Customized emulator testing quickly overcomes the challenges arising from a mixed use of different communication standards

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In 2010, the China Ministry of Industry and Information Technology (MIIT) officially selected Wuxi National Hi-Tech Industry Development Zone as a national electronic information industry demonstration base, setting off a global IoT trend. Aside from existing WLAN and Bluetooth, additional networking standards designed for IoT applications have been burgeoning over recent years. According to Eric Yu, Assistant Vice President, Signal Integrity Business Unit, Integrated Service Technology (iST), IoT applications are diverse and so are their use scenarios, so they impose wide-ranging requirements on communication technologies. This is also the biggest challenge to be addressed during the development phase of IoT products.

Communication technologies for IoT applications can be categorized based on the distance over which signals are transmitted into near-field, short-range and long-range. Communication is essential to IoT system operation and stability is a crucial consideration in product design. Although there are no mandated IoT testing standards regarding to performance at present, experienced laboratory test procedures can help manufacturers ensure their product quality. Furthermore, professional labs with extensive experiences can also help discover blind spots that may have been overlooked during the design phase and solve problems that occur when a product is put to use under special circumstances, said Yu.

Current lab tests include basic tests, performance tests, special function tests and certification tests. Basic tests check safety, regularity, energy consumption and reliability. Performance tests measure connectivity, desense and transmission capacity. Special function tests validate system integration and information security. Certification tests verify compliance with special requirements set by government institutions or industry alliances.

Among the four types of tests, certification tests involve the right to use the logo mark and intellectual property right while basic tests on safety, regularity and energy consumption are required by national or regional regulations. In comparison to certification tests and basic tests, performance tests and special function tests are not mandatory and are generally self-initiated by manufacturers. However, due to IoT's special characteristics, Yu thinks the performance tests and special function tests will play an influential role to IoT product design.

Yu further said, the market has begun to see such a mixed use of multiple communication technologies. However, certifications of wireless communication standards are still implemented on a one-by-one basis. Only Cellular Telephone Industries Association (CTIA) in U.S. has proposed specifications on device performance when operating concurrently with cell phone signal and Wi-Fi signal. Other countries or regions have yet to engage in such practices.

Furthermore, there is the problem of desense. Wireless communication uses a very concentrated range of frequencies, mostly on 2.4GHz and 5GHz now. Communication technologies operating within the same range of frequencies can use different demodulation techniques so that the receiving end can make accurate detection of the signals but interference is still unavoidable, particularly in the 2.4GHz band, which already has Bluetooth and WiFi. Furthermore USB 3.0 operates on 5GHz data rate could also have strong interference to 2.4GHz signals. There have been reports of such interferences occurring in TV, for example.

As the media industry began to undergo some changes in 2016, people getting use to watch video signals stream over Ethernet rather than over cable networks. The way it works is that signals coming to the home via external Ethernet are then sent to TV using Wi-Fi through an Access Point (AP). As such, Wi-Fi has become the fourth main test item for TV. For a home theater systems with standalone speakers, signal transmission between the TV and speakers is via Bluetooth connection. Accordingly, the TV sends video signals via both Wi-Fi and Bluetooth in the same 2.4GHz range, which makes it susceptible to interference. The situation is bad enough for TV. Just think how much worse it will be when a future home is deployed with a complete IoT system and all devices are operating simultaneously Customized testing is the solution to such a problem, proposed Yu.

To test smart home devices, a common current practice is to set up a mockup home environment such as a living room, bathroom, kitchen or bedroom and then install IoT devices there to check how well the devices operate together and gain an understanding on their communication and operation status in the environment. This only checks one particular indoor setting but not able to cover different types of indoor environment which cannot be considered as a quick and effective initial test. In real-world application, IoT systems have to cope with different home settings and decorations and their functions may also vary based on home owner needs. As such, the test practice using a mockup home environment to check interoperability and performance provides little help to manufacturers.

For now, emulator testing will be a cost-effective approach, said Yu. A software-and-hardward-based emulator environment is built wherein throughput capacity, roaming and desense tests are conducted. However, this must be backed by robust technologies. Take iST for example,its chose the emulator bases on correct theory and trustworthy. It is no easy to build a test environment using an emulator. iST's emulator developed with theory and field trial results taken into consideration produces a model of a real environment. First, a far field test environment is defined according to CTIA' test specifications and then correct parameters are input to the emulator to create channel models of the indoor environment.

Eric Yu, Assistant Vice President, Signal Integrity Business unit, Integrated Service Technology (iST). (Photographed by DIGITIMES)

Yu comments that connectivity is the biggest challenge for IoT system operation. On a system level, performance tests sometimes not only can help boost system performance from 80% to 90% but of more critical importance, they can help a system jump from 0% to 80%. After all, only when signals can be transmitted without error and glitch will system deployment be meaningful. Yu also reiterates with IoT developments picking up speed over recent years, different types of applications will begin to emerge. Mixed use of multiple technologies will be the only way to go. Testing is an essential step in guaranteeing system reliability, and customized testing tailored to fit different use scenarios will also be instrumental to product R&D in the future. The use of emulator to create modeled test environments will help manufacturers quickly get to the root of the problem and establish a strong foothold in the IoT market.