

# Strategic Integration of Ultra-Low Power Technologies

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## I. MISSION OF THE ULP INTEGRATED SYSTEM PROJECT

The ultra-low power (ULP) research area aims to drastically improve system performance in terms of power consumption by 100- to 1000-fold. Our project has the mission of strategically integrating the ULP research area to resolve problems for humanity and to strengthen Japan's industrial competitiveness. We aim to make global contributions by designing and demonstrating ULP integrated systems as applications of the ULP research area. It should be noted that the ULP integrated system should become practical in 5 to 10 years, i.e., 2017 to 2022, which is after the completion of the ULP research project, but the research project's results would be fundamental in facilitating future engineering efforts. Therefore, promising targeted markets and system functions will be designed for implementation between 2017 and 2022.

## II. BASE OF PYRAMID AS THE MARKET FOR ULP INTEGRATED SYSTEMS

### A. Base of Pyramid

The Base of Pyramid (BoP) is the largest but poorest group of 4 billion people who live on less than \$1,500 per year. Satisfying the needs of the BoP is recognized as the only way for long-term sustainable growth in the world [1,2]. Many developing countries believe that they could promote economic development by enhancing their export industry for the wealthy class. Such export-oriented policies have led to excessive production and global deflation. Thus, the poor at the BoP live in high-cost economies. There should be more opportunities to fulfill the business needs of the BoP.

### B. Target BoP Users

Further pyramids exist in a BoP country. Who should be selected as the target users? Sustainable prosperity exploration requires huge amounts of new values that do not exist today. Emerging economies following advanced economies are faced with many obstacles such as environmental pollution, which inhibit their growth. The development of the BoP money economy damages the natural economy and the traditional economy, where most economic activities are performed without using money. To ensure sustainable growth, worlds-in-

collision should be avoided by developing businesses for undiscovered needs of villages at the BoP. Destructive technologies tend to easily find their markets at the BoP with few obstacles. Innovations occurring in developing markets are then accepted by advanced markets in a process that has become known as reverse innovation.

### C. Communication Service Needs of BoP

It is surprising that many BoP people use mobile phone services. This success indicates the strong need for communications services at the BoP [3]. Narrow-band communications with mobile phones are available, but broadband internet services have not yet reached the BoP users, because the internet requires rich social infrastructure for electricity and communication networks.

Therefore, we decided to design a ULP integrated system to provide the people in BoP villages with communication services between 2017 and 2022, without waiting for the establishment of the usual rich social infrastructure. The proposed services should include not only advanced internet services but also ubiquitous network services.

## III. ULP INTEGRATED SYSTEM COMPOSED OF "PLACE & PLAY" SUBSYSTEMS

### A. System Design Concept: "Place and Play"

The application of ULP technologies to integrated systems is expected to reduce overall integrated system power consumption, although the reduction might not be as drastic as individual ULP technology research projects indicate. Assuming that we use ULP technologies together with rapidly evolving renewable energy technologies, we propose a system design concept referred to as "Place and Play (P&P)," which will provide ULP integrated systems that can function with poor social infrastructure. Every ULP integrated subsystem has an independent power supply that is designed to function wirelessly and communicates with other subsystems so that the overall integrated system works in a "Place and Play" manner. Innovative ULP technologies will make the subsystem more useful and convenient by reducing the power of consumption subsystems and consequently their size. Figure 1 shows an image of a P&P system providing broadband internet services to villagers. The suitcase in the figure represents the P&P system.

