



WHITE PAPER

LEVERAGING THE KOREAN ECOSYSTEM FOR IOT

Introduction

South Korea has always been the flag bearer of technology revolution in Asia. But for a country that is smaller than Iceland and ranks 109th in the world in terms of size, emerging as the number one IoT connected nation in the world is quite a feat. According to OECD Digital Economy Outlook published in July'15, the number of connected devices per 100 Koreans is a whopping 37.9, followed by Switzerland (29 units) and the US with 24.9 units. In terms of total number of IoT connected devices, today, there are more 18 million connected devices in Korea, which places the country in the 3rd spot following the US (84 million units) and China (78 million units).



However the Korean technology success story has been the result of solid technology infrastructure backed by strong government technology policies over the years. The Korea government continuously provides infrastructure, grants, education, and financing supports for technology SME companies, especially in IoT space as a national importance to support creative economy and innovation policy that the current administration is striving through. It is amazing to see how Korea government has built its infrastructure eco-system systematically to support design, prototyping, certification, and commercialization efforts for SME companies. It is no wonder that Korea today is the provider of more than 70% of world's DRAM and NAND flash products, more than 45% of cell phones (more than 60% smart phones) and more than 50% of rechargeable batteries.

Summary

Korea at the forefront of IoT

- There are 18 million IoT connected devices in Korea, placing the country in 3rd spot following the US (84 MM units) and China (78 MM units)
- More than 70% of world's DRAM and NAND flash products are produced in Korea
- Korea has over 2,000 researchers with over \$1B in research grants, generating over 800 patents annually
- Korea is leading the development of 5G technology envisioned to enable a majority of future smart devices
- Blackbox and electronic on-board report (EOBR) is mandated for all commercial vehicles and more than 50% of passenger cars are equipped with a visual black box (video camera)

Senaya leading the change...

- Senaya has deep-rooted ties with the Korean technology ecosystem
- Senaya has built strong IP and key engineering 'knowhow' in unpowered asset tracking using Korea based technologies
- Senaya 'Smart Ping' IP portfolio teaches how to issue a ping when a critical business event takes place
- Senaya batteries provide the highest charge density per volume in the broadest temperature range (-50°C < T < 85°C) all at an affordable cost
- Senaya devices offer the most compact form factor solution both for land and air logistics

Strong commitment to foster the IoT Industry

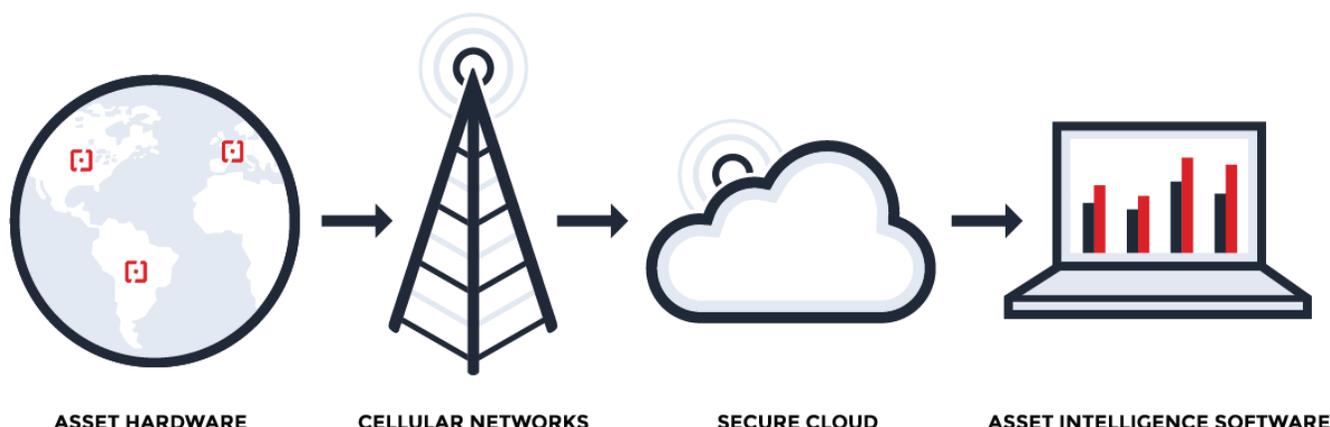
When it comes to IoT, Korea is committed to invest 420 billion won (US\$357 million) to foster the IoT industry over the next four years. The Ministry of Science, ICT, and Future Planning reported that it is shifting focus as the country's traditional tech industries have been slowing down throughout 2015. This raises the need to find new growth engines in other areas such as wearables and Internet-of-Thing (IoT) devices to compete with other global tech giants. ETRI (Electronics and

Telecommunication Research Institute) is in a core position in this technology evolution having more than 2,000 researchers with over \$1B research grants generating over 800 patents annually. ETRI has the distinction of co-developing CDMA technology with Qualcomm, developing the first WiBro/WiMax, and is currently focusing on 5G which is envisioned to enable key new capabilities for the smart devices in the IoT world.

South Korea at the forefront of Telematics

South Korea is also in the forefront in telematics where blackbox (video camera) and electronic on-board report (EOBR) have been mandated for all commercial vehicles several years before the rest of the world. In Korea, the Tachograph smart device records all vehicle status (speed, brake, steering wheel conditions, location, etc.) every 10ms and reports the data. All buses and trains are equipped with tracking devices, and real time operation information is broadcasted through apps. Now, this capability is being extended to taxis and limousines as well so that a passenger can directly connect with transportation vehicles in real time.

A passenger knows when a bus will arrive at the next stop in real time with an error less than 15 seconds. For over a decade, 30+ certified manufacturers provide Tachograph devices with fully validated field tests and certifications. The US is expected to mandate EOBR and hours of service (HOS) information to address traffic safety concerns. Partnership with Korean firms in this context could be a strategic option. Additionally, more than 50% of passenger cars in Korea are equipped with a visual black box (video camera) that facilitates reporting of traffic accidents and reckless driving.



Senaya has deep-rooted ties with the Korean technology ecosystem

One of the key strategic assets of Senaya is the deep-rooted ties with the Korean technology ecosystem both through industry and academia.

Senaya has been closely working with Korean government industry partners to build IoT strategy and practices. Some of the areas of meaningful collaboration are – low power wireless area network (LP_WAN), next generation battery technologies, fog based computing, and lightweight LTE devices for the IoT. Senaya has built strong core IPs and key engineering knowhow in unpowered asset tracking management space using Korea based technologies.

Senaya's "Smart Ping" IP portfolio teaches how to issue a ping, especially a cellular ping, when a business critical events take place. Senaya also uses batteries that provide the highest charge density per volume in a broad temperature range ($-50\text{ }^{\circ}\text{C} < T < 85\text{ }^{\circ}\text{C}$) at an affordable cost based on Korean technology innovation. With the Smart Ping and battery/power management know how, Senaya's devices offer the most compact form factor solution for both land and air logistics, at a given device operation lifetime or longest battery lifetime at a given device form factor.

Senaya is also developing forward looking, future proof solutions in wireless communications. Recently, a consortium of Senaya and its development partners were awarded a multi-million dollar grant to develop an IoT dedicated LTE SoC chipset based on 3GPP LTE CAT.1/0 (Rel.12). The consortium is currently designing the next generation IoT wireless communication protocol by seamlessly integrating LP_WAN and LTE CAT.0 stacks.

Senaya is designing an advanced LP_WAN technology where accurate ranging capability is being built utilizing very low data rate and power consumption. Many of the base technology platforms are derived from years of academic and industry researches done in South Korea. Access to knowledge, capital and infrastructure from Korea provides Senaya a significant advantage in the IoT space.

The strategy of Senaya of riding on the shoulders of giants to leap frog over others is expected to create new grounds in the days to come.



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