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5G for IoT and Mobile

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A research and technology roadmap, including real-world examples, illustrates the range and complexities of an evolving 5G/IoT ecosystem. >>

5G Has Two Flavors: Mobile Broadband and IoT

The research in 5G, especially for future radio interfaces, has to be seen under two quite separate aspects:

- Use cases for mobile applications are about very high bit rates, such as future terminals with 3D-displays at 8K-resolution or holographic displays. Thinking about peak data rates as a function of millimeter waves with carrier frequencies up to 100 GHz may be necessary to provide throughputs of 10 Gbit/s or greater.
- For the Internet of Things (IoT), among the use cases under study are Industry 4.0 environments for future factory automation, Intelligent Traffic Systems (ITS) for autonomous vehicles, eHealth for smart medicines packaged with wireless modules, and smart energy with the IoT as the enabling technology for communication over complex 'Smart Grids.' In each case, the requirements look very different, though each one typically requires only a few kilobits per second but with guaranteed 10 ms latency and/or 99.999 percent reliability rates.

IoT Will Be the Main Traffic Driver for the 'Internet of the Future'

The numbers of 'Things' predicted for the IoT are all quite large and vary by the source and year. Cisco is forecasting 50 billion connected devices while Intel is projecting 200 billion. Huawei estimates that the number will be 100 billion. In all cases, the suggestion is clear that this large number of Things will probably generate the majority of traffic in the future Internet when compared to the traffic originated by human users. We can assume that use cases will involve all manner of sensors and active tags, and that the readers for passive tags will be wireless. Such cases can include a range from cross-regional mobile devices like containers or cars to moving units with fixed locations and a constrained range like industry robots or rotating production units, or the remote devices in a smart electrical transmission grid where wireless connectivity provides the same simplicity and flexibility that are advantageous in production environments. In each of these cases, Machine-to-Machine (M2M) communication is of the highest importance.

M2M Is Only One of Many Important Parts of the IoT

Industry is obliged to deliver an IoT wireless communication platform that fulfills all requirements.

The critical success factors include reliability in very different use cases, such as high sensor density, building coverage and penetration, guaranteed QoS and secure end-to-end communication and, not least, power sources that fit the use case. For instance, it is neither realistic nor practical to frequently change batteries for sensors or wireless modules during use in Building Technology applications or smart medicines. Research in 5G is working on the exact solutions that will offer these connectivity technologies for public and private networks to cover these and other use cases. Many such services will be carried, we expect, by telco networks and others via private solutions. Research activities concentrate on both radio interfaces and the fixed architecture that has to be kept flexible for future adoptions. Software-Defined Networks (SDN) and Network Function Virtualization (NFV) will enable these offerings by partitioning network resources into 'slices.'

Perhaps the most critical factor for determining the success of the IoT will be cost. We assume that the cost of all connected 'Things' attached to all goods in a supermarket, plus the cost of the necessary infrastructure, need all be affordable — especially as the Business-to-Business (B2B) advantages in logistics and supply-chain management will not be obvious to the consumer.

The IoT Value Chain Includes Cloud Storage and Big Data Analytics

Another crucial point for the IoT is the 'value chain,' which, for instance, would comprise the 'Thing' with a sensor and wireless module, network connectivity over a 5G circuit, a collection of data in the cloud, and, finally, the ability to analyze the data, which means Big Data analytics. Having the value chain work end-to-end is an area of research that requires more study, as today it is a challenge to combine data from different IoT sources that populate different databases in different data formats. This is exactly the type of situation that will happen in 'Smart City' environments where different data sources have never been integrated and grown larger or separately over time. More difficult yet are the tasks involving time stamps with very different time intervals, or time stamps that are derived asynchronously. Fortunately, companies like Huawei have competencies across all parts of the IoT value chain and are well positioned to address these types of issues.

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Example Solutions for eHealth, Intelligent Traffic Systems, and Industry 4.0

It is difficult to imagine the full range of research topics without a few concrete examples. Intelligent Traffic Systems and autonomous cars are receiving a lot of attention. It is assumed that in high-speed, high-density traffic that autonomous vehicles will use three different information sources to maintain safe highway travel: First are on-vehicle cameras and sensors; second is information from car-to-car communications; and third is information from the infrastructure — in other words, data from the cloud transmitted from base stations and roadside terminals. In combination, these three sources will optimize autonomous vehicle safety to the maximum possible extent.

In eHealth, pharmaceuticals are prescribed at specific times or intervals of time. In a diabetes case, one can imagine insulin pens equipped with sensors and wireless modules that, when connected to the IoT, have a range of possible interactions with the patient, from simple reminders to the release of a recommended dosage mechanically. Time of use, actual usage, and other data can be provided in real time to an intelligent health monitor for use in improving the treatment and drawing conclusions about future procedures.

Industry 4.0 is being organized by the German government to be the future of manufacturing production systems. Within this context, the IoT will play a crucial role alongside other key technologies like Cyber Physical Systems in which all parameters of a production line, such as sensors, actuators, tags, and readers, will be collected and uploaded to a cloud. Analysis of this data will occur in near-real-time in order to predict equipment status and operating compliance. Models and projections will trigger predictive maintenance activities. Further analysis may reveal inefficiencies that can be rectified to achieve faster throughput or cost savings.

Each of the preceding examples provides focus on the importance of our research into 5G-communications and the entire IoT value chain. It is essential that Huawei and others are committed to the necessary long-range planning and technology developments in preparation for the widest range of concrete use cases. There is really no other way that our customers and, in turn, their customers will succeed in the long run. ▲