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This article briefly covers a young company's success in deploying Taiwan's National Grid Advanced Metering Infrastructure (AMI). Ubiik, a start-up based in Taiwan, completed deployment of 63,000+ smart meters, connectivity infra-structure and backend systems for the Taiwan Power Company (TPC) to support a 2018 contract.

Ubiik is a relatively young company having started its development work on Advanced Metering Infrastructure (AMI) only a few years ago. This work started in 2016. Today, only four years later, Ubiik celebrates the completion of its fourth and final phase for its 2018 project: a deployment of 63,000+ smart meters inclusive of wireless connectivity infrastructure for the Taiwan Power Company (TPC or Taipower). Ubiik is now well underway in their second project, deploying an additional 260,000+ smart meters and scheduled to start a third round of deployments in 2021.

Ubiik works closely with TPC and acts as a service provider for the Weightless™ technology network infrastructure here in Taiwan. The completion of the fourth phase of acceptance test marks a major milestone in Ubiik's evolution to become a leading supplier of AMI in Southeast Asia. This article discusses the details of Ubiik's AMI offerings along with how Ubiik became a qualified AMI vendor and completed successful deployment of 63,000+

smart meter connectivity solutions. The final round of acceptance tests administered by the TPC mark a milestone showing definitively the quality of the Weightless™ protocol as a solution for Internet of Things (IoT) and Machine to Machine (M2M) applications.

2021

- Weightless™ ePaper products shipped to European semiconductor fabrication plant customer
- Closed Series A funding of US$5 million led by Taiwania Capital.

2020

Won US$17 million AMI tender from Taipower to expand the communication network and HES for additional 380,000 meters.

2019

- Completed delivery of 11,000 smart electricity meters and cloud platform to a Japanese customer for energy management.
- Won US$16 million AMI tender from Taipower to expand the communication network and HES for additional 265,000 meters. Ubiik's Weightless™ network becomes the largest LPWA network in Taiwan.

2018

Won US$8 million AMI tender from Taipower to deliver and deploy the communication network and Head End System (HES) for 70,500 smart meters using Weightless™ and LTE Cat-1 technologies.

2016

Founded in 2016, focusing on design and development of Weightless™ LPWAN communication technologies and IoT solutions.

What is Weightless™ & What Other Products does Ubiik Offer?

Weightless™ is a wireless connectivity solution. It was developed by Ubiik and made into an open royalty free standard with support from the Weightless™ Special Interest Group (SIG)—a UK Non-profit. The Weightless™ protocol is designed to provide robust and reliable bidirectional communication between smart devices and the cloud in both city and suburban environments. It supports Firmware-Over-The-Air (FOTA) and operates at very low powers.
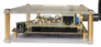
The low-cost end devices—also known as FAN modules (field-area-network modules) —can maintain a wireless communication range from 2 km (dense urban) to well over 10 km (suburban). Weightless™ is unique in that a single base station or data concentrator unit can support a very high density of end devices in crowded, urban environment.

A single base station (hub) can support up-to 1000 devices. Depending on frequency of transmission and quantity of data this support can potential go well beyond this number.

Figure 2 demonstrates some of the smart devices or associated connectivity solutions provided by Ubiik. Ubiik is a data and network service provider that focuses primarily on Weightless™ network infrastructure and connectivity for a range IoT and smart device solutions. Where necessary Ubiik can also provide other connectivity options including NB-IoT, LTE-Cat-1, LTE-Cat-M1 cellular protocols.

Furthermore, Ubiik also provides solutions for backend and cloud platforms providing comprehensive Software as a Service (SaaS) tools for smart devices. Users and vendors can leverage Ubiik's existing connectivity infrastructure provided by DCUs to connect their devices much like they would with 4G or other cellular technologies. Here, a whole host of smart city applications are possible For further information on Ubiik's products check out the website at: www.ubiik.com.

Wireless Base Stations

Indoor Base Station (Data Aggregation Unit or DCU)

Outdoor Base Station (Data Aggregation Unit or DCU)

Base Station (Data Aggregation Unit or DCU) Starter Kit

End Device Module (EDM)

Wireless Smart Devices

GPS Tracker

ePaper Remote Display

Wireless Gas & Air Sensor

Smart Device Field Area Network (FAN) Weightless Module

Smart Device LTE-Cat-1 / NB-IoT Module

End Device Evaluation Board (EVB)

Figure 2: A partial snapshot of Ubiik's wireless solutions portfolio.

How Ubiik Got Started in the AMI Business

In 2017, Ubiik saw a promising business opportunity in the technology gaps of existing IoT connectivity solutions. To address these challenges, the company drafted a specification of a protocol called Weightless™ that could yield high scalability, reliability and low power consumption.

Ubiik adopted the Weightless-W protocol as a starting point. The protocol had aimed to solve the problem of connectivity needs for wireless sensor networks. It utilized TV Whitespace—the unused bandwidth between TV channels in the broadcast frequency spectrum. Unfortunately, the regulatory issues made its use complicated and applicable only to a limited set of use cases. To address these challenges, Ubiik developed a new, simplified and more full-featured version of the Weightless-W protocol initially known as Weightless-P. This was made into an open standard by the Weightless™ SIG and eventually renamed to just Weightless™. Ubiik brought this specification to life embedding the protocol stack into two main hardware components: the base station and end device module. It was the development of this first module and base station that began the pathway for Ubiik into the AMI business.
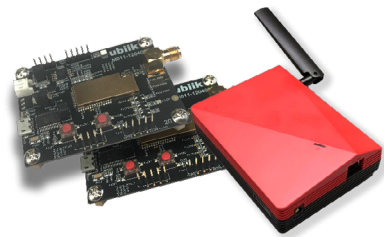
Figure 3: The Weightless™ Starter kit provides developers with everything needed to deploy, test evaluate, and prototype using Weightless™ LPWAN technology

Qualifying as a Vendor for TPC

TPC had encountered some challenges with past contracts towards upgrading the National Grid infrastructure in Taiwan and had decided to pursue a multi-vendor approach to upgrading their metering infrastructure with smart wireless connectivity. Four vendors would provide AMI infrastructure to different regions of Taiwan for a 2018 Tender. **Figure 4** below shows Ubiik's deployment in assigned regions.
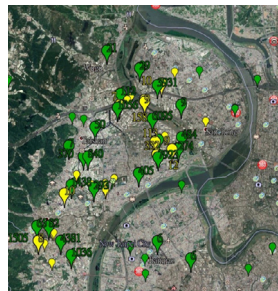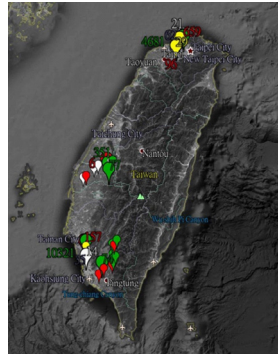
Figure 4: Map breaking down TPC regions for which Ubiik has deployed smart meter connectivity infrastructure during its 2018 contract.

Here, they required all vendors competing for AMI contracts to go through a stringent series of qualifying tests. These tests are shown in **Figure 5**. From among 13 vendors passing the first qualifying phase, only 5 passed the final phase with one of these eliminated during negotiation phases.

During evaluation of technical proposals, an extensive series of questions required detailed responses. After this, during the second phase a laboratory test of 1,250 smart meters with installed connectivity solutions from vendors was undertaken in a simulated environment. In a third and final phase, field tests in real world environments were executed. In these tests, wireless deployment in some of the most challenging city environments were undertaken. Ubiik's performance and success in these field tests showed just how effective it was at implementing solutions for AMI. Ubiik was among the top 4 vendors and was awarded three regions of Taiwan (Northern, Central and Western) for AMI deployment.

Phase I : Technical Proposal Evaluation
- Ubiik submitted technical proposal based on Weightless™ to Taipower in June 2017
- Ubiik's technical proposal approved by Taipower in July 2017

Phase II : Laboratory Testing
- Event data delivery reached 90% within 30 minutes, 99% within 60 minutes.
- Overall data delivery reached 99%+ in 48 hours

Phase III : Field Testing
- Field testing on 1,000 residential households
- Overall data delivery reached 95%+ in each 4 hours interval within 24 hours

Figure 5: Qualifying tests required by TPC to be eligible to implement AMI in Taiwan.

Deployment and Acceptance Tests

The project required the complete deployment of 63,000+ smart meters with wireless connectivity over a two-year period between 2018 and 2020. **Figure 6** shows an example of how these meter and base station installations have and continue to take place in Taiwan under Ubiik's leadership.

Areas assigned to Ubiik, by TPC, were divided into 6 sub-regions. Installations of communication modules or Field Area Network (FAN) communication devices and meters were done consecutively region by region—likewise with the corresponding base stations or DCUs. Acceptance tests were then carried out in four distinct phases. As of the publishing of this article, Ubiik successfully passed all four stages of these tests. These tests are listed below:

Figure 6: On the top, meter and communication module installation. On the bottom, ground level base station installation.

1. Phase 1: After installation, 5% of all installed meters in each sub-region (or grouped set of regions) are manually inspected to ensure that the communication modules are fully functional. To incrementally complete this phase of testing, 6 sub-regions were grouped consecutively as 1 sub-region alone, 2 sub-regions and 3 sub-regions.

2. Phase 2: After completion of installation checks, 2 out of 10,000 meters are chosen at random via the backend system and tested to check that they can respond to a request for an On Demand reading successfully.

3. Phase 3: At this stage, an aggregated test is performed. Here, meters function as normal to send data to the backend. This data must be aggregated across all meters in all regions in which meters are installed. The resulting performance must match that shown in **Figure 7**. Load profile data from every meter installed must be obtained every 15 min and provided to TPC within 4 hours. Likewise, power quality (ALT) information from

each meter must be obtained every 1 hour. Midnight register data is the set of data that is eventually used for billing purposes. This set of data should be delivered to the TPC Meter Data Management System (MDMS).

4. Phase 4: Finally, a last step is to ensure that, in the event of a disaster, all data throughput and processing can be completely transferred to the backup server within 30 min. Testing is done via delivery of the load profile, ALT data, midnight data to the TPC MDMS.

Load Profile (Data Every 15 mins. Delivery within 4 hours) Consumption (kWh), Current/Voltage Per Phase ...	4-hour Delivery: **99%**
ALT Data (Data Every 1 hour. Delivery within 4 hours) Demand (kW), Current/Voltage/Angle Per Phase, Power Factor...	4-hour Delivery: **99%**
Mid-night Register Data (Data Daily. Delivery within 4 hours)	Daily Delivery: **100%** Billing Cycle Delivery: **100%**
On-Demand Reading (Delivery within 30 mins) Less than 1,000 meters for data in 48 hours period	Daily Delivery: **98%**

Figure 7: Acceptance tests required for completion of TPC contracts.

Ubiik's Future Deployments and Strategic Goals

As Ubiik wraps up its deployment of 260,000+ meters for its current 2019 to 2020 project with TPC, additional goals are on the horizon. Ubiik is in the process of expanding not only in Japan with projects related to AMI but also quickly working its way to becoming a provider for worldwide AMI and smart device connectivity solutions. Here Ubiik offers energy management solutions and acts as a service provider making complete vertical solutions and management services available at all levels of connectivity (see below) for smart energy applications and more.

1. Support for smart meter standards such as DLMS/COSEM and other smart device standards. Production of complete smart meters or smart devices.

2. Communication and connectivity via wireless transceivers that support the Weightless™ protocol as well as cellular protocols such as NB-IoT, LTE-Cat-1 and LTE-Cat-M1. Production of communication modules that can be embedded into existing smart devices as needed.

3. Data aggregation support from wireless smart meters or other smart devices using DCU base stations. Management of connectivity for a network of DCUs and end devices.

4. Provision for a backend or Head-End System (HES). This system provides the high-level network management, security, data storage and processing and validation tools.

5. Provision for client-side user interfaces to manage and maintain the network and MDMS as well. Access to APIs and frameworks for integration of both downstream connectivity options and upstream applications from third party vendors.

Conclusion

Ubiik has become a leader in AMI technologies in Taiwan and the completion of the fourth and final phase in its 2018 deployment of 63,000+ smart meter connectivity solutions. With the company's consistent success in passing through a series of stringent tests in AMI applications and with 210,000+ additional end devices being installed from 2019 to 2020, Ubiik is poised for global expansion. Ubiik can also build an infrastructure to provide wireless connectivity for a range of other smart devices for different application use cases in energy management and beyond. This infrastructure can be leveraged by end customers looking to integrating wireless connectivity in much the same was current cellular networks provide connectivity for mobile phones. As such, Ubiik can utilize the deployment of its existing infrastructure to provide connectivity solutions.

Join Ubiik on this journey as we develop some of the smart technology and infrastructure paving the way towards a more sustainable and energy efficient world.