D2D COMMUNICATION PUSHES THE BOUNDARIES OF FUTURE TELECOM SYSTEMS

It's no secret that today's networks are carrying exponentially more traffic as demand from new devices and their applications increase. The rising traffic being generated by smart devices and mobile broadband services is on course to becoming too much for network resources such as spectrum to handle.

A new research initiative is underway to address this. The joint project sees Ericsson Research, Wireless@KTH and the Automatic Control Lab of the Royal Institute of Technology (KTH) in Stockholm collaborating not only to investigate how to better support D2D communication but also the opportunities it presents in 5G networks.

This discussion follows on from one of our consistently most-read blog posts, D2D Communications – What Part Will It Play in 5G?

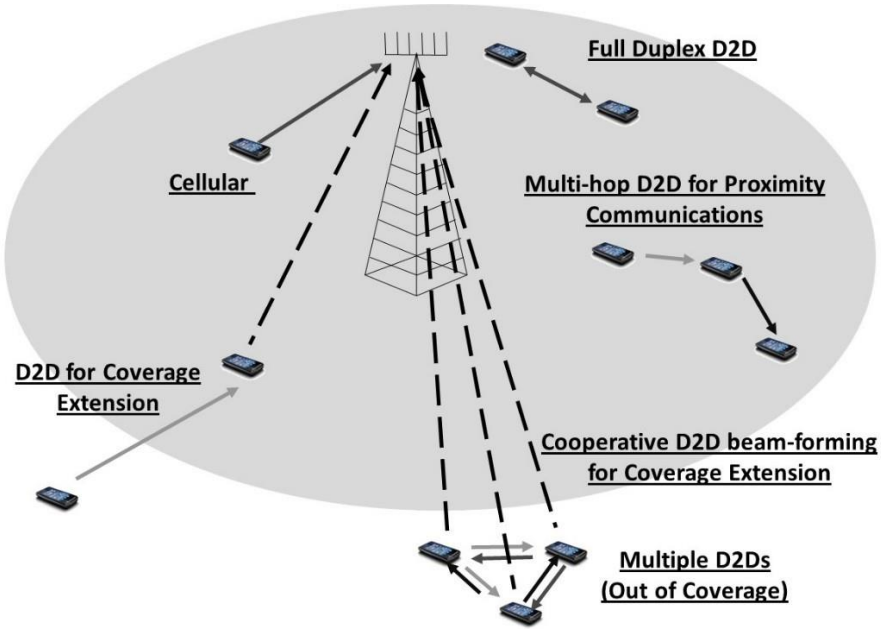
THE POWER OF ADVANCED SMART MOBILE DEVICES

The traditional user-in-the-loop model (UIL) views users as mere receivers of services. Schoenen et.al. wrote about this in the IEEE Communications magazine in February, 2014 ("User-in-the-Loop: Spatial and Temporal Demand Shaping for Sustainable Wireless Networks"). The idea of the UIL builds on the observation that a majority of human users show willingness to shape their service demands in space/time if they recognize the benefits associated with such behavior. For example, a behavioral survey reported that more than 50 percent of mobile users are willing to move around 40 meters in indoor or outdoor environments provided they receive some level of discount on regular charges.

Our Beyond User in the Loop: User in the Service (BUSE) model extends this to actually include users – especially of advanced smart mobile devices – as integral elements of the wireless system. While largely responsible for the increase in traffic loads, advanced smart mobile devices, with their increased capabilities in processing-power, memory, multiple wireless interfaces and radios may simultaneously now also be enlisted to reinforce the network to handle this extra demand. Once entwined in the infrastructure, they can be engaged in varied network-related activities such as wireless broadband provisioning, video content distribution, device-based relaying, and social proximity services, to name but a few. We are treating the evolving network infrastructure, available spectrum, and user devices, as one large diverse cooperating ecosystem and seeks to identify the win-win opportunities therein.

FUTURE COOPERATION BETWEEN USERS AND NETWORK OPERATORS

We are also exploring future cooperation between users and network operators on the spectrum level, for example within carrier frequencies such as the Innovation Band, higher frequency millimeter-wave bands, and potentially even on today's expensive licensed cellular frequencies. By way of example, an advanced cellular device (such as a smartphone) may easily serve as a semi-static relay node or wireless router in a home or small office environment towards a 5G cellular system, thereby segregating local in-home traffic from spilling out unnecessarily into the larger cellular network.



Exploiting knowledge of device positions enables new ways of communicating and delivering services to users. In the BUSE scenario, new ideas involving this proximal communications, such as network-assisted multi hop relaying, multi-antennae communications and D2D links utilizing full duplex transceivers are envisioned. To this end, BUSE leverages earlier research collaboration activities: Basic elements necessary for BUSE's vision, like network-assisted D2D communications, were originally explored in the European research project METIS and its follow-up METIS II. We can point for example to the IEEEAccess articles "*An Overview of D2D Communications Technology Components in METIS*", and "*Device-to-Device Communications for National Security and Public Safety*", and the recently published book *5G Mobile and Wireless Communications Technology*. These elements are now being standardized in the industrial partnership forum 3GPP, leading the way towards proximal-based connectivity in upcoming 5G systems.

MEETING THE DEMANDS OF TODAY AND TOMORROW

The BUSE project is a good example of how Ericsson Research is at the technological forefront of network design. We regularly work closely with partners, often comprising of members from academia, in innovative joint research activities like this one. In our role as a key partner in the BUSE project, we share the vision of evolving wireless infrastructure and user devices as a collaborative and socially aware cooperating ecosystem. Indeed, the role of social awareness in creating win-win situations among the mobile ecosystem stakeholders has been explored in a parallel cooperation with Tampere University of Technology and the University Mediterranea of Reggio Calabria. Results are described for instance in the IEEE Wireless Communications article "*Towards Trusted, Social-Aware D2D Connectivity: Bridging Across Technology and Sociality Realms*" by A. Ometov et.al. This is ultimately how we push the boundaries of telecom systems to meet the demands of today and tomorrow.

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