Mobile WiMAX Assessment in Sub-urban Area to Support TV Broadcasting

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***Abstract*—The IEEE 802.16-2005 (Mobile WiMAX) is a specification of a broadband wireless network intended to support multiple services namely video based services. This paper evaluates the network capacity in order to support TV broadcasting. As of today, despite the standard, in a SISO configuration, specifies bit rates as high as 20 Mbps, our tests showed that the multicast capacity obtained in the urban area was around 6.5 Mbps. Besides, the tested system supports handover. The results also show that WiMAX is able to support mobile services at least up to 140 km/h.**

I. INTRODUCTION

This research work has been carried out under SUIT [1,2] which intends to broadcast and stream scalable and multiple descriptive visual contents in an optimal way through DVB-T/H along with IEEE802.16e (Mobile WiMAX) [3] networks to homes and to extended home environments. SUIT considered an end-to-end chain composed of a playout, last mile networks, and terminals of different computational and display capacities. The testbed allows us to test different types of technologies. We have tested SVC [4] over DVB-T at high speed up to140km/h [5]. More recently, we started testing mobile WiMAX in the context of broadcasting/multicasting over moving vehicles. SUIT assessed the QoS of mobile WiMAX in an urban area and thus providing recommendations for future services for the business and consumer markets.

II. TEST BED

SUIT field trials took place in Aveiro-Portugal and the coverage areas by two sites, SS-Social Security building and IT- Institute of Telecommunications building, are shown in Fig. 1. SS is the tallest building in the city, 50 m high. SS site was used to assess WIMAX 16e in urban area whereas IT site was used to assess WiMAX 16e under high speed mobility. The overlap region allowed us to test handover.

Our system used for field trials is composed by a transmitter, an antenna and one receiver with GPS. An 1 W transmitter has been mounted in a shelter and place on the top of a building in each site. A 2.5GHz TDD power amplifier (1W linear, 36dB gain) was designed and included in the transmitter. The transmitter is shown in Figure 2. A 17 dB antenna (the one on the top of the mast in Fig. 2) with vertical polarization was connected to the power amplifier.

This research work was financially supported by the European Commission (IST-4- 028042). We acknowledge this support as well as all SUIT partners for the valuable technical discussions.

Fig. 1. Coverage area.

The antenna on the bottom of the mast is an UHF antenna used in SUIT for other purposes like DVB-T/H tests. There is another mast (not shown in the figures) with a patch antenna providing a 60 Mbps radio link connecting the playout (in IT site-see Fig.1) to the transmitter. The receiver is a CPE with a modem from RUNCOM and with a sensibility of -85dBm. As the test bed is fully connected using the IP protocol, we can switch on/off and configure the transmitter remotely from the playout.

Fig. 2. SUIT transmitter in a shelter. WiMAX 2.5 GHz antenna is on the top of the mast.

III. ANALYSIS OF THE RESULTS

SUIT uses two WiMAX 16e BST (Base Stations) at 2.52 GHz (SS site) and 2.54 GHz (IT site). Each with 10MHz bandwidth. The field trial results we are going to discuss are based on one condition: SS on and IT on, allowing us to test handover.

All measurements were carried out with a GPS. The power (RSSI) and carrier-to-interference and noise ratio (CINR) were measured simultaneously. Figs. 3 (a) and (b) show a measurement campaign. The campaign started in the roundabout, moved to the motorway A25 to the left side, returns back to the motorway, now in the opposite direction, back to the start roundabout. Then, the campaign moves into the city center, to the next roundabout, then crosses the tunnel under the motorway A25 and back to the start roundabout. The number 2 marked in the trajectory in small circles means the CPE is connected to SS BST. The measurements were capture every second. It can be observed in the urban area, most of the time, the CINR is above 20dB which is the minimum value to ensure multicast with 6.5 Mbps. CINR above 30dB was obtained in several positions (yellow and red), namely in the motorway A25. CINR greater than 24dB can even allow to obtain 8.5(16-QAM, FEC=1/2) -6.5=2Mbps in unicast.

(a)

(b)

Fig. 3. Measurement trajectory. Both transmitters are located in the right hand side (yellow marked). (a) Whole area, (b) zoomed area.

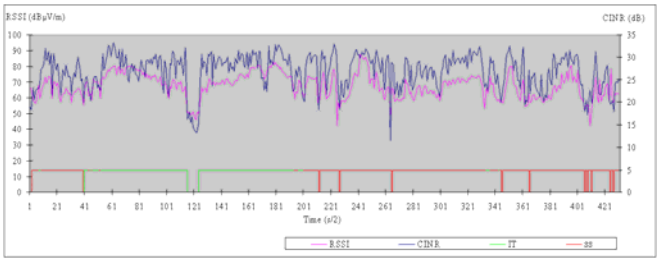

Fig. 4. Both BSTs. Measured power and carrier-to-interference and noise ratio.

Fig. 4 shows the power RSSI (pink line) and CINR (black line) and the connection state (lower line). When the connection state is zero, it means the receiver is receiving less than 6.5 Mbps. 96% of the time the receiver is receiving 6.5 Mbps. The throughput was less than 6.5 Mbps during the return back under the bridge (see Fig. 3a) due to lack of power. The connection state line also show to which base station the mobile vehicle is connect to, green to IT and red to SS.

The average in the motorway speed was 120km/h and in the city center the speed was around 20 km/h. The receiver antenna used in all measurement campaign, has 12dBi gain.

IV. CONCLUSIONS

This paper reports a measurement campaign in Aveiro-Portugal. Our WiMAX transmitting system support unicast, multicast and handover. The reception quality is good in the city and in the motorway even at high speed close to 140 km/h. Aveiro is a 70 thousand population city which can be covered by one BST with 4 sectors. However, from our experience and as a final remark, it seems that, for 2 Mbps unicast services (houses and vehicles), mobile WiMAX is able to provide enough capacity for small cities like Aveiro with 4 WiMAX BST sites, two of them with 4 sectors and the other two with 3 sectors. WiMAX SISO is unable to provide unicast services to high density cities. In the later case, higher capacity systems (MIMO) are required.

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Publicação: 05.12.2008
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