PROJECT RESULTS

CAT121

Highly integrated, energy-efficient and cost-effective technologies ensure delivery of 5G mobile networks [EAST]

The award-winning EAST project will ensure the realisation and implementation of 5G mobile networks, while delivering such key benefits as: smaller 5G cells; reduced energy and lower operational costs; improved transmitter switching across bands; and massive MIMO (multiple-input, multiple-output) systems.

True, today's 3G (third generation) technologies provide mobile users access to a fully featured internet. However, speeds are somewhat limited when compared to the content that is currently available; and while 4G can technically reach speeds of up to 100 Mbps, the reality is that most of us experience data rates below 50 Mbps. Furthermore, due to infrastructure issues, there have also been some drawbacks with 4G, such as energy inefficiency and high latency.

Fifth generation (5G) networks could change all of that. As the latest generation in cellular mobile communications begin their roll-out, focus is on the benefits these advanced networks promise to deliver, which include: higher data-rate; reduced latency; energy savings; cost reduction; higher system capacity; and massive device connectivity. In addition, as indicated further in this report, a more robust solution which 5G offers is also necessary to handle the enormous growth in mobile devices and data.

More integrated, efficient and cost-effective 5G networks

Before describing the EAST project, it is important to briefly look at two important design considerations. The first is radio frequency (RF), the rate of oscillation of electromagnetic radio waves in the range of 3 kHz to 300 GHz, and which is the frequency band that is used for communications transmission and broadcasting. If 5G is to actually deliver speeds that are up to 1,000 times faster than the current 4G ones, it would need to utilise the spectrum more effectively.

The second consideration has to do with multi-antenna technologies, such as massive MIMO (multiple-input, multiple-output) systems, which are the most likely candidates to significantly improve spectral efficiency in 5G networks. Implementing MIMO with large scale antenna arrays, typically with 64 or more transceiver elements, should increase the capacity of a cell well beyond what is achievable today.

EAST started out by defining several design and architectural elements, which were deemed key to a successful 5G implementation: namely, the creation of smaller cells and the use of MIMO or smart-antenna techniques operating at higher bandwidths with lower power consumption. However, by introducing more (small) cells with multiple transmitters, data handling, integration, power consumption and cost reduction became crucial and needed addressing.

To achieve this, major steps were taken at the system/design level (novel transmitter architectures), at the technology level (new silicon processes and packaging solutions), as well as, in the development of characterisation and modelling tools to handle the increased bandwidths and linearity requirements of 5G network applications.

In particular, the following issues were dealt with accordingly:

- Enhanced data rates (video bandwidths up to and beyond 100MHz);
- Higher transceiver integration (10-100 times size reduction);
- Higher functionality (MIMO/smart antenna);
- Drastic cost-reduction (10-100 times compared to micro/macro base stations);
- Re-configurability (multiple-transmit bands);
- Higher overall system efficiency (greater than 60%);
- Reduced energy consumption;
- Shorter time-to-market.

It should be noted that EAST also focused on the overall integration of RF front-ends for 5G base-station and handset applications with their critical building blocks, namely: the signal up-conversion / conditioning (digital pre-distortion), power amplifiers, low-noise amplifiers, switches and antenna.

PROJECT CONTRIBUTES TO

- Communication
- Energy efficiency
- Digital technology
- Process development
- Manufacturing science

PARTNERS

NXP Netherlands
BESI
Bruco
Anteverta-mw
Nokia
TU-Delft
TU-Eindhoven
TNO

COUNTRIES INVOLVED

- Ireland
- Netherlands

PROJECT LEADER

Dre van den Elshout
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KEY PROJECT DATES

1 May 2015 - 30 April 2018

And there are significant benefits. EAST will lead to smaller and more energy-efficient 5G cells and massive MIMO systems in the future. Concepts developed in this project will enable switching 5G transmitters across bands without creating unwanted signals in other bands. They will also reduce power consumption and therefore lower costs for network operators. On the receiver side, the highly efficient antenna concept will allow switching between 5G bands with stronger resulting signals, thus eliminating the need for expensive filter and switching gear. EAST also balances the increase of power consumption with more energy-efficient concepts, as mentioned previously. Importantly, these improvements in power consumption will also decrease the environmental footprint of 5G and drive cost savings for network operators deploying 5G.

Necessary close co-operation and collaboration

The EAST consortium consisted of vertical and horizontal actors – from technology developer and provider to system integrator – who provided all the necessary project competences and resources. Development work in EAST resulted in four patent applications. Project partners were also active in disseminating knowledge gained from EAST, and in promoting the project and its achievements through conference papers and journal contributions (22), and technology workshops (5). In addition, EAST provided research work for several technical-university master's and PhD candidates.

Growth in mobile devices, apps and data will drive 5G

Even though analysts predict that the number of smartphones sold in 2018 will be slightly lower than in 2017 (the industry's first ever annual decline), sales are nevertheless substantial at 1.4 billion units per year. Crucially, mobile devices (smartphones and tablets) will soon be – if they are not already – the preferred platform to access the internet, overtaking the computer In addition, an increase in the number and usage of apps and online services, like mobile payments and video streaming, and future ones (such as controlling 'smart' home appliances), means that mobile data is not only growing in quantity, but also in value to business and consumers. According to Statista, a statistics portal, global mobile data traffic is projected to increase nearly sevenfold between 2016 and 2021. According to 2018 data, the global mobile population amounted to 3.7 billion unique users. As of 2017, mobile devices accounted for 49.7% of web page views worldwide. And Europe has the highest mobile broadband subscription penetration rate, around 78.2%.

All of this will, in turn, drive 5G deployment. Demand for 5G, once it takes off, should be considerable. According to Statista, 5G is expected to hit the market by 2020. By 2021, the number of 5G connections is forecast to reach between 20M and 100M. Some estimates put the figure at 200M. Crucially, spending on 5G mobile infrastructure for that same year is forecast at around US$ 2.3 billion.

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