The Cyber Security of Energy Smart Appliances for Demand Side Response

Standards development with BSI

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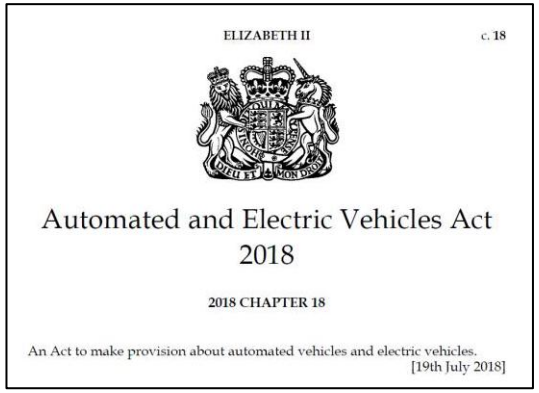
Context - Standards Development

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**



ELIZABETH II c. 18

Automated and Electric Vehicles Act 2018

2018 CHAPTER 18

An Act to make provision about automated vehicles and electric vehicles.
[19th July 2018]

Department for Business, Energy & Industrial Strategy

Approach: Scope

Appliances

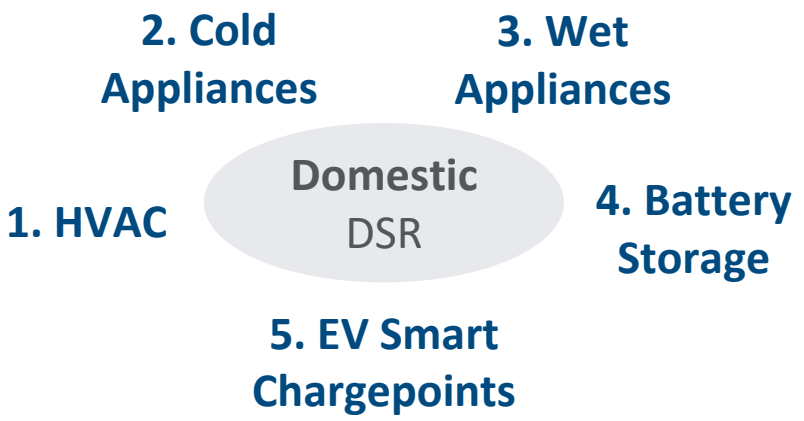
- The standards cover **5 appliance types**, most suitable for **domestic DSR**
  (Note: I&C DSR is out of scope)
- Only covers **home EV chargepoints**
  *(Parts could be **applicable** to **private and public** sector)*

Principles

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

Compatibility

- The standards are **compatible** with, but **don't mandate**, the **GB Smart Metering** system



Policy Principles	
1. Interoperability	the ability of an ESA to work seamlessly across any DSR service operated by any system player.
2. Data privacy	the secure storing of data on the device or with any controlling party.
3. Grid-stability	the prevention of outages on the grid caused by erroneous operation of ESAs.
4. Cyber-security	the prevention of unauthorized access to an ESA by third-parties.

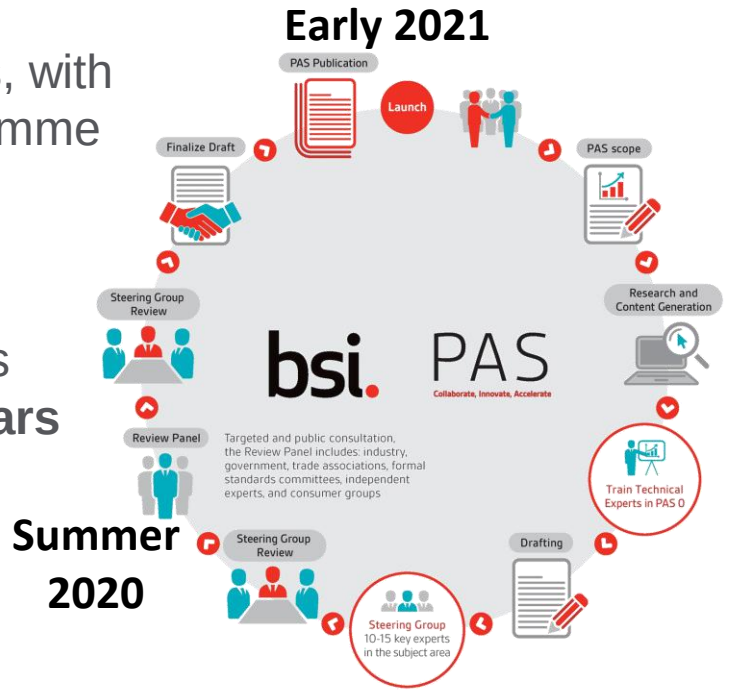
Approach: Process

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**

PAS 1878 Appliance-side: "**ESA specification for classification**"

PAS 1879 Grid-side: "**DSR framework for operation**"



BSI ESA Programme		
40+ Organisations (9 Trade Associations)		
ABCB	Energy UK	Newcastle Uni (EV)
ADE	ESC	NG ESO
APPLiA	ESSAC	Ofgem
BEAMA	EVET	OVO/Kaluza
BSI Assurance	Flexitricity	Pearlstone Energy
Carbon Co-op	Geo	Samsung
CBI	Hive	Schneider Electric
Citizens Advice	HMG	SMMT
CPIN	Innovate UK (EV)	Sustainability First
CRED	Kiwipower	Tech UK
CSO Confidential	Landis+Gyr	UKAS
EDF Energy	Moixa	UKERC
ENA	NCSC	WPD
Also 120+ individuals on Invited Review Panel		

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Approach: Technical

Operational

- Specify **only the <u>minimum</u> requirements** to deliver DSR inline with 4 **Policy Principles**, which **allows innovation** on top
- Specify framework for **called DSR services**, with handles for **other services** to be **built on top** by innovators

Commercial

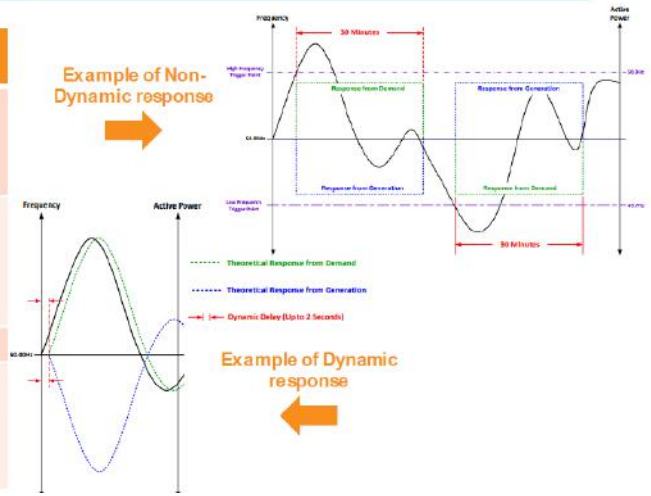
- Construct a **framework** to **enable revenue** streams (e.g. fast response times to enable high value DSR services) and **not restrict business models**

International

- Standards to **align** with **existing international** standards where **possible**, *(Note: some of these are still **under development**)*

1.3 Frequency response speeds

FFR product type		Response speed	Length of response
Non-Dynamic – Secondary response is the only Non-Dynamic response currently procured.		Within 30 secs	30 mins
Dynamic – A Dynamic service can provide Primary, Secondary and High response, or Primary and Secondary only or High only.	Primary	Response required within 2 secs, with full response by 10 secs.	20 secs
	Secondary	Within 30 secs	30 mins
	High	Within 10 secs	Indefinitely unless otherwise agreed.



ISO International Organization for Standardization

IEC INTERNATIONAL ELECTROTECHNICAL COMMISSION

CEN CENELEC ETSI

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Technical – ESAs and DSR

(Draft PAS proposals)

Department for Business, Energy & Industrial Strategy

Definitions – DSRSP, CEM, ESA

DSR Service Provider (DSRSP)

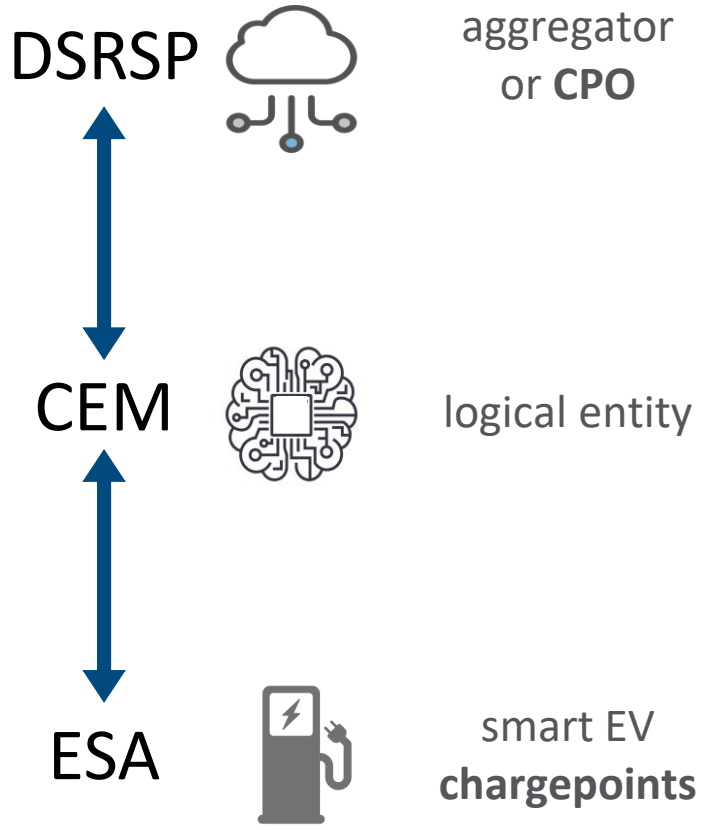
- An organization providing **demand-side** related **energy management services** to electricity system operators, electricity utilities and electricity generators

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**.



System Architecture

2 DSR service types:

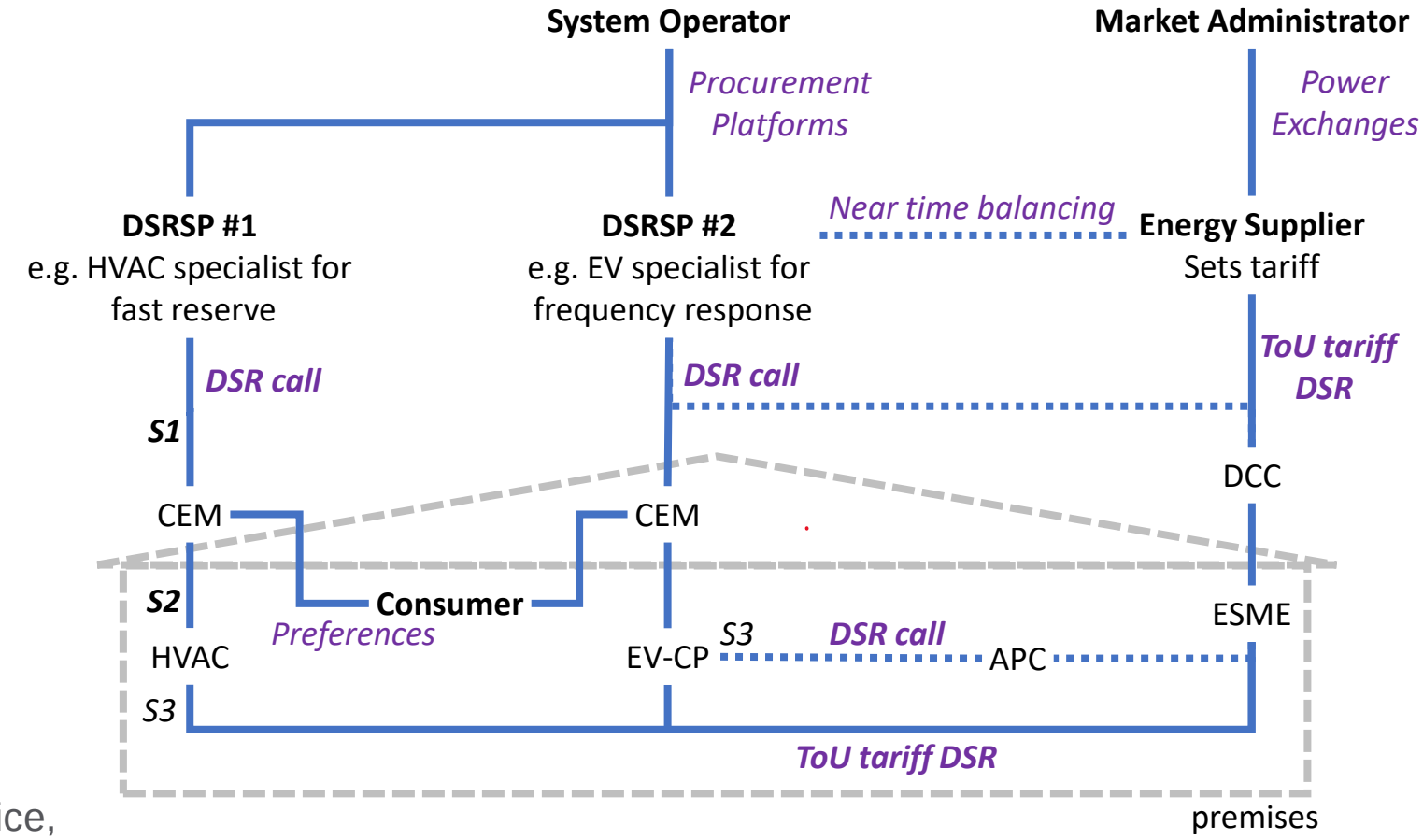
- Multi-party real time **markets**
  e.g. ToU tariff via **supplier** (**Routine** Mode)
- Bi-lateral in advance **contracts**
  e.g. DSR call via **DSRSP** (**Response** Mode)

3 interfaces:

- **S1**
  - **Interoperable**, specified for **any DSRSP**
- **S2**
  - **Proprietary**, e.g. can be **OCPP for EV**
- S3
  - (optional) for GB Smart Metering

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

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



System Operation

From the system architecture, a **hierarchy of DSR operation** is defined:

- **Routine** Mode
  - This is **baseline** DSR operation
  - The CEM controls electricity consumption according to the **consumers wishes** and **external stimuli**, e.g. ToU tariff
- **Response** Mode
  - This **overrides** the baseline during a **DSR call**, unless the consumer **manually overrides**
  - The CEM controls electricity consumption according to the **consumers wishes** and **DSRSP's chosen flexibility option**, e.g. frequency response

- The CEM creates **flexibility options** based on **consumer preferences**, appliance operation and external data. These define the **baseline option** for **Routine** Mode and **max/min options** for **Response** Mode.
- The flexibility options are **updated whenever their status changes**, so the **DSRSP keeps a live merit order** for DSR calls.

- During a DSR call, the DSRSP will **request flexibility** from **~100,000 devices**. Requests will be **statistically calculated** with overheads as some **non-response is expected**.

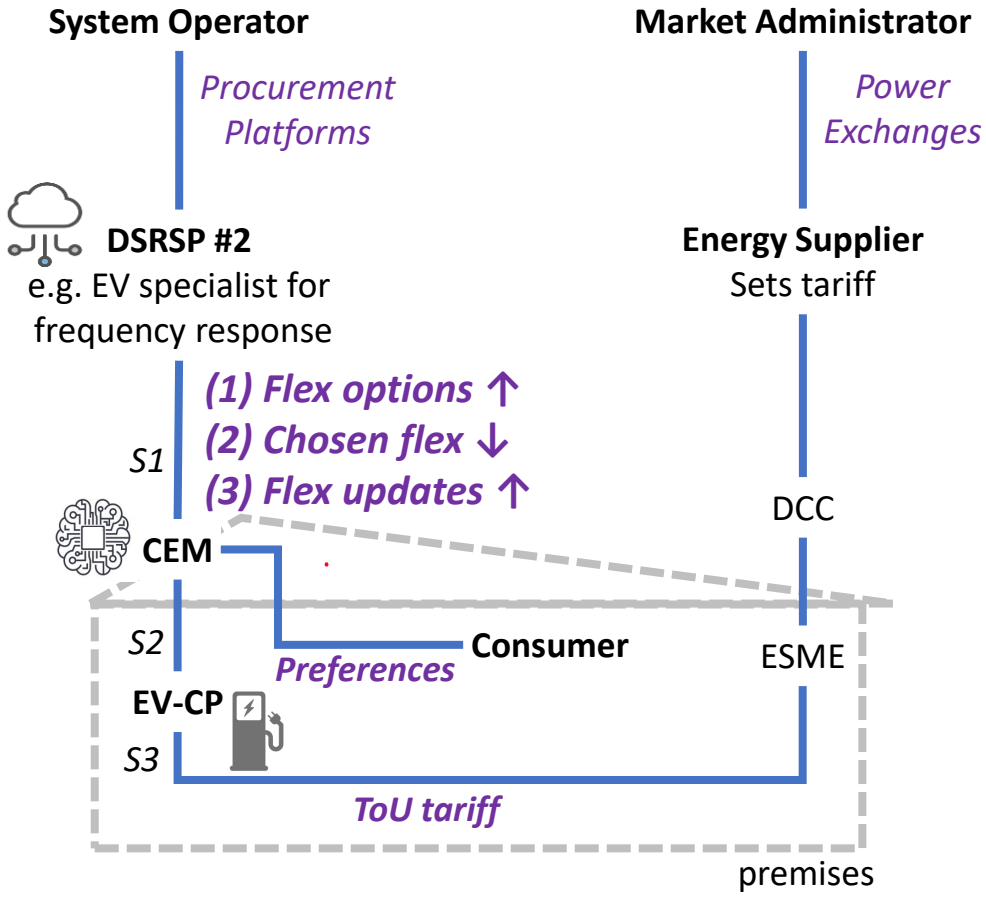
Worked Example

- During **Routine Mode**, the **CEM** regularly creates and sends **flexibility options** to the DSRSP, the route is:
  (1) CEM>DSRSP
- The CEM sends **updates** whenever the flexibility **status changes.**

- During a **DSR call** from the system operator, the DSRSP selects an appropriate **flexibility option** and **duration time** and sends the **chosen flexibility** to the **CEM** for the **ESA to implement**, the route is:
  (2) SO>DSRSP>CEM>ESA
- The DSRSP keeps a live merit order of **pre-registered flexibility**, so a **single request** delivers a DSR response, enabling fast response **high-value DSR services**.

- During **Response Mode**, the **CEM** regularly sends **active power and flexibility updates** to the DSRSP, the route is:
  (3) CEM>DSRSP
- The CEM 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.

- When the DSR **call period ends**, after duration time, **Routine Mode** operation can **resume**, e.g. based on **ToU** tariff from **Smart Meter**.



Technical – ESA Cyber Security

(Draft PAS proposals)

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Principles for Cyber Security

- Approach should protect the **cyber security** and **data privacy** of the **communication** system, the electricity **network** and the **user**
- ESA **aggregation** and grid connection presents **CNI risk**, so requirements should **go beyond IoT** security
- Security requirements should be **proportionate to risks**, while respecting **compromise** between **cost – usability – security**
- Requirements should apply across **all architectures**, to deliver the **same minimum level** of security
- Note: sometimes necessary to **specify 'how'** security is implemented, in order to **achieve interoperability**

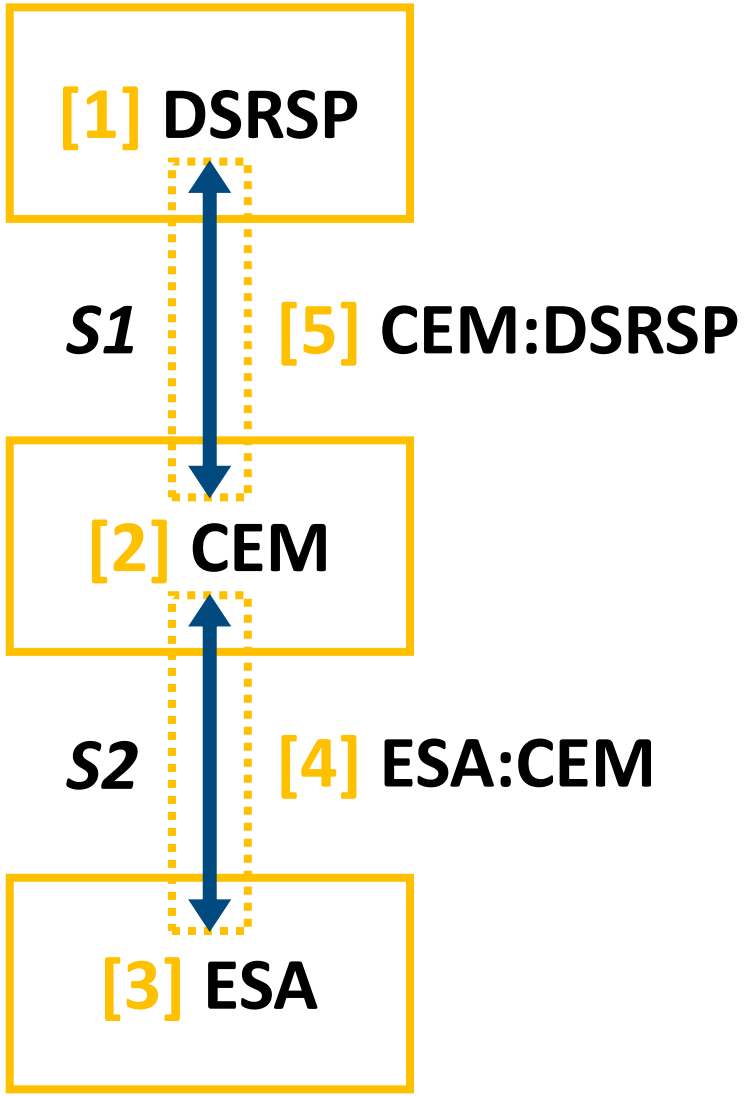
Approaches to Cyber Security

To assure **trust and integrity**, the framework employs common, **existing security techniques**

Verified **actors** **[1] DSRSP**
- **appropriate authority** verifies **DSRSP is legitimate**
- **PKI** system for messaging with **digital certificates**

Verified **assets** **[2] CEM** + **[3] ESA**
- at **initialisation**, **firmware validation** and manufacturer verification
- during operation, **secure** software/firmware **updates**

Secure **communications** **[4] ESA:CEM** + **[5] CEM:DSRSP**
- messages secured by **authentication** and **encryption**
- **ESA-CEM** established using **secure initialisation protocols**
- **CEM-DSRSP** established using **PKI system**

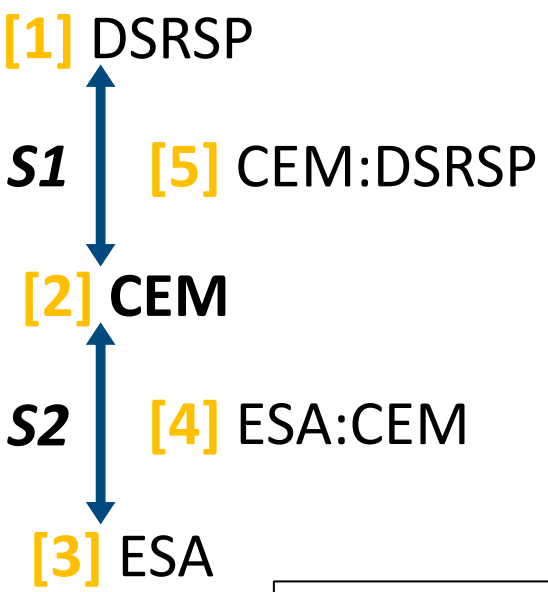


Notes on Approach

- With **CEM between S1 and S2** it may need to un/re-encrypt messages, so important that CEM **integrity is secure**

- **S1** interface is **interoperable**, so **prescriptive** on 'how' security is **implemented**
- **S2** interface is **proprietary**, so requires **minimum principles** or **equivalent to examples**

- Best practice **IoT security** is **required**, compliance with **ETSI standard Cyber Security for Consumer IoT**
- Best practice **organisational security** being considered, possibly referencing **ISO 27000**, but **under consideration**



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Thank you

If you have further questions, please contact me:

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Especially if you would like to be on the **Invited Reviewers Panel** during the **Public Review period**.

ESA Programme website:

www.bsigroup.com/smart-appliances-flexible-energy