

BuNGee: Beyond Next Generation Mobile Broadband

BuNGee's goal is to increase the overall mobile network infrastructure capacity density to well beyond what current next-generation technologies (e.g., LTE and WiMAX) are promising, utilizing a new deployment strategy.

At A Glance: BuNGee

Beyond Next Generation Mobile Broadband



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EC Contribution: € 2,975,953 m

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BuNGee Main Objectives

In dense urban areas where the market demand for wireless broadband access is the highest, the current next-generation technologies LTE and WiMAX support a mere 100mbps/km². This is insufficient, and seriously jeopardises the wide scale uptake of IMT-Advanced technologies.

BuNGee's goal is to dramatically improve the overall infrastructure capacity density of the mobile network by an order of magnitude (10x) to an ambitious goal of 1Gbps/Km² anywhere in the cell – thereby removing the barrier to beyond next-generation networks deployment.

To achieve this objective, the project will target the following breakthroughs:

- unprecedented joint design of access and backhaul over licensed and license exempt spectrum;
- unconventional below-rooftop backbone solutions exploiting natural radio isolations;
- beyond next-generation networked and distributed MIMO & interference techniques;
- protocol suite facilitating autonomous ultra-high capacity deployment.

To evaluate the effectiveness of these approaches, **a high capacity radio cell prototype will be built targeting over 1Gbps/Km²**. It shall serve as proof-of-concept in real life scenarios and demonstrate the superiority of BuNGee's architecture for mobile networks.

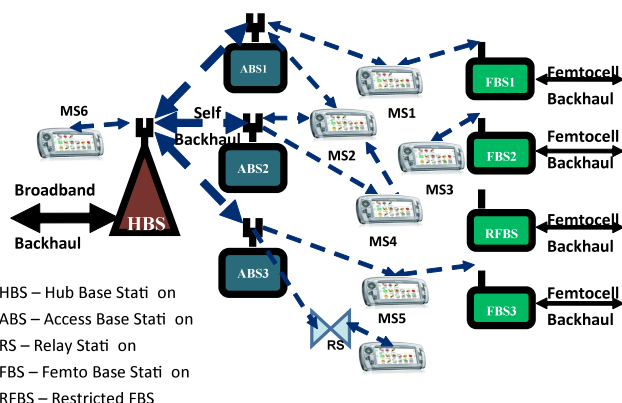
The developed technologies will be proposed as new standards for high capacity radio access networks, mainly to ETSI BRAN and IEEE 802.16 and/or LTE-Advanced, to maximise the exploitation benefits in Europe and globally.

BuNGee's capacity density of 1Gbps/km² will be the catalyst for accelerated uptake of next generation mobile broadband networks.

Technical Approach

The unprecedented approach we are proposing in BuNGee is:

- to have a much denser base station grid below the rooftops (e.g., on utility poles) and thereby bringing the *backhaul network below rooftop*;
- to exercise *aggressive reuse* combined with high spectrum efficiency, by using novel antenna, RF, base-band and network techniques;
- to undertake a *joint design of backhaul and access networks*, using heterogeneous radio elements, licensed and licensed-exempt spectrum, a cognitive radio approach, among others, aimed at achieving a maximum system capacity and QoS;
- to design a data and control plane protocol suite that facilitates autonomous operation by means of a *complete self-organising networking paradigm*.



The work is divided in 6 Work Packages, with four of them being technical:

WP1 focuses on compiling user requirements and translating them into technical specifications, used to define BuNGee initial system architecture.

WP2 focus on Channel modelling, antenna research, and collaborative networked and multi-beam MIMO.

WP3 addresses the resource assignment and higher layers protocols within the system and for the joint access-backhaul.

WP4: BuNGee's proof-of-concept, including simulations.

WP5 and **WP6** focus respectively on Dissemination & Exploitation and Management.

Key Issues

The project will focus on the following inter-related research areas:

1. High-Capacity 4G Mobile Network that is Cost-, Spectrum- and Energy-Efficient

The novel BuNGee heterogeneous architecture allows a significant increase of available capacity to all the users in any point of the deployment.

2. Novel mobile Radio Network Architecture

BuNGee defines a novel radio system architecture, integrating the Hub Base Station, the Access Base Stations, the Relay stations and the Femto cells

3. Multi-beam antenna assisted MIMO

BuNGee will develop novel extremely high capacity MIMO techniques specifically adapted to the BuNGee architecture.

4. Co-Operative Technologies at Base Station

BuNGee will use co-operative technologies for MIMO operation and also for radio resource assignment.

5. Dynamic Channel Modelling and Estimation

The channel modelling of the HBS-ABS link models will include as many dimensions as possible, i.e. space, polarization, frequency and time, but will also minimise complexity for implementation in the system-level simulator.

6. Cognitive Radio and Network Technologies for Reduced Management Complexity

Cognitive radio principles are extensively used in maximizing the system capacity. BuNGee will also develop technologies for interference cancellation, especially for license-exempt usage.

7. Innovative Usage of Licensed, Unlicensed and Unused Radio Spectrum

In BuNGee, the spectrum is seen as an integrated resource. The traffic is split between licensed and un-licensed spectrum based on traffic requirements (QoS, data rates). The un-licensed spectrum is used according to its propagation characteristics, bandwidth and interference levels.

8. System Live Test

To prove the concepts of BuNGee, a Live Test in a real life mobile environment will be conducted.

Expected Impact

BuNGee will offer a new deployment strategy based on below rooftop deployment of access base stations utilizing existing structures as utility poles in conjuncture with self backhauling of these access base stations by wireless links. This approach offers much lower CAPEX and OPEX relative to traditional cellular deployment approach, thereby significantly lowering the cost/bit of the access network