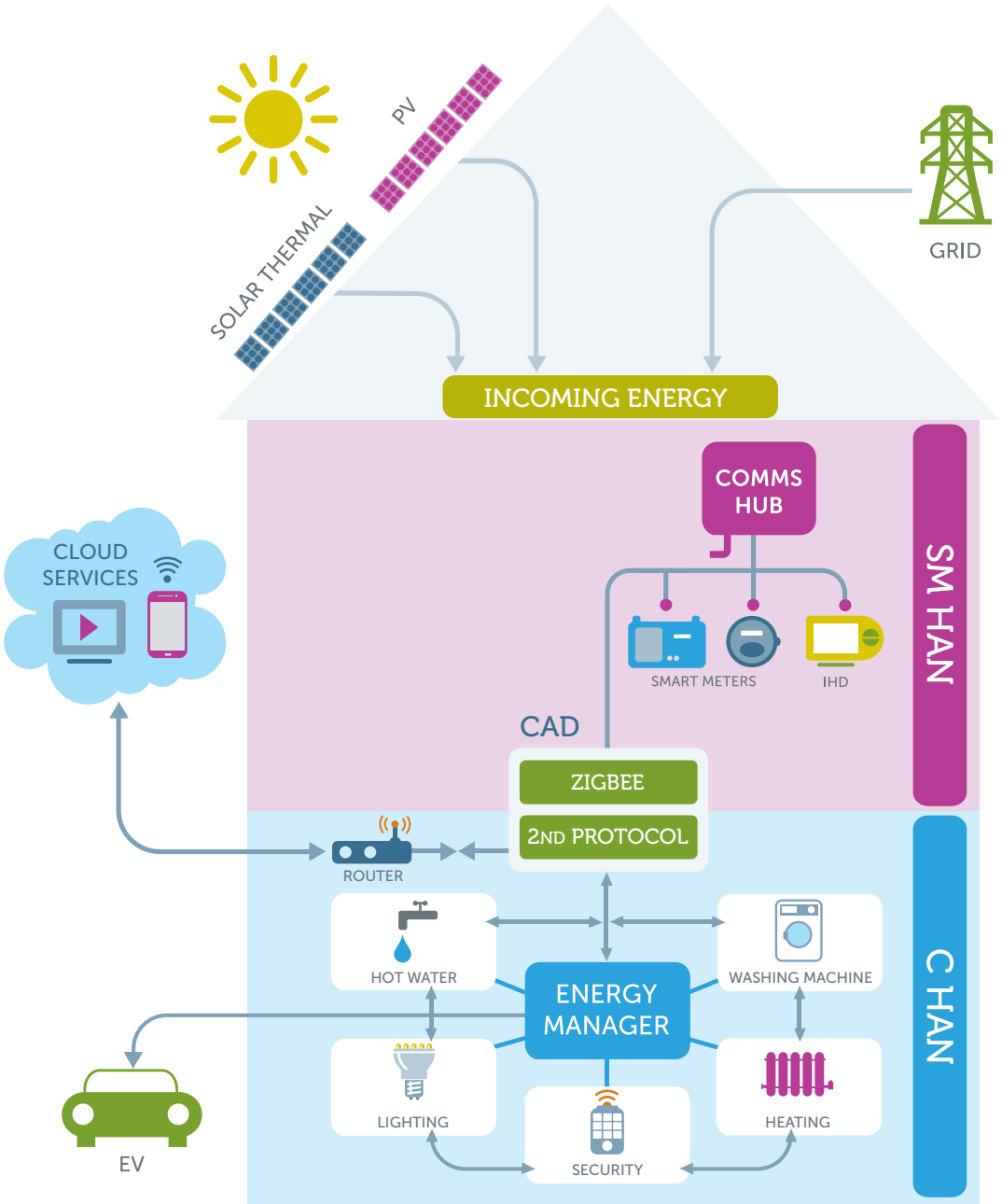
Bringing power to life.

The BEAMA Connected Homes Demonstration

BEYOND SMART METERING

applications for connected homes



legrand CHAMELEON Itron Vaillant Dimplex geo

INTRODUCTION

The Smart Meter rollout will create an unprecedented new platform for innovation in energy services – 53 million smart electricity and gas meters will be installed by energy suppliers in homes and small businesses by the end of 2020, each storing a consumer's consumption and tariff information. It is this platform that supports the development of new technologies and services in the Consumer HAN and empowers consumers to take energy saving measures. This will allow consumers to switch energy supplier more easily and end estimated bills .

BEAMA is the leading trade association that represents manufacturers of electrical infrastructure products and systems from transmission through distribution to the environmental systems and services in the built environment.

The connected homes market is an important sector for BEAMA and BEAMA members, including the mandated rollout of smart metering equipment and in-home displays across Great Britain.

The GB smart meter rollout places a strong emphasis on consumer benefits and the pace of market demand for consumer engagement solutions in the UK is greater than anywhere else in the world. BEAMA expects to see significant innovation in consumer energy management as part of the Consumer Home Area Network (C HAN), following the rollout of smart meters.

Smart meters provide the foundations for engaging consumers and there are multiple benefits consumers will be able to access with the right service provision and technology available on the market. Here, BEAMA has sought to demonstrate a handful of applications and customer options, as part of a much wider market.

The Connected Home

Smart devices in the home can operate in isolation to manage the efficiency of individual services (heating, hot water, lighting, assisted living etc). These can operate without a remote connection to the outside world (internet connections) and without incoming energy use data from the grid and/or local onsite generation. But when combined as a system, incorporating home energy management or a hub to receive data from the outside world – the efficiency of an automated system is increased and the benefits are multifaceted. Here the role of automation is key and can ensure consumers maintain comfort in their home while reducing energy costs and peak demand.

The connected home can be broken down into two Home Area Networks (HANs), the Smart Metering HAN and the Consumer HAN (Fig 1). The Smart Meter HAN (SM HAN) is mandated and defined for every GB household, while the Consumer HAN (C HAN) is unique to a customer's requirements and building type. It is in the C HAN where we are seeing a significant amount of innovation today.

THE GB SMART METER ROLLOUT PLACES A STRONG EMPHASIS ON CONSUMER BENEFITS

THE GB SMART METERING HOME AREA NETWORK

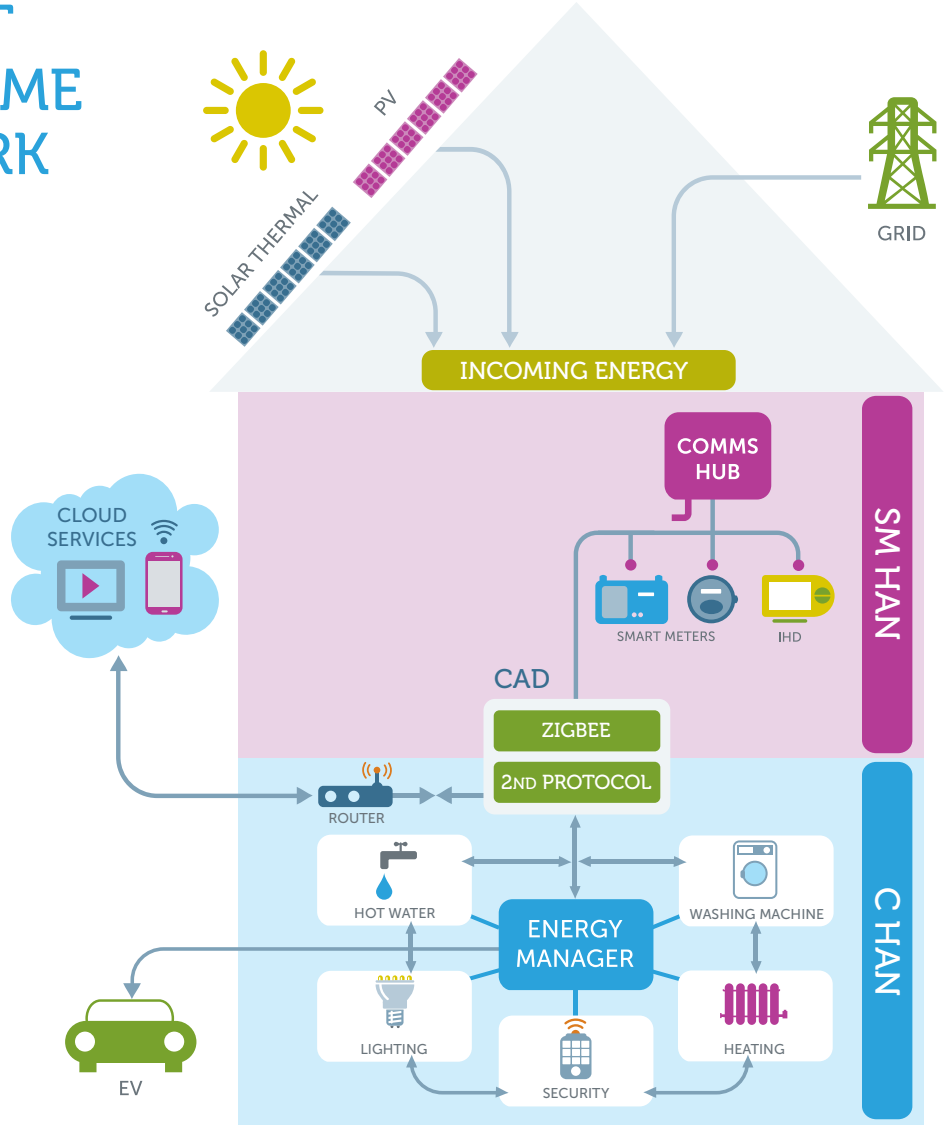


FIGURE 1: CONNECTED HOME ARCHITECTURE

Accessing data via the Home Area Network

Smart Meters will establish a wireless 'Home Area Network' in a consumers home. This will be a local ZigBee wireless network (SM HAN) which gas and electricity smart meters and in-home displays will use to exchange data. Consumers will also be able to pair other devices that operate ZigBee Smart Energy Profile (SEP) to this network; such devices are typically known as Consumer Access Devices (CADs). The CADs being produced today are small boxes that connected to WiFi routers to stream energy data. The smart metering system must support a minimum of 4 CADs in the property, including an In-Home Display (which all consumers will be offered when they have a smart meter installed). The process for consumers to pair a CAD device to the SM HAN will be available from the start of GB rollout in 2016.

ZigBee Smart Energy Profile

The ZigBee Smart Energy protocol is going through the process of becoming a European standard (EN) through CENELEC and should be published by end 2015. The ZigBee Smart Energy Protocol communicates at a frequency of 2.4GHz (the same as many other wireless devices), and trials are currently under way to determine the best technical and policy solutions to overcome any potential range limitation of this frequency. A fully tested HAN solution is expected to be completed for volume release in 2017.

The ZigBee Smart Energy Profile has formed the basis for the HAN in SMETS1 meters, of which 2 million have been successfully installed, providing valuable experience, momentum, and consumer and market confidence for the rollout.

For more information on the role of the DCC and remote access via the Wide Area Network using the DCC please refer to the leaflet published by DECC, Smart Meters, Smart Data, Smart Growth.

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/397291/2903086_DECC_cad_leaflet.pdf

THE CONSUMER HOME AREA NETWORK

What is a CAD?

A CAD IS A PHYSICAL OR LOGICAL DEVICE THAT LINKS THE SM HAN AND THE C HAN WHICH IS LINKED TO A WIDE RANGE OF FIXED AND PORTABLE BUILDING SERVICE TECHNOLOGIES. THE CAD IS A GATEWAY FOR DATA INTO THE C HAN.

The Consumer Home Area Network (HAN) is where we see significant innovation, and this is unique to each customer. The Smart Metering HAN is a fixed piece of infrastructure that has been designed to ensure the existence of a Consumer HAN. The two key features that ensure this are; the Consumer Access Device (CAD) and the In-Home Display (IHD).

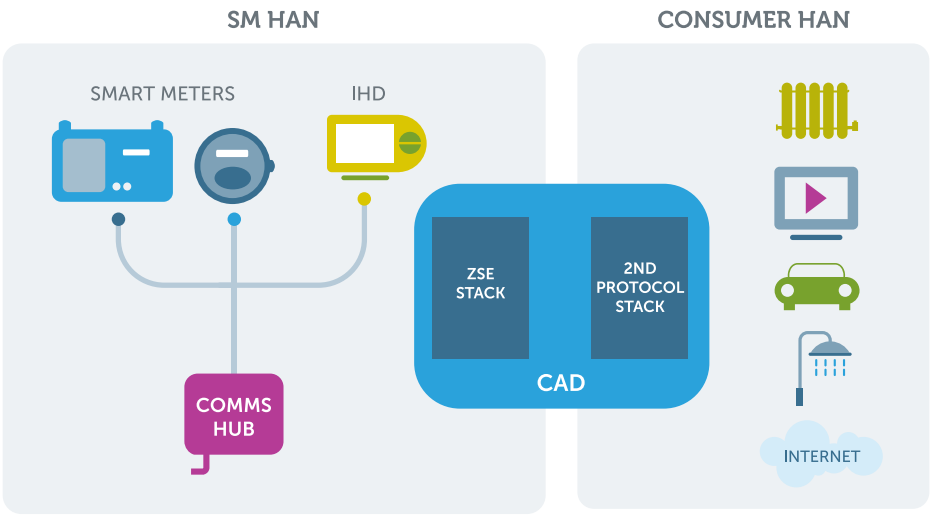


FIGURE 2: THE CAD GATEWAY ARCHITECTURE

When paired to the SM HAN, a CAD will be able to access updated consumption and tariff information directly from their smart meter; a CAD can request updates of electricity information every 10 seconds and gas information every 30 minutes.

To promote innovation, DECC have not set any further requirements for CADs. This means that businesses can provide CADs that, as well as operating ZigBee, can also operate other communication protocols (e.g. WiFi or Bluetooth). Such CADs could forward data to other non-ZigBee devices within the home (smart appliances) or via the internet (e.g. for remote analysis or display on a smart phone).

This means that businesses who offer related products and services – such as smart heating systems or home automation controls – could access energy and tariff data from the smart metering system by building support for the ZigBee Smart Energy Profile into their hubs.

The CAD is configured to return data to a service provider or to another devices (e.g. smart phone). This data will not go via the DCC – it will be sent via an alternative communications system (e.g. via WiFi or via a consumer's internet connection).

The ability for devices to share data across different platforms is an important enabler of the 'Internet of Things' (DECC Smart Meters, Smart Data, Smart growth 2014).

For more information on CADs please refer to the BEAMA CAD Guide
http://www.beama.org.uk/resourceLibrary/consumer-access-devices-a-beama-guide.html

DEVELOPING A MARKET FOR CONNECTED HOMES

Providing Interoperability to consumers

There is a lot of work already ongoing in Europe to develop standards for connected devices in homes (e.g. CEN CELENEC TC 205). A lot of this standardisation work will achieve common data objects and use-cases to be applied by the range of technologies on the market, thereby ensuring interoperability of devices.

BEAMA supports the need to ensure open standards in the Consumer Home Area Network as a means to achieving interoperability and ensuring we do not lock consumers into one technology. BEAMA members acknowledge that very few consumers purchase devices and appliances from the same manufacturer and therefore, in maintaining open standards we will ensure the interoperability and inter-changeability of devices and appliances in the home. We therefore do not need to mandate the communication infrastructure in the C HAN.

Access to data and connected devices

There are a number of ways in which consumers and / or appliances can access data via the CAD. The CAD can send data gathered from the SM HAN and C HAN to the cloud to enable the provision of energy management applications to consumers, and also within the home direct to devices and appliances (Fig 1).

Connection to the SM HAN is prescribed. The other side of the CAD and link to C HAN is where a number of communication options exist (Fig 3). The second half of the CAD (2nd protocol stack ref Fig 2) is typically used to enable the Smart Energy information to be used by other systems and devices. This interface could be proprietary or through a standard Application Programming Interface (API).

The CAD can bridge to other devices in the home directly without sending data to the cloud. In this case hardware and associated software would be required to support connection with other devices and smart appliances.

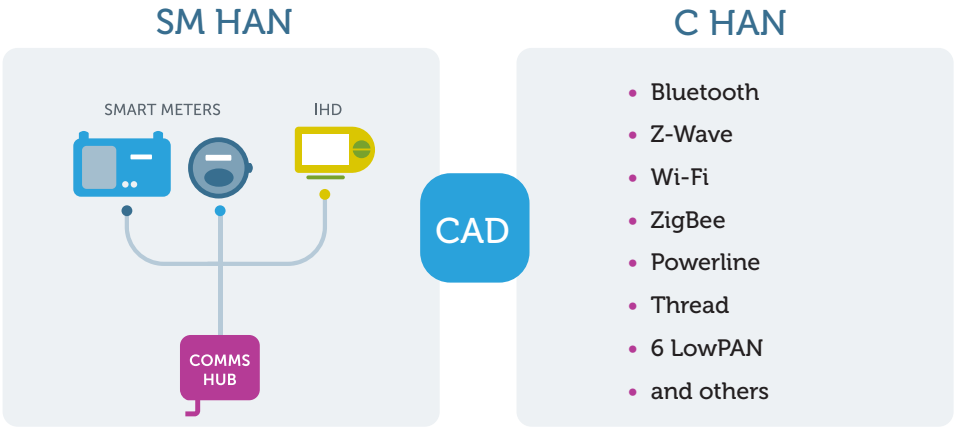


FIGURE 3: COMMUNICATION OPTIONS IN THE C HAN

Next steps for the connected homes market

- Allow the standardisation bodies to determine the common technology platforms for connected devices. It is too early to mandate this through regulation or government programs given the infancy of the market. Consumer interests are best served by international standardisation rather than by market forces.
- The value proposition for domestic customers hinges on having the right market proposition from energy and service providers, and tariffs that enable and encourage consumers to reduce peak demand. The timing for reform in this area and the provision for demand flexibility in the market for domestic customers' needs to be mapped out so that manufacturers and the standards bodies can move forward.

The timely development of standards and market incentives will depend on customer demand and engagement. Market projections for this sector vary considerably but expectations are that up to 27% of UK households will have at least one smart system, including smart thermostats and energy management platforms by 2020 (Strategy Analytics).

For more information please view the BEAMA Consumer Access Device Guide
http://www.beama.org.uk/resourceLibrary/consumer-access-devices-a-beama-guide.html

THE BEAMA CONNECTED HOMES DEMONSTRATOR

Participating companies:

CHAMELEON™

Dimplex

geo GreenEnergyOptions

Itron

legrand

Vaillant

Introduction

BEAMA members have collaborated to develop demonstrations of how the smart metering infrastructure will facilitate more advanced demand side energy management for domestic consumers, and improve the efficiency of existing services including heat and hot water.

The equipment demonstrated is all available in today's market. However, the applications of Time of Use (ToU) tariffs and associated services we are showing are however not available today. There are steps member states need to make to ensure the market for energy flexibility is something consumers can participate in, and are rewarded for. In doing so the full range of benefits facilitated by smart metering will be achieved.

THE BEAMA CONNECTED HOMES DEMONSTRATOR

Demand Side Response

Electricity Demand-Side Response (DSR) refers to a system in which consumers adjust the amount of electricity they use (their demand) at particular times in response to a signal (e.g. tariff). In this demonstration we have applied a 3 tiered tariff structure similar to that trialled in Low Carbon Network Fund projects, as a means to show the applications customers can access for domestic energy systems. The tariffs applied aim to demonstrate how consumers can reduce peak demand and improve the overall efficiency of primary services (heat, hot water, lighting etc).

Tariffs applied in the demonstration

High price = 23.52 pence / kWh
Medium price (default) = 11.76 pence / kWh
Low price = 3.99 pence / kWh

For the purposes of this demonstration we have not focused on issues around pricing, as this is covered through trials and LCNF projects. Our objective for this project is to showcase the range of benefits consumers could access in a demand-side market, and related technology applications .

BEAMA have published a separate policy document to outline the market barriers that exist for customer services of this kind, and the associated industry recommendations going forward.

Demo Scope

The demonstrations are based on automated systems in the home. A review of previous DSR trials with a range of different tariffs has found that it is 60 – 200% more effective to apply automation for peak energy demand reduction (Frontier Economic and Sustainability First 2012). In most cases this also helps ensure the efficiency of the energy services in the home. Customers will always have control and override of any automated system, and industry are producing a range of effective applications and platforms that make it easy for consumer to engage with their energy use.

Each panel contains a Smart Metering Home Area Network (SM HAN), including all mandated equipment under the GB smart metering program, plus a CAD. The key focus of each panel is the IN HOME DISPLAY, this is where you can view real time consumption and tariff data in the home, and from this understand what is triggering actions in the Consumer HAN.

The following pages provide more detail on the scenarios demonstrated by the BEAMA members.

Connected Homes and Smart Metering

This demonstration shows the integration of the SM-HAN to C-HAN via the Consumer Access Device (CAD). The simplified demonstration is based around a 3 level Time of Use (TOU) tariff structure. The demonstration includes the availability of onsite generation through an installed PV array. Only electricity use is considered in this demonstration.

The C-HAN automates the switching of the various loads within the house based on the tariff in operation. The load level and cost being experienced is made available to the user through both the In Home Display (IHD) and the Smart Meter display.

In addition to **automated switching of the house loads through the energy manager system, users are able to manually turn off or on loads through touch screens or switches –** the resultant changes in the total house electricity load is displayed on the IHD and meter.

In the event the Assisted Living Alarm is triggered, the C-HAN will switch the loads to a predetermined setting whatever tariff is in operation – in the demonstration relevant lights and heating are turned on.

Using the secure SM-HAN, tariff and load information from the Smart Meter is transmitted to be displayed by the IHD and simultaneously transmitted through the CAD to the C-HAN. Using the 3 fixed TOU tariffs being applied in the demonstration, the C-HAN energy manager uses the tariff information to generate 4 broad scenarios:

Morning (High price): loads mainly lighting and other general loads are low

Midday (Medium/Default price): loads all within PV generation capacity – no grid power used

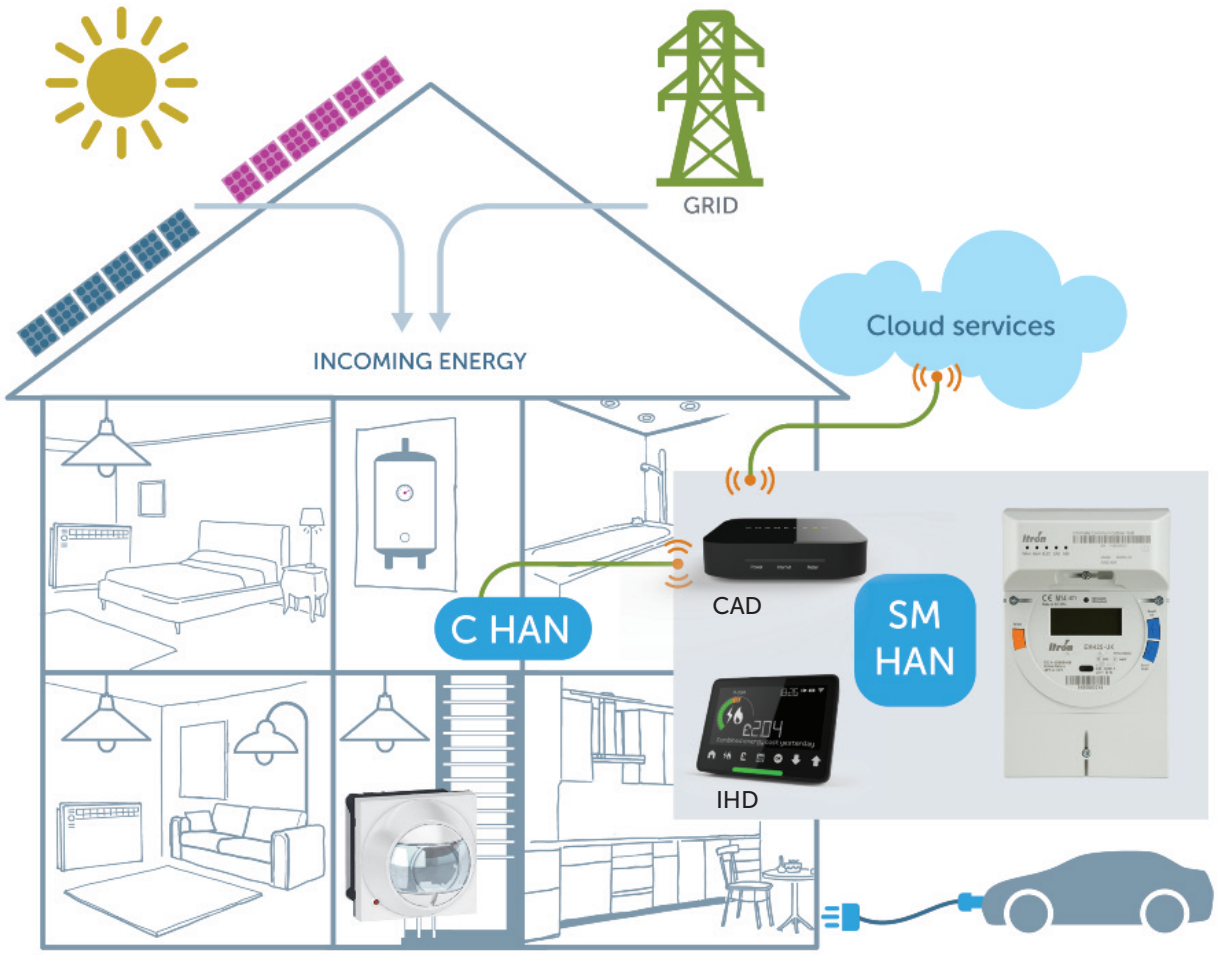
Evening (High price): loads mainly lighting and other general loads are low

Night (Low price): Storage loads (heating and water) and EV charging

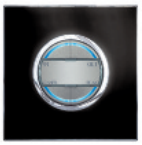
Participating companies

legrand® Itron CHAMELEON™

Connected Homes and Smart Metering



CONTROL SCREEN



SCENARIO SWITCH

CONTROL SCREEN

ASSISTED LIVING ALARM

Connected Homes and Hybrid Heating Systems

This demonstration shows the integration of the SM-HAN and C-HAN via the Consumer Access Device (CAD). The simplified demonstration is based around a 2 level Time Of Use (TOU) tariff structure. The demonstration focuses on domestic heating and hot water. The hot water used for showering and washing is stored in the hot water cylinder. The two sources for this hot water are the solar thermal hot water panels installed on the roof, or when the sun is not shining the gas boiler quickly and efficiently supplies this energy.

The heart of the hybrid heating system is the smart thermostat which intelligently and automatically switches on the most efficient heating appliance. During a heating demand shown by the LED next to the thermostat, the system is calculating if the gas boiler or the electric heat pump should provide heating to the radiators. This switching can be seen during the simulation with the green LEDs next to the heat pump and boiler.

The thermostat calculates the efficiency of the boiler and the electric heat pump, looking at the tariff information for both heat sources, in this example natural gas and electric. As the electrical tariff changes the actual cost of running the heat pump will change and the intelligent thermostat will review the heating requirement and switch between the heat pump and the boiler.

Most importantly this all happens automatically with the intelligent thermostat receiving the information via the gateway from the CAD. The switches between the boiler and heat pump with no loss of heating comfort or interruption to the home owner. The homes will always enjoy the lowest cost and most efficient heating whilst the energy demand is pro-actively managed.

Morning: heating demand starts early morning, and the heat pump starts warming the home. As people wake and electricity demand and costs increase the system switches to the boiler.

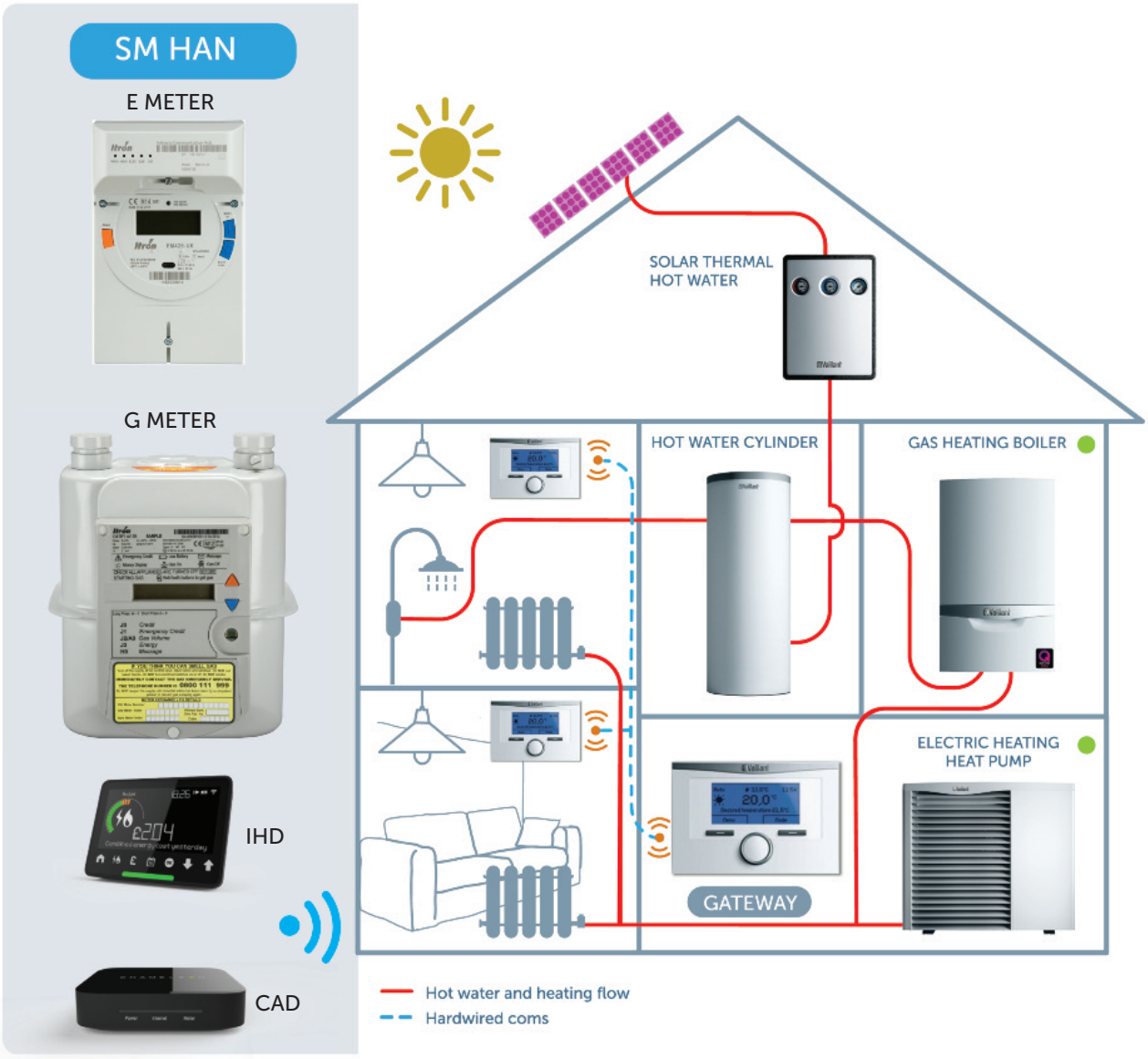
Afternoon: heating demand required, heat pump starts to meet the heating demand, as people return home from work and start cooking, electrical demand and costs increase, the system receives an update and the system switches to the boiler.

Evening: As the electrical demand and costs being to drop the system again updates switching the heating back to the heat pump.

Participating companies

Itron Vaillant geo GreenEnergyOptions

Connected Homes and Hybrid Heating Systems



Connected Homes and Electric Heating Systems

This demonstration shows the integration of the SM-HAN and C-HAN via the Consumer Access Device (CAD). The simplified demonstration is based around a 3 level Time Of Use (TOU) tariff structure. The demonstration includes the availability of onsite generation through an installed PV array and solar thermal. This particular demonstration focuses on displaying applications for electric heat and hot water systems and the dynamic between onsite generation, customer demand and electricity price.

The home Hub takes this input of data containing the tariff structure and aligns it with the future energy requirements of the property. A structure of energy storage devices for heating and hot water combined with this smart interpretation of supply availability allows energy to be bought when it best suits the supplier, and then provided when it best suits the user.

12am – 7am (low rate tariff)
When supply is readily available and the tariff rate is low, the smart electric property stores energy in heating and hot water products, ready to supply demand later during the day.

7am – 5pm (domestic generation)
Should any domestic generation become available, this will also be used optimally, running any appliances that are on in the house, directing any excess into the property's hot water stores for use later in the day.

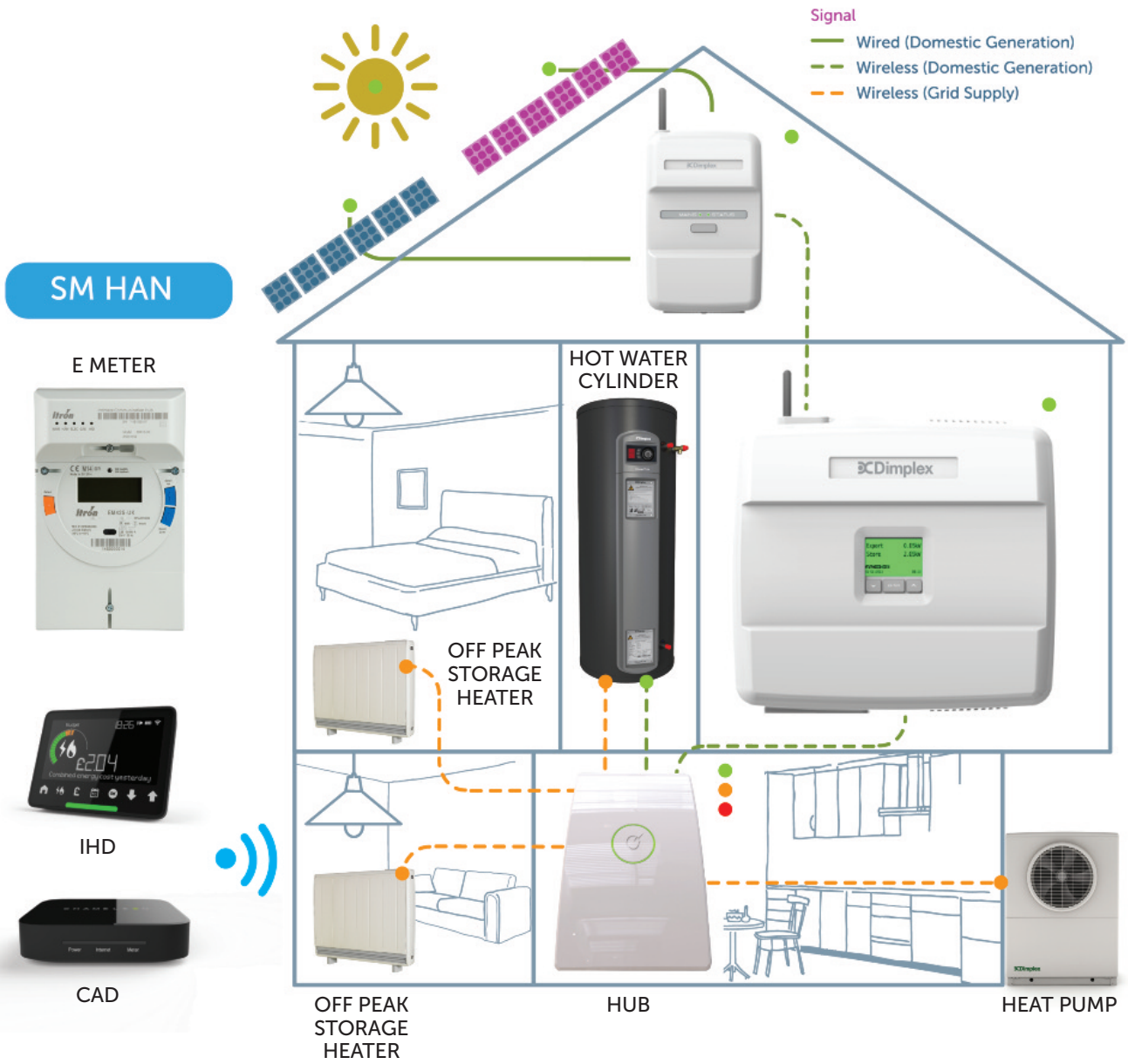
5pm – 9pm (high rate tariff)
When demand is stretched and a high tariff rate is introduced, the property minimises its requirement for energy from the grid, using the heat and hot water stored when the tariff was low and domestically produced energy were available.

9pm – 12am (low rate tariff)
When the low tariff comes back in the now depleted reserves are restored and the system makes use of excess supply, ready for use during the next high-tariff period.

Participating companies

Itron geo DCDimplex

Connected Homes and Electric Heating Systems



THE TECHNOLOGIES

Chameleon Technology (UK) Limited: IHD3-HS-PPMID and Consumer Access Device (CAD)

IHD3-HS-PPMID:

The Chameleon IHD3 is an award winning In-Home Display (IHD) with integrated Pre-Payment Meter Interface Device (PPMID) functionality.

Specifically targeted at the mandated utility space, IHD3 is positioned to offer a low cost, engaging customer solution, which is compliant to all relevant standards and can support additional value efficiencies as part of any mass roll out.

CAD:

The Chameleon CAD is an accessible solution for a comprehensive range of energy data (including real-time usage); acting as nucleus to the truly connected home ecosystem. Provision of such data can be used in a number of ways:

- **To inform/control other devices within the households' Home Area Network:** providing notification to appliances of key events such as a cheaper tariff rate. This allows householders to benefit from the most economical use of energy.
- **Relayed to the cloud to complement external solutions:** Visualisation of real time data on other platforms (i.e. smart phone/tablet), integration of real time data with wider APIs (such as accurate cost/energy spend data to smart thermostats). Access to this data can allow 3rd parties to enhance their customer proposition, whilst households benefit from a more comprehensive service provision.

The Chameleon CAD can be provided as a standalone unit or as an embedded solution within other connected devices.

CHAMELEON™

IHD3-HS-PPMID

CAD

Dimplex – Quantum Energy System

System Description

- The Dimplex Quantum Energy System works to minimise the cost of space heating and hot water energy requirements whilst maintaining a comfortable room temperature.
- Energy for space heating and hot water is stored when rates are low or domestic generation is available. This avoids peak-supply times and the high prices that come with them.
- This also provides a national 'battery' of storage products that can be demand-side-managed; allowing for frequency response, load shedding and maximisation of renewable generation by the grid.

Dimplex

THE TECHNOLOGIES

EM425-UK Smart Electricity Meter

The flexible foundation to help shape the future of the smart grid

Itron's range of smart electricity meters offer a highly flexible and reliable solution for residential metering that combines extensive metrology expertise with high quality communication technologies. They offer:

- Ring-fenced metrology
- Built-in supply switch and auxiliary latching relay
- Graphics-capable dot matrix display
- Over The Air (OTA) firmware upgrades
- Future-proof communications

As part of an end-to-end solution, the EM425-UK single phase smart meter provides a strong foundation that any smart grid can be built on. Itron smart grid solutions deliver real, quantifiable benefits – today and into the future.

RF1 sV ZB Smart Gas Meter

Secure and reliable metrology for the smarter generation

Itron's range of smart gas meters has been built upon the proven design and success of previous products and continue to provide reliable and accurate metrology alongside increased functionality and flexibility. They offer:

- Future-proof modularity
- Remote valve operation
- Field swappable battery
- Standardised digital communication interface
- Over The Air (OTA) firmware upgrades

As part of an end-to-end solution, the RF1 sV ZB smart gas meter provides a strong foundation that any smart grid can be built on. Itron smart grid solutions deliver real, quantifiable benefits – today and into the future.

Join us in creating a more resourceful world; start here: www.itron.com

Vaillant aroTHERM intelligent hybrid heating system

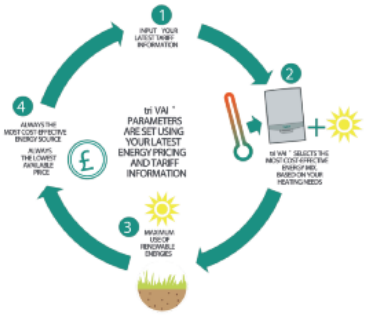
The Vaillant aroTHERM hybrid heating system

1. Using the latest tariff information
2. The system will maximise the use of renewable energy – taking into account the cost of energy
3. Automatically selecting the most cost effective and carbon saving heating source
4. Automatically selecting the best energy mix taking account of your comfort level

- Always the most efficient energy source
- Always the lowest price available
- Online and Smart Phone Controllable
- Reduces stress on the grid and ready to roll out to all UK homes

Opened to take signals from SMART meters for changes in tariffs giving active management and use with time of use tariffs

For more information visit http://www.vaillantrenewables.co.uk/



THE TECHNOLOGIES

About geo

geo is a consumer engagement company that designs and produces smart energy, smart heating, smart home and solar PV systems, online services and mobile applications. geo's products & services put you in control of your energy and water consumption, making it possible to have an energy-efficient, comfortable home.

geo is a leader in making energy smarter for consumers by capturing, presenting and visualising the data from smart meters. We have experience in developing, testing and deploying consumer energy products & services in the UK, Europe, Middle East, Africa, Asia, Australia and the Middle East.

geo's **smart products portfolio** consists of:

- **In-Home Displays, virtual displays and apps** that work with smart electricity, smart gas and smart water meters
- **Consumer gateways** that connect to smart meters, enabling new, innovative online consumer energy services
- **Solutions for deploying smart meters** in large and high-rise buildings

Consumer Access Device

Duet II Touch Button

Find out more about geo at www.greenenergyoptions.co.uk

THE TECHNOLOGIES

Legrand smart home systems

Smart homes for life...

- Lifestyle
- Comfort
- Care and wellbeing
- Safety and Security
- Savings

Breathing life into homes..

A seamless and secure handshake between the smart grid, the Internet of Things and a smart home's electrical and communications infrastructure allows the grid and the home to be truly smart.

BEAMA CONNECTED HOMES MEMBERS

Cable Management Group
Chameleon Technology Ltd
Climote Ltd
Daikin
Drayton Controls
Eaton Electric Ltd – Tyseley
EDMI Ltd
Efergy
Elster Metering Systems Ltd
GDC Group
Green Energy Options (GEO)
Hager Engineering Ltd
Heatrae Sadia Heating
Honeywell ACS Control Products
In Home Displays Ltd
Itron UK Ltd
Legrand Electric Ltd
MK Electric
Navetas Energy Management Ltd
NetThings Ltd
Pegler Yorkshire Group Limited
Schneider Electric Ltd (Telford)
Secure Meters (UK) Ltd
Sentec Ltd
Siemens Transmission and Distribution Ltd (Tyne and Wear)
Smart Buildings Ltd
Vaillant

For more information about BEAMA Connected Homes please contact:

Yselkla.farmer@beama.org.uk
Manager – Emerging Markets

November 2015

Westminster Tower
3 Albert Embankment
London SE1 7SL

www.beama.org.uk

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