Smart Electrical Outlet/Socket (SEOS)

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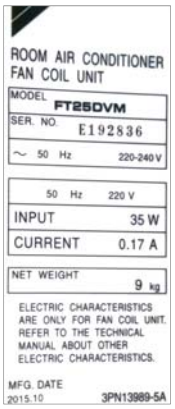
BACKGROUND OF RESEARCH

- Plug-Loads and interactions with them have become unavoidable part of daily life of modern humans. In offices, 15-20% of energy use is through plug-loads. It can reach more than 50% of total energy use in high-efficiency buildings. Plug-loads are hard to realistically manage through automation since they are very diverse, and their operation in a building varying with respect to time and space.
- Plug-loads are supplied energy through electrical sockets/outlets, but existing sockets are not smart enough to readily identify the appliances that get connected to them. This is a major barrier to actualize smarter building-grids.

OUR SOLUTION

- We propose a Smart Electrical Outlet\Socket (**SEOS**) which can instantly know both metadata and operational electrical data of plug-loads that get connected to it.
- This is achieved through placing inexpensive near-field communication (NFC) chip on the plug-load, which carries a Universally Unique Identifier (UUID), and have **SEOS** hardware & server link UUID to various data. **SEOS** hardware comes in two versions – a) wall-socket b) portable-socket.
- Each and every plug-load can be uniquely identified and mapped to their live *Digital-Profiles*, that hold metadata and measured data.



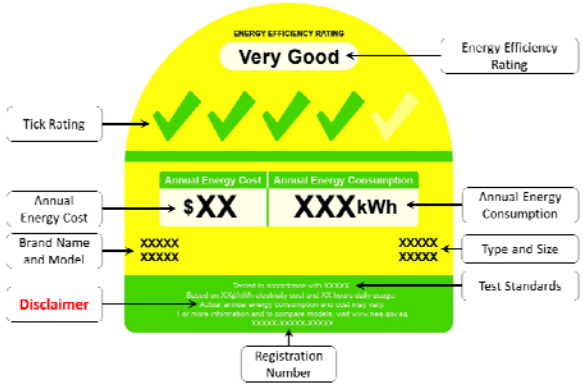


Fig. 1. Examples of metadata of plug-loads meant for human beings to read, but are usually inaccessible by automation systems in buildings

Metadata can be nearly anything!

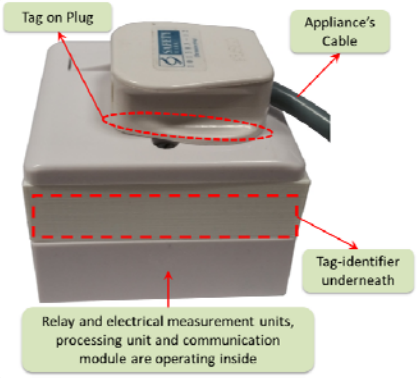


Fig. 2. Mechanism of operation of SEOS hardware.

Building-Firewall: **SEOS** can authorize plug-loads like how "firewalls" authorize programs.

Analogy for a plug-load's Live Digital-Profile

facebook profile + fitbit profile

Benefits of **SEOS**

- ✓ Smart identification
- ✓ Smart authentication
- ✓ Power-quality-aware plug-load control
- ✓ Real-time inventory
- ✓ Automated auditing

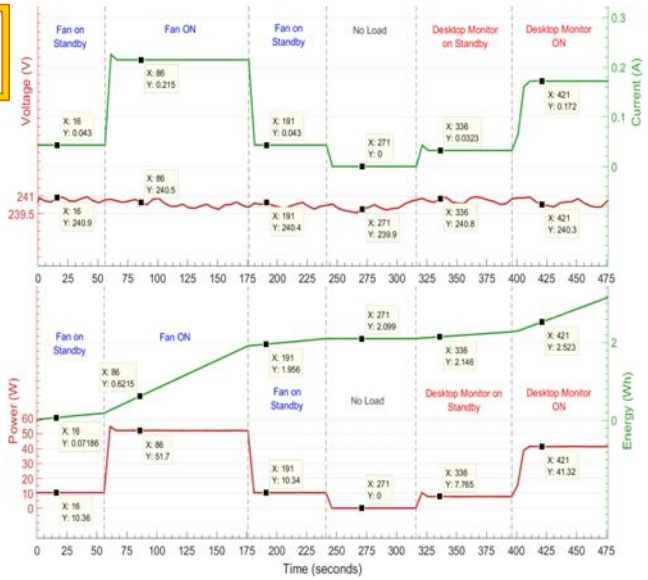


Fig. 3. Identification of states of plug-loads using **SEOS**

CONCLUSION & FUTURE WORK

A Smart Electrical Outlet/Socket (**SEOS**) has been proposed. It has the unprecedented ability to instantly acquire the metadata and operational electrical data of plug-loads. **SEOS** ecosystem can perform smart on/off control of the plug-loads based on digital-profiles, thus providing a multitude of digitalized services in buildings through edge/cloud computing in the future.

[1] Krishnanand K. R., Hoang Duc Chinh, Manish Gupta, S. K. Panda, and Costas J. Spanos. "Smart Electrical Outlet/Socket Device, System, and Associated Method." Patent Cooperation Treaty Application No. PCT/SG2019/050066 (04.February.2019)

[2] Krishnanand K. R., Hoang Duc Chinh, Manish Gupta, S. K. Panda, and Costas J. Spanos. "Context-Aware Plug-Load Identification Towards Enhanced Energy Efficiency in the Built Environment." In 2018 IEEE International Conference on Environment and Electrical Engineering and 2018 IEEE Industrial and Commercial Power Systems Europe (EEEIC/I&CPS Europe), Palermo, Italy, pp. 1-6, IEEE, 2018.

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