designed shortly for better publicity. The aim for this redesign is to make the UC4G activities and achievements more visible to the public. Existing outcomes such as WP1 report, WP2 visiting fellowship awards, WP3 workshop presentation slides, and joint publications etc. will be publicised on the new project website. To make sure that there will be no violation to the Confidentiality Agreement, Dr Xuemin Hong will send emails to all the UC4G partners asking for any objections. Publishing the contents will be made as a default option.

### 3. EPSRC funding: balance funding between the UK and China

The MOST in China has funded 2 projects, worth of more than £1M, to several UC4G partners.. It is possible that some Chinese partners may get other funding from the MOST to further support the collaboration with the UK, under the framework of the UC4G project.

Simon Fletcher from NEC suggested that we shall continue to seek for the EPSRC funding to support the UK-China Science Bridges in Wireless Communications area, to match the funding support from China. The idea will be further discussed in a future PMC meeting.

### 4. New members of the UC4G collaboration consortium

Many universities and institutes/companies in the UK and China have indicated their strong wishes to join the UC4G consortium and/or the to-be-established UK-China Joint R&D Centre for Future Wireless Communication Networks. **It was agreed that the consortium and/or the centre can be opened to accept new members.** Those universities/companies which wish to join the consortium/centre should submit a 2-page proposal highlighting what they can contribute to the consortium/centre. These proposals will be reviewed by the PMC in future meetings.