



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



Notes of UC4G Project Progress Workshop 2010

Mike Fitch, Cheng-Xiang Wang, Peter Grant, Xuemin Hong

Date/time: 10:00-17:00, Thursday 8 July 2010

Venue: Roberts G08 Sir David Davies LT, University College London (UCL), London, WC1E 7JE.

Presentations

Dr Cheng-Xiang Wang gave two presentations, one on overview of project progress and the other on FUTURE / FUTURE+. In September, the sponsor (EPSRC) is expecting a 4 page report (with 2-page appendix) and a 3 minute video giving highlights of progress. Two workshops are planned for WP3: 23 – 24 August in Beijing and 13 – 14 September in Shanghai. They are two distinct elements of the same workshop, with the second dedicated to Green Communication issues. Dr Wang and Dr Xuemin Hong visited the University of Surrey in June 2010 to gather information on their testbed.

Dr Yang Yang gave an overview of the WiCo testbed, whose business model is to produce and sell patents to fund further research (i.e., non-profit). It is capable of link and system level tests. It is able to run several parallel links to investigate the bottleneck effects of control channels. It is connected to the Shanghai supercomputer centre with its 25k cores. This testbed will be made available to WP4 and this was discussed further under the agenda item on WP4 during the afternoon. WiCo is closely related to Southeast University, which is one of the key universities for Mobile Communications and sensing technologies.

After the morning coffee break, **Dr Wei Chen** gave a presentation on a different topic than on the agenda, on cognitive radio, and the contributions of Tsinghua University to the national projects in cognitive radio. Dr Chen further gave a description of his work on 3-D spectrum holes and optimising scheduling, modulation depth, coding and radio environment mapping to aid sensing. SDR hardware from Lyrtech has been used for a cognitive radio testbed.

Dr Xiaohu Ge gave his presentation on energy efficient technologies (secondment research topic at Heriot-Watt University) and the work of HUST. Analytical model using Poisson distributed base-stations was presented and some preliminary results were shown.

Dr Hongjun Tang gave a presentation on 3D polarised antennas (secondment research topic at University College London) with pictures of radiation patterns from prototypes. He has achieved high bandwidths (100MHz at 2.6GHz) and has evaluated the trade-off between size of antenna, bandwidth and gain. Dr Tang also introduced the contributions of Southeast University to some national projects in China.

After lunch, **Prof Alister Burr** gave a talk on the work on dimensioning of small cells that leads to the notion that about 10X more base-stations will be needed for LTE than are currently available and this is before building penetration loss is accounted for. This increase in number of base-stations and hence backhaul links leads to the need for network coding. It is partly based on work carried out on the EC project Bungee.



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Dr Xuemin Hong then gave an overview of existing testbeds and proposed some characteristics that the WP4 testbed should have. This highlighted two aspects that are not covered by existing testbeds but that are of interest to the project, which are Carrier Aggregation and Green issues. It also pointed out the limited budget of £100k. It led very well into the discussion on WP4 that followed.

We then had three industry presentations. **Simon Fletcher** talked about the typical time delays and processes involved in taking products from standards and getting them to market, followed by a vision of what next generation terminals would be like. Comments from the audience were that batteries have not moved on for several years – and software for terminals is not consistent or well understood. **Chris Nokes** gave a talk on DVB-2 in its different variants for satellite, cable and terrestrial broadcast. Expanding on DVB-T2 he gave detail on its performance and limitations. He had questions about HD / SD mix in one channel. [Mike Fitch also wonders whether television sets could use LTE, e.g., for encryption key management and for an interactive channel?]. Finally, **Rob MacPherson** and **Shamaz Majid** gave a pitch on Huawei's LTE activities around the world and some detail on the Telefonica trial, with a video clip showing downloads and interactive applications.

Discussions

After a coffee break, Dr Mike Fitch and Dr Cheng-Xiang Wang co-chaired a discussion focusing on WP4 testbeds. The following topics were discussed:

1. Resource and the architecture of testbeds

WP4 has only a £100k budget to build the testbed. In terms of man-power, the testbed activity in the UK is supported by some of the UC4G network manager's (Dr Xuemin Hong) time, some project students (HWU has 4 MSc projects at the moment), and perhaps some WP2 exchange researchers in the future. Both the budget and man power are extremely limited. Therefore construction of a comprehensive new UK testbed is not a feasible option.

The consensus was to try to build a simple, yet useful (possibly at link-level) testbed at HWU and use it as a gateway to gain remote access to the existing testbeds of Chinese/UK partners. The testbed will provide a web-based interface to all the partners for them to remotely control the integrated testbeds and perform testing. Specifically, Dr Yang Yang confirmed that the Shanghai SWAN testbed already support remote access capability (www.swan.sh) and can be opened to the UC4G partners to run specific experiments on this resource, including a C8 channel emulator. However, licensing issues were raised as potential problems as Elektrobit may prohibit C8 to be used in such a shared fashion.

The cost of developing a remote control interface in the UK was discussed and the consensus was that it is expected to be relatively low.

2. Testing demands and features of the testbed

The to-be-built testbed should be an enabler to allow close-to-real-world testing of emerging technologies. It



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is clear that not all emerging technologies can be tested. In principle, the new testbed should not duplicate what has been evaluated already on commercial 4G testbeds. However, since most commercial testbeds are not open, there are still significant advantages and values to perform testing of some key technologies in an open testbed. Some suggested technical areas which can be tested include:

- User experience
- Terminal software
- Scheduling and QoS
- Cooperative communications (relay, CoMP, network coding, backhaul and coding, etc)
- Green radio
- Carrier aggregation
- Self optimising networks

3. Joint planning of WP4 with WP2 and WP3

We need to show a reasonable demonstrator to the sponsor within 2 years. To be able to do this we may have to set up the testbed within 1.5 years, allowing 0.5 years to obtain results from the testbed and demonstrate its values.

We need to think more about how the current research activities (WP2) will use the testbed and then map the requirements onto the different test-beds. The testbed requirements will be reviewed in the WP3 Beijing/Shanghai workshops in August/Sept., but it was thought that this is too soon to reach a final set of requirements. We should organise a WP4 workshop around December 2010, dedicated to refining the testbed requirements and how they can be met within the time and budget requirements.

There was discussion on whether we should explore testing the new algorithms developed by the WP2 exchanges but these are rather diverse and not fully coordinated technically. Some potential areas became apparent after some discussion

- Channel modelling (with practical channels, synchronisation errors, antenna correlations etc)
- Some aspects of network coding (TBC)

There were discussions in the last PMC meeting on 5 July 2010 that the remaining WP2 Visiting Fellowships after 3 rounds of applications/awards may be diverted to the testbed development.

4. EPSRC mid-term evaluation

Finally, the EPSRC mid-term evaluation, the deadline of which is 23 Sept. 2010, was briefly discussed. We have the WP1 report, Video-recorded Tsinghua Workshop (Aug. 2009), and video-recorded UCL workshop as the working material. Also, we will video-record the Beijing workshop (23-24 Aug. 2010) and Shanghai Workshop (12-13 Sept. 2010). Kenneth suggested that we may ask professional people (e.g., students in Arts) to make the video more impressive.