Energy Smart Appliances Standards for Demand Side Response

PAS 1878 and 1879 standards and the Interoperable Demand Side Response (IDSR) programme

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Science and Innovation for Climate and Energy (SICE)
ESA standards development
Objectives

• Standardisation helps to **lower costs** and **promote innovation** in technologies, while **accelerating the uptake** of **secure and interoperable** smart products and services

• Develop **technical specifications** which could be referenced and required by **future regulations** and would enable certification

• Demonstrate **UK leadership** on the international stage, by promoting published standards for **international adoption**
## Approach: Scope

### Principles

- **4 policy principles** underpin the standards, developed in consultation with industry stakeholders.

### Compatibility

- **Compatibility** with, but no mandate of, the GB Smart Metering system.
- Alignment with existing international standards where possible.

### Innovation

- Specify only the **minimum requirements** to deliver DSR in line with 4 Policy Principles, which allows innovation on top.

### Policy Principles

<table>
<thead>
<tr>
<th>Policy Principles</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Interoperability</td>
<td>the ability of an ESA to work seamlessly across any DSR service operated by any system player.</td>
</tr>
<tr>
<td>2. Data privacy</td>
<td>the secure storing of data on the device or with any controlling party.</td>
</tr>
<tr>
<td>3. Grid-stability</td>
<td>the prevention of outages on the grid caused by erroneous operation of ESAs.</td>
</tr>
<tr>
<td>4. Cyber-security</td>
<td>the prevention of unauthorized access to an ESA by third-parties.</td>
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Approach: Process

British Standards Institution (BSI)

- A standardised technical framework, covering both ESAs and DSR for end-to-end system across 2 PASs

- Developed in an industry-led process, with expert Steering Groups and a programme level Strategic Advisory Group

- Producing PASs (publicly available specification) in a fast-track standards process, which is updated every 2 years

**BSI ESA Programme**

<table>
<thead>
<tr>
<th>40+ Organisations (9 Trade Associations)</th>
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</thead>
<tbody>
<tr>
<td>ABCB</td>
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<tr>
<td>ADE</td>
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<tr>
<td>APPLiA</td>
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<tr>
<td>BEAMA</td>
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<tr>
<td>BSI Assurance</td>
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<tr>
<td>Carbon Co-op</td>
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<tr>
<td>CBI</td>
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<tr>
<td>Citizens Advice</td>
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<td>CPIN</td>
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<tr>
<td>CRED</td>
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<td>CSO Confidential</td>
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<td>EDF Energy</td>
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<td>ENA</td>
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Also 120+ individuals on Invited Review Panel
PAS 1878 – some technical details
Definitions – DSRSP, CEM, ESA

DSR Service Provider (DSRSP)
• An organization providing demand-side related energy management services to electricity system operators, electricity utilities and electricity generators

Consumer Energy Manager (CEM)
• A logical entity, that can be physical or virtual, which deals with flexibility information and requests
• Translates between the DSRSP and the ESA

Energy Smart Appliance (ESA)
• An internet connected device that can modulate or shift its electricity consumption in response to signals.
2 DSR service types:

- **Routine DSR**
  Operate based on **incentives** set in **advance**, often multi-party market signals
  e.g. TOUT incentive via **Supplier**

- **Response DSR**
  Operate based on **requests** made in **real time**, often due to firm bi-lateral contracts
  e.g. grid FR request via **DSRSP**

**PAS** specifies how **response requests** are sent/received, but how **routine incentives** are optimised against is left to **innovation**
System Architecture – Part 2

3 interfaces:

- **A** - Interoperable, specified for any DSRSP
  - OpenADR

- **B** – Proprietary, can be ESA specific
  - e.g. can be OCPP for EV-CP

- **M** - (optional) for GB Smart Metering

ESA must be **supplied with CEM as a minimum**, but this does not restrict **3rd party** provided CEMs

User **subscribes individual ESAs** to a DSR service, allows **specialist DSRSPs** for specific ESAs

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OpenADR User Conference June 2023
Interface A

- PAS 1878 mandates that any implementation of Interface A shall support the use of **OpenADR**

- The use of OpenADR guarantees interoperability and therefore **enables consumer choice**

- PAS 1878 provides a structure that is mapped on to the OpenADR protocol
A hierarchy of DSR operation is defined, with consumer preferences always respected:

- **Routine** Mode
  - This is baseline DSR operation
  - The ESA controls electricity consumption according to the consumers wishes and any external incentives e.g. TOUT or grid CO2 intensity

- **Response** Mode
  - This overrides the baseline during a response request
  - The ESA controls electricity consumption according to the consumers wishes and DSRSP’s chosen flexibility option, e.g. for frequency response

- **Consumer** override Mode
  - Additional manual override *(note: their preferences are already built in)*

- **Failsafe** protections Mode

- During a Response request, the DSRSP will statistically request flexibility from ~100,000 devices which makes the system more resilient as some non-response is expected.
System Operation – Part 2

- A ESA creates flexibility offers as power profiles (P vs T), based on consumer preferences, appliance operation and any external incentives.

- At a minimum 3 power profiles:
  1. **Intended Operation (IO)**
     - Consumers preferences baseline
     - Runs in Routine mode
  2. **Most Delayed (MD)**
     - Consumers preferences with maximum delay
     - Option for Response mode
  3. **Least Delayed (LD)**
     - Consumers preferences with minimum delay
     - Option for Response mode

- The 3 profiles are updated whenever their status changes and sent to the DSRSP, so the DSRSP keeps a live merit order for response requests.

*profiles can include frequency response capability*
Worked Example (illustrative)

- During **Routine Mode**, the ESA regularly creates and sends power profiles to the DSRSP, the route is:
  
  (1) ESA>CEM>DSRSP

- The ESA sends updates whenever the flexibility status changes.

- During a **DSR Response request**, the DSRSP selects an appropriate power profile and duration time and sends the chosen flexibility to the CEM for the ESA to implement, the route is:

  (2) DSRSP>CEM>ESA

- The DSRSP keeps a live merit order of pre-registered power profiles, so a single request delivers a DSR response, enabling fast response high-value DSR services.

- During **Response Mode**, the ESA regularly sends active power and power profile updates to the DSRSP, the route is:

  (3) ESA>CEM>DSRSP

- The ESA sends updates whenever the flexibility status changes and in accordance with the technical requirements of the DSR service.

- The DSRSP can then call more/less DSR response from its live merit order as necessary to meet system requirements.
IDSR innovation programme
Interoperable Demand Side Response Programme

- Over £12.8M funding; 13 projects including independent testing/demonstration partners

- **Development and demonstration** of energy smart appliances and systems for the delivery of interoperable demand side response:
  - PAS 1878/1879
  - GB Smart Metering System

- Providing **feedback** on PAS 1878

- Part of the up to £65m **Flexibility Innovation Programme** within the £1bn **Net Zero Innovation Portfolio**

## Interoperable Demand Side Response Programme

<table>
<thead>
<tr>
<th>Stream</th>
<th>Project name</th>
<th>Lead applicant</th>
<th>Partner Organisations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Energy Smart Heat Pump</td>
<td>Samsung Electronics UK</td>
<td>Passiv UK</td>
</tr>
<tr>
<td>1</td>
<td>Project DSRR</td>
<td>Green Energy Options</td>
<td>Vailant, EDF, GreenSync Pty Ltd, Smarter Grid Solutions Limited</td>
</tr>
<tr>
<td>1</td>
<td>PAS-DSRFlex</td>
<td>Landis + Gyr Ltd</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Zen Smart IDSRI Interoperability</td>
<td>Systems Mechanics Limited</td>
<td>Ev.energy Limited, carbonTRACK UK Limited</td>
</tr>
<tr>
<td>1</td>
<td>IREF: Interoperable Residential Energy Flexibility</td>
<td>Centrica Business Solutions Ltd</td>
<td>Mixergy Ltd, Daikin Airconditioning Limited, Glen Dimplex UK Limited</td>
</tr>
<tr>
<td>1</td>
<td>Tomorrow’s Homes Today</td>
<td>Voltalis UK</td>
<td>The Electric Heating Company Ltd, Dcbel</td>
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<td>Landis + Gyr Ltd</td>
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<tr>
<td>2</td>
<td>ChameleonFIP</td>
<td>Chameleon Technology (UK) Limited</td>
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<tr>
<td>4</td>
<td>Laboratory testing</td>
<td>Engage Consulting Ltd</td>
<td>NMI, SMS</td>
</tr>
<tr>
<td>4</td>
<td>Demonstrations in Real World</td>
<td>Resillion</td>
<td>Quality Logic, ScottishPower, Power Networks, Demonstration Centre</td>
</tr>
<tr>
<td>3</td>
<td>OpenDSR for All</td>
<td>The Society for the Reduction of Carbon Limited</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Project Open IC</td>
<td>Green Energy Options Ltd</td>
<td></td>
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<tr>
<td>3</td>
<td>Feasibility assessment to understand the different functional and technical options available to create interoperable domestic energy management system</td>
<td>Accenture UK</td>
<td></td>
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</table>
The UK Government has sponsored the development of PAS 1878 and PAS 1879. These create an end-to-end framework for domestic DSR. Interface A shall support the use of Open-ADR to enable interoperability. The UK Government has funded the IDSR Programme which is developing domestic DSR systems against PAS 1878 and PAS 1879. The findings from this programme will feedback into the next version of PAS 1878.

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**System Architecture – HEMS integration**

**DSR service type:**

- **Routine** DSR
  - Operate based on **incentives** set in advance, often **multi-party market signals**
  - e.g. household optimisation via **HEMS** (Home Energy Management System)

**Interface:**

- **C** - **Interoperable**, specified for **any HEMS**
  - (currently undefined)
- **B** – **Proprietary**, can be ESA specific
  - e.g. can be **OCPP** for EV-CP
- **A** - **Interoperable**, specified for **any DSRSP**
  - **OpenADR** (+optional EEBUS/DLMS/etc)
- **M** - (optional) for GB Smart Metering

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**OpenADR User Conference June 2023**
Mapping of PAS 1878 and CENELEC/IEC functional architectures