Singapore Deregulation and Smart Homes

Building a Foundation for A Energy Smart City

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Singapore Energy Deregulation

+ **Liberalisation of Retail Electricity Market**
  - Since 2001, Energy Market Authority of Singapore have opened the retail electricity market to competition
  - Eligible consumers can buy from SP, a retailer or directly from the wholesale market at half hourly interval based on wholesale prices.
  - Currently business with an average of 2000 kWh are eligible. This leads to 90,000 business accounts that accounts for 80% of the market.
  - 1st April 2018, Open Electricity market for residential customers are started in Jurong District to allow residential Customers to buy from SP or from any retailers.

+ Today there are 14 power retailers to choose, not including Singapore Power

+ Packages vary from fixed price, discounted price, peak/off peak, solar mix and even **demand response** offers but where is the demand response infrastructure ?

Deregulation

open electricity market | The Power to Choose

Starting 1 April 2018 in Jurong

Singapore Implements Carbon Tax

+ Carbon tax of $5/tonne for all facilities producing more than 25,000 tonnes or more of greenhouse emissions starting from 2019-2023

+ After that, likely to increase from $10 to $15/tonne by 2030 and action to the rest of the smaller polluters will be taken when necessary.

+ Impact will be felt "minimally" to end consumers and assistance will be provided like the GST when it was first introduced

Figure 2: Role of Carbon Tax in Singapore's Mitigation Strategy
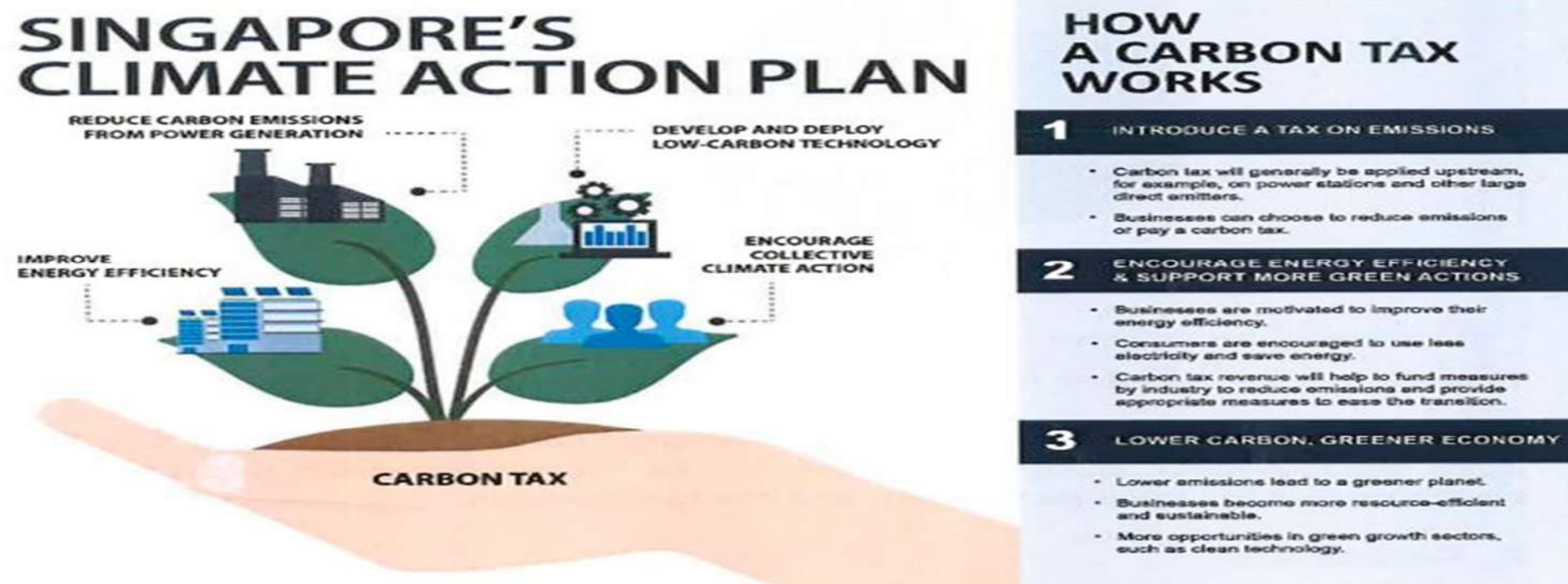
Smart City Vision ?

Leveraging a 2-way high speed communications infrastructure with millions of devices, sensing, analyzing the data to bring services and innovation

+ **Using Technology to Drive Meaningful Improvement in Smart living**
  - Energy Smart
  - Healthcare
  - Telecom
  - Transport
  - Analytics M2M
  - Analytics for Enterprises Transport and Public Safety

+ **Smarter Home Grid and Energy Smart Customers**
  - Full redundancy in communications
  - Integrated information from devices to developers
  - Direct control of loads/Demand Management via SSO
  - Outage & service condition information via SSB
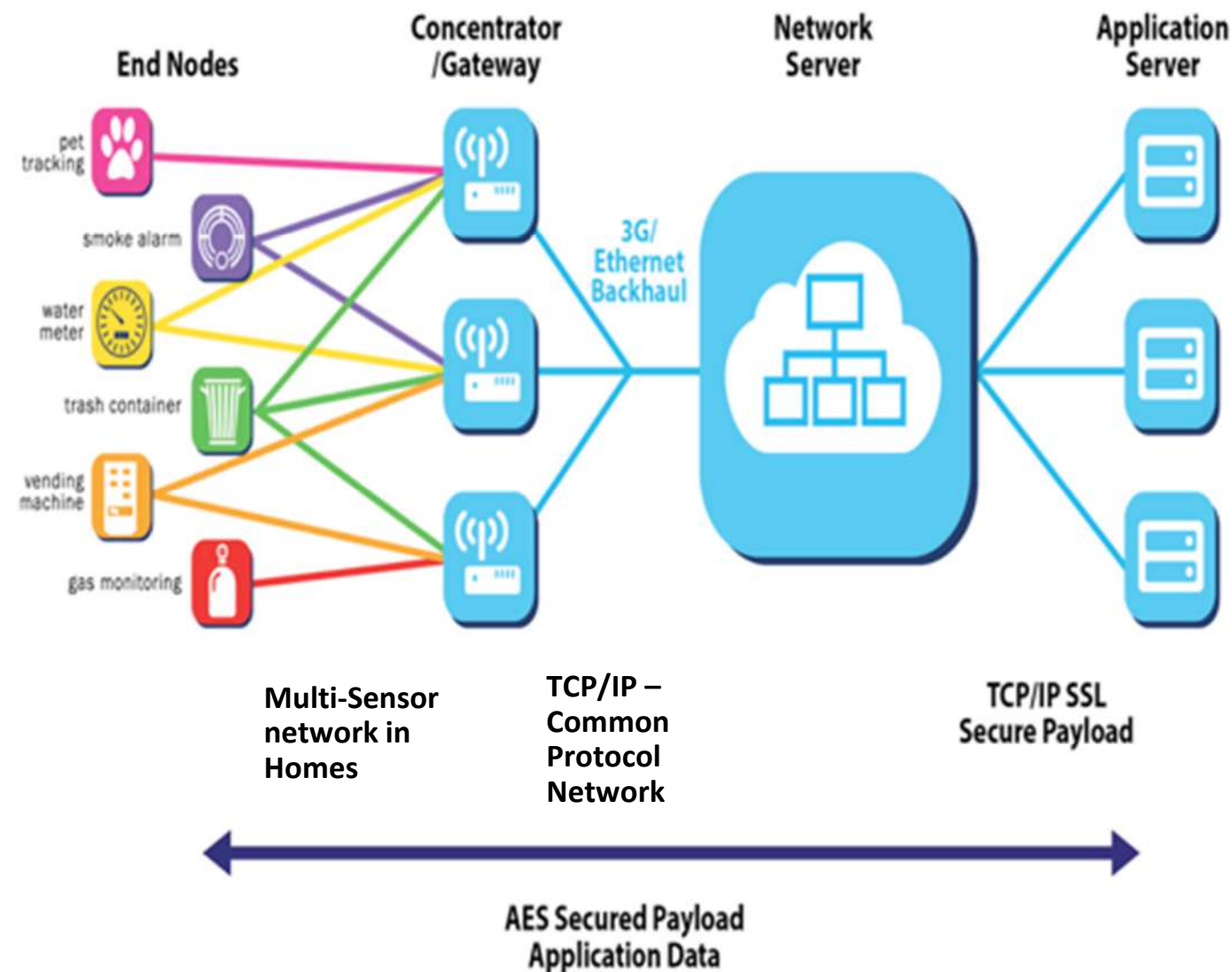
+ **Built with the future in Mind**
  - Lowering costs for connectivity
  - Leverage open architecture principles in system design
  - Future customer service offerings for energy retailer, security, tele-health, tracking and many others

We believe in creating the environment, the ecosystem and finally the people skills to encourage innovation and development….
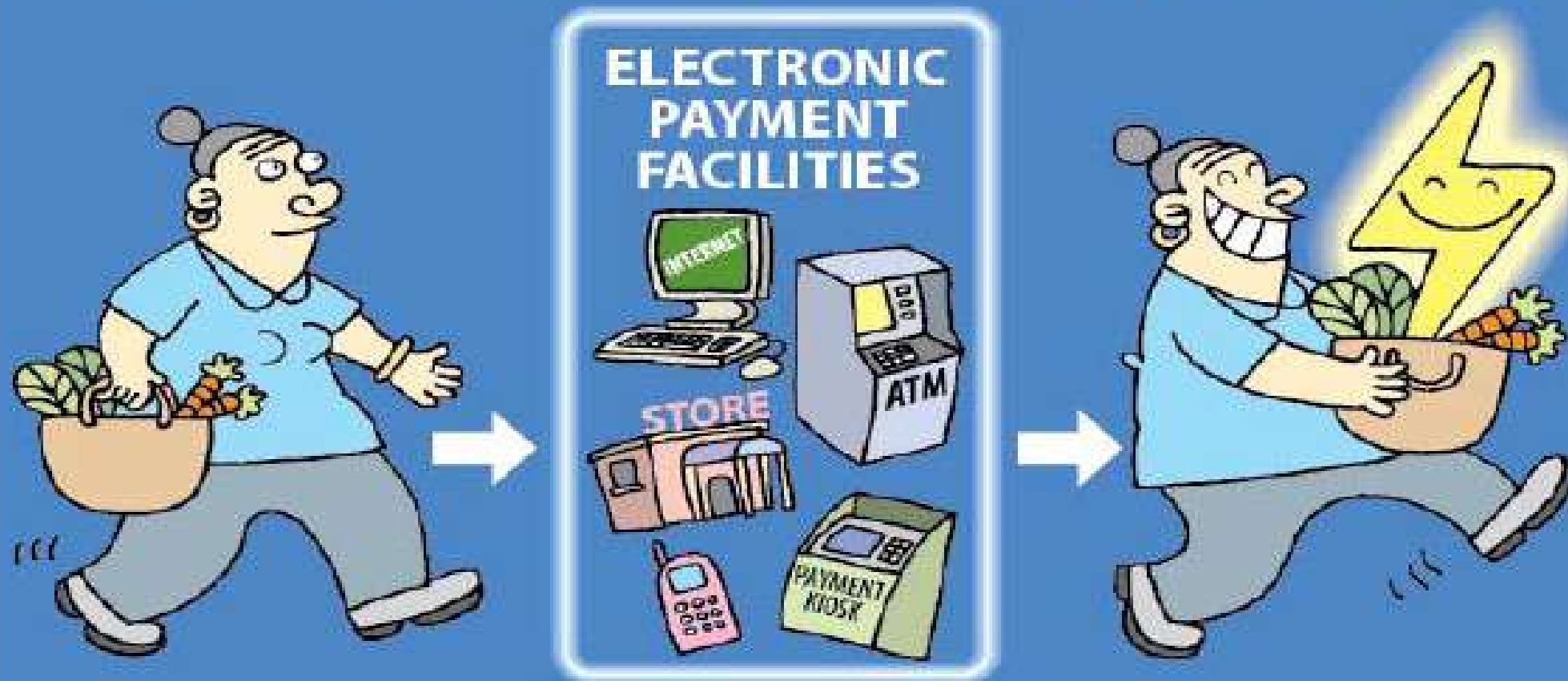
Smart City Challenges

+ There are many challenges in the vision for Smart Homes in a Smart City
  - Increasing expectations of consumers
  - Cost of Communications
  - Need to integrate large number of sensing devices
  - Different Agencies different needs and different KPIs – e.g How do we support demand management for EMA, tele-heath for MOH, How do we monitor noise pollution for NEA ?

+ Need for a Universal Gateway, Standards, Safety Code… ?

+ Need for a Common Protocol or support for Multi protocol ?

+ Need for a **Device Management System** to securely handle all types of sensors, sensor networks, protocols at the last mile network. Centrally managed all their software security, packages

+ Ensuring a secure network approved by CSA

+ Must be a **Cost effective** Network

End Nodes — pet tracking, smoke alarm, water meter, trash container, vending machine, gas monitoring

Concentrator /Gateway

Network Server — 3G/Ethernet Backhaul

Application Server

Multi-Sensor network in Homes

TCP/IP – Common Protocol Network

TCP/IP SSL Secure Payload

AES Secured Payload Application Data

Results from the EVS

+ The EVS Trial Run at Marine Parade has ended successfully on 31st July 2009 as scheduled with 1000 consumers

+ A post-Trial Run survey was conducted

+ Normal Billing resumes after the Trial

+ Survey Findings

  – For the same period of time, the volunteers' consumption were found to rise less than the national average

  – Load Shifting, Load Saving – Awareness of Usage by 10%

  – Average usage reduce by 3%, highest savings at middle to high income households

+ The Secret to savings – The Maid…

+ Currently we have around 5000 meters used for EVS metering for private Master- Sub metering for commercial/Tenant/Student complexes

Our Smart Home Components

+ **Smart Home Management System:** A Device Management platform to manage all their homes remotely, control all devices, their upgrades nand support the building of smart applications by others for the future homes.

+ Smart Home **Universal Gateway** inside our Smart DB (SSB) to handle
  - data storage/depository,
  - Analytics
  - Allow ecosystems to build other apps on Open API
  - security, connectivity and data collection in a reliable and robust manner.

+ **Smart Sockets (SSO)** for detail load monitoring and allow "load curtailment" to turn off ONLY.

+ Allow Connection Other Devices

System Architecture

Redundant Sensor Cloud Control Centre

Central Management System

Direct Motion + light

Sensors

WIFI Wall Plugs with USB (optional)

Internet Connection

Connect to Home WIFI

WIFI + BLE

NB-IOT Connection, where applicable

Smart DB

PIR, Camera, Temperature, Ultrasonic Sensors for home security can be added by residents. Home Payment Services

Built in Raspi 3 DIN Rail Smart DB gateway:-

- Quad Core 1.2 Ghz
- 1GB RAM, 8 GB SANDisk
- 2 X WIFI Cards, BLE, 2 expandable USB for additional networks (NB-IOT + Zigbee)
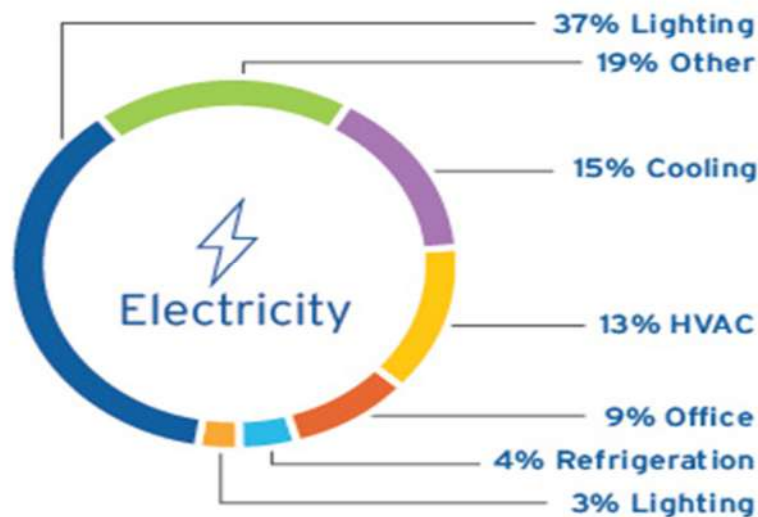- Prosyst MBS Device Platform Managing Agent

One Dedicated Device SSID to manage all equipment provides better stability and security

The Universal Home Gateway Enabler

By enabling the following features, it sets the foundation for other applications by covering some of the most expensive and difficult features to be provided as part of the common package

They include

1. **Financial/Bank Grade Security**

2. **Central Device Management System**

3. **Non Intrusive Load Management (NILM)**

BANK-GRADE SECURITY

256-BIT SSL ENCRYPTION

REAL-TIME DATA BACKUP

SSAE-16 DATA CENTER

TWO-FACTOR AUTHENTICATION

tax1099

Electricity

37% Lighting
19% Other
15% Cooling
13% HVAC
9% Office
4% Refrigeration
3% Lighting

Smart Analytics and Smart Home Assistant

+ Smart Analytics and Load Segregation
    - Ability to identify the the usage to each type of appliance
    - Perform both front and back analytics allows the flexibility to improve user response and yet allow HDB to conduct deep research on the collected data

+ Smart AI Home Assistant App (e.g. The Butler App)
    - The app will be the common app to use to manage the homes and its devices, like a master controller to enable and disable any devices and connections.
    - Users can use it to manage their SSO and standard sensors.
        – Smart Control Schemes
        – We have added contact sensors including door contactor, motion sensors, temperature sensors, WIFI Camera, WIFI smart plugs, smoke detectors and of course, the new SSOs to make such services more viable as the cost of providing the gateway as part of the HDB setup.
        – We will also possibly install a common last mile network for critical alarms such as smoke alarm, security and state of health sensors.
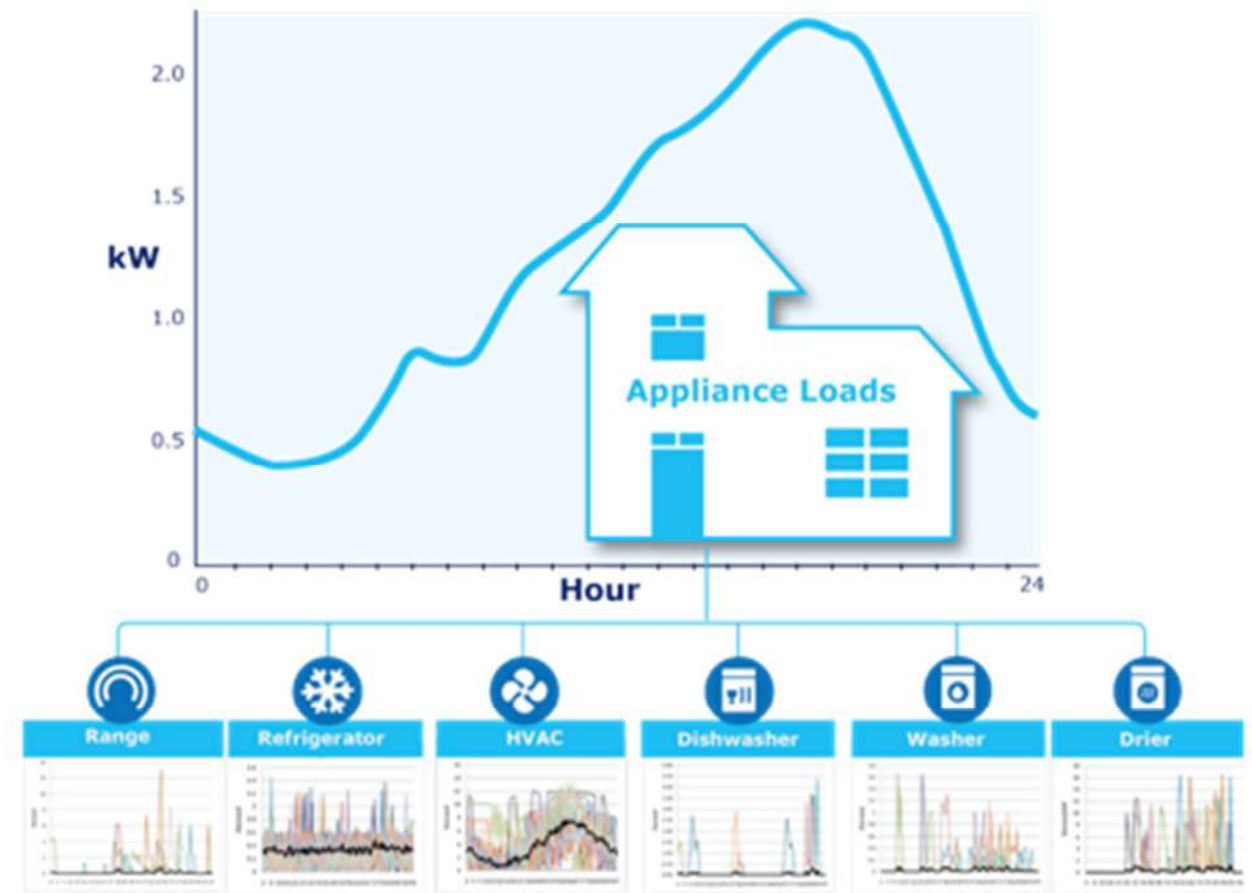
The electronic Butler

NILM Analytics Platform

+ Load Analytics Intuitive control apps

+ Load Identification for Energy retailer Energy valet services

+ Load Curtailment- demand management

+ Condition based monitoring **

What Lies under the curve ?

Use Case Scenarios - Energy Valet Services by Energy Retailers

+ **Use Case Scenario – Allowing Retailers to Manager your Usage**

+ At the current setup, retailers offer a package and customers choose a package

+ By allowing creating a trusted environment, retailers can offer smart sensing such as motion sensors, temperature monitoring and usage analysis to assist end consumers to manage their load

+ Imagine an infrastructure that allows adding of sensors and SSO with control
  - Retailer A offers an energy package with peak and off peak
  - Retailer B offers a similar energy package but gave a package of $150 smart sensing package which include motion sensors, noise sensors and 3 temperature/thermostat sensors to decide if the customers is at home, number of people at home, temperature in the room. With this, they can
    - Auto increase or on/off the aircon via thermostat to the aircon
    - Using the SSO to off the TV, Fan and even the water heater, when no one is bathing.
  - Retailer C offers an interruptible load scheme, where he allows retailer to turn off their loads when its needed due to a generation loss, fault .. To balance the grid. He gets paid by standing by. This retailer managed to find 100,000 aircon of 3 KW each (300 MW), 200,000 TV of 500 W (100 MW) each and other loads that can turn off. All by just offering an app provided based on Smart Sockets to indicate
    - Intent to participate, which loads and we will measure its capacity
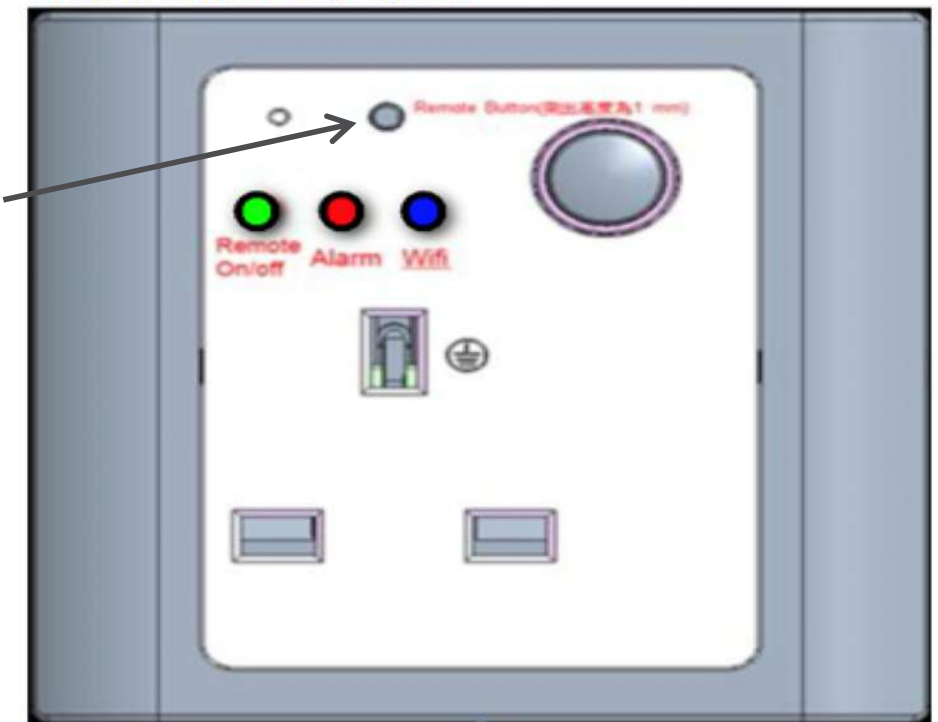   - when he wishes to participate
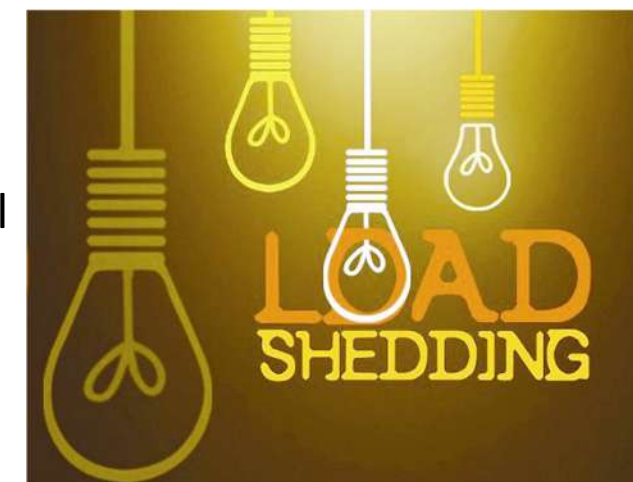
Smart Sockets Key Features

+ Ability to curtain load Smart Sockets with built in power metering and built in relay for 20 A

+ Comes with wireless connectivity and ability to "disable" the remote control via a "Tact Switch"

+ Clear indication that the "remote control" feature is on or off. When on, it only allows turning off

+ User can simply press a button on the face panel to disable it and when turned on, app will counter check to request for identification of load and enabling with a password

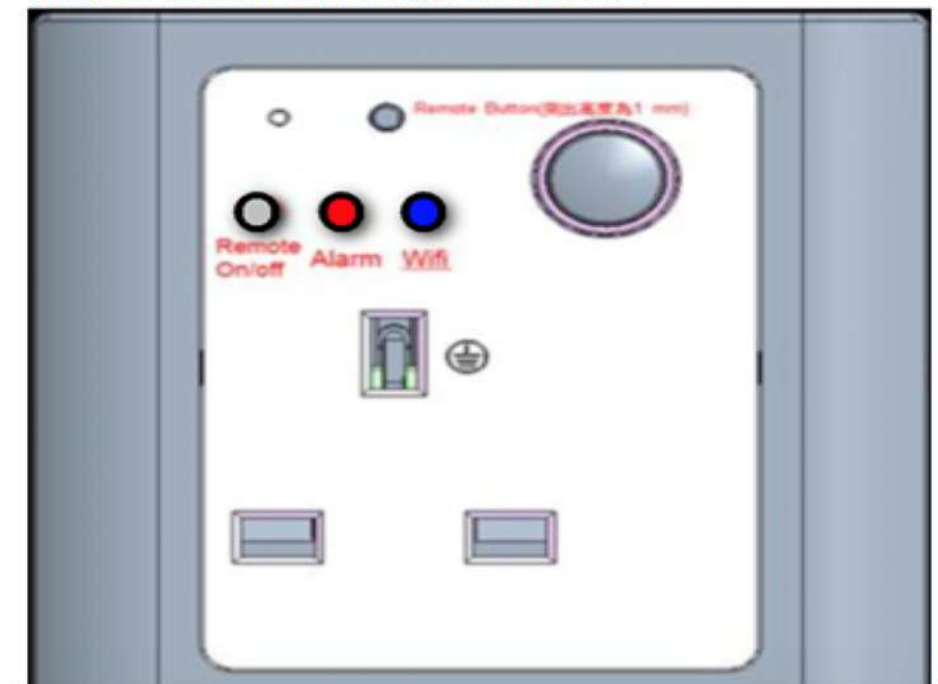+ When there is load change, remote control will be turned off and ask owner to check

Wi-Fi connectivity indicator: **Blue**
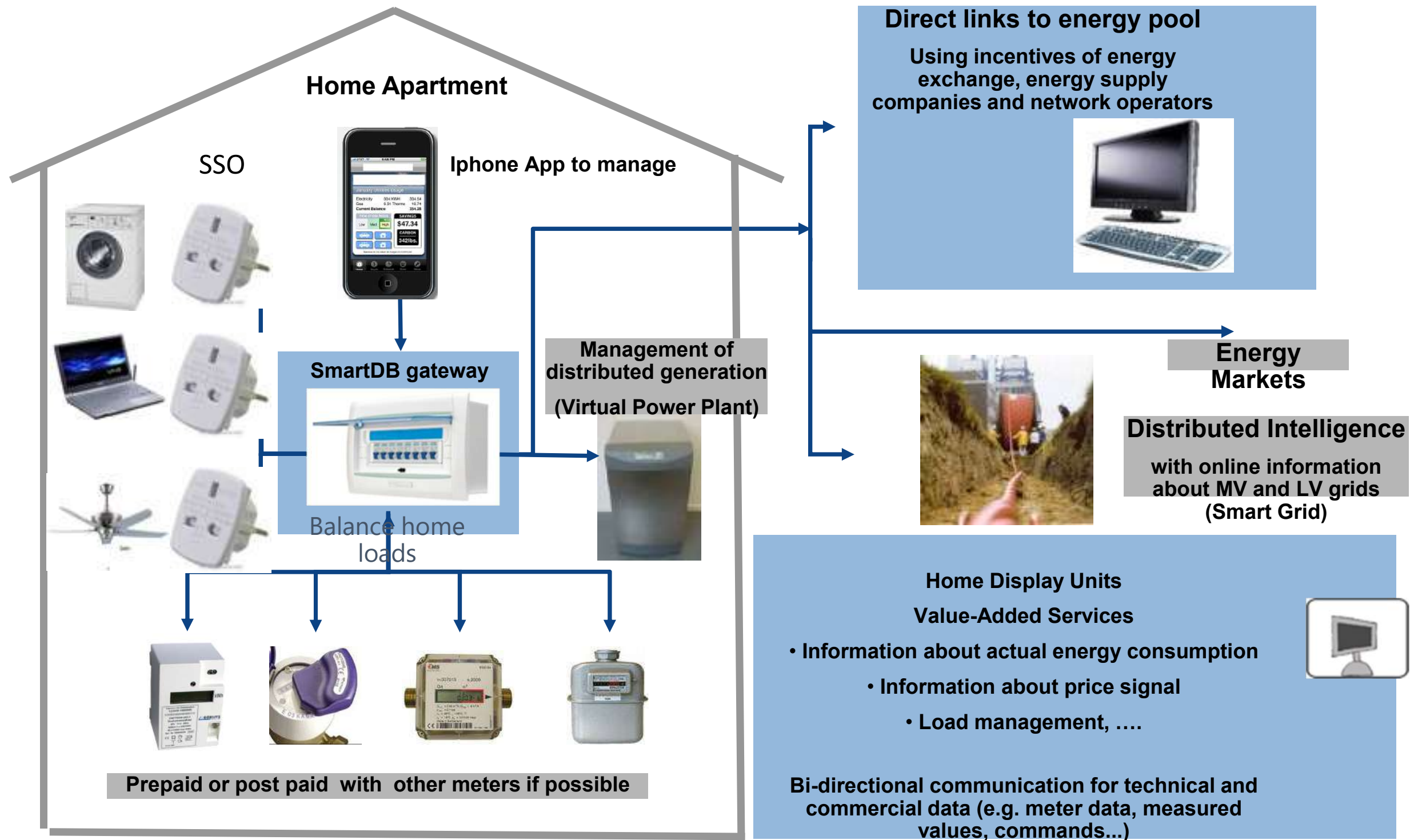Alarm indicator: **Red**
Remote control **ON: Green**

Remote on/off

Remote control OFF: Turn off indicator

Smart Home/Smart Grid Applications

Home Apartment

SSO

Iphone App to manage

Direct links to energy pool

Using incentives of energy exchange, energy supply companies and network operators

SmartDB gateway

Management of distributed generation

(Virtual Power Plant)

Balance home loads

Energy Markets

Distributed Intelligence

with online information about MV and LV grids (Smart Grid)

Prepaid or post paid with other meters if possible

Home Display Units

Value-Added Services

• Information about actual energy consumption

• Information about price signal

• Load management, ….

Bi-directional communication for technical and commercial data (e.g. meter data, measured values, commands...)

Use Case – Security Services

Using the same home gateway, low cost sensors can be deployed in ubiquitous ways. They can include

- Motion

- Noise

- Door contacts

- Window contacts

- Pressure sensors

- Light sensors – thief usually use torchlights to see what they stealing.

- Device Management from single gateway

A low cost solution that are more secure and easy to deploy

Imagine, a security service for $2-3/month. Just by adding door contactors and motion sensors, easily connected to the gateway.

Other Use Case Scenarios

+ Water and Gas metering for households for usage analysis

+ Other Services
  - Elderly Care– motion sensors in toilets, detect falls, heart sensors connected via Zwave - reduced healthcare costs
  - Noise monitoring
  - Tracking

 *Using a secure trusted gateway lowers cost to all by having a shared platform

Financial Grade Encryption

Community Connectivity everywhere

- Community Network – Community Responders – they provide "Assured Connectivity" for security and alarms and responds to emergency to homes nearby- 3 per block

- By providing connectivity everywhere, we hope to offer a common network for many services

- Reduces cost of setup and running cost to service providers and benefit the public
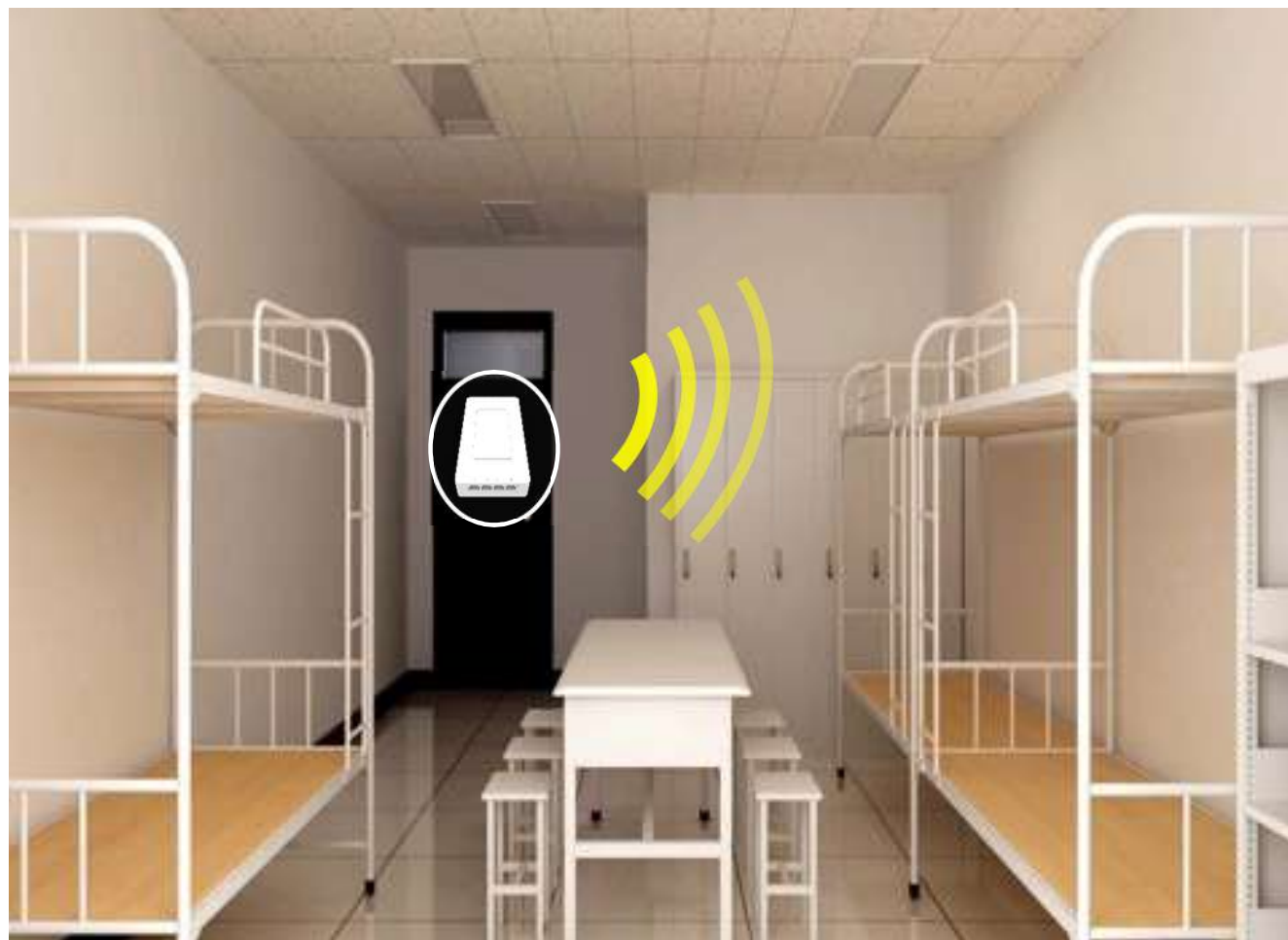
Fiber

Conclusions

Building the universal gateway that supports a built in wireless network and smart applications provides foundation for the smart city

Providing a device management platform that can collect data, manage data and millions of devices including lighting device, meters, beyond what a typical Smart DB head end can handle.

Independent RF Network ensures the lowest costs of setup and maintenance

Smart Homes/ City is gaining momentum worldwide

The key is to allow partners and developers to innovate with the right policies