We need Intelligent Monitoring and Control not more smart meters

Dr Martin Gill

Our clean energy future sees consumer installed devices and appliances increasingly supporting grid stability. Our regulators intend to support this future by forcing consumers to install multiple (expensive) smart meters. This article considers how visibility and control of these consumer assets could be far more cost effectively delivered via an interoperable standard protocol.

Introduction

Historically electricity flowed from large centrally controlled generators to consumers. The role of the utility meter in this simple market was to bill consumers for the electricity they used.

Spiralling energy costs have forced consumers to install solar systems. Today 30% of Australian households both use and generate electricity, a number forecast to double in the next decade.

The Energy Security Board (ESB) has expressed concerns the rapid uptake of solar is adversely impacting network stability. Their analysis suggests as our reliance on fossil fuelled generation decreases, system operators must be given visibility and control of these consumer installed sources of renewable generation and soon, flexible load.

The Australian Energy Market Commission (AEMC) is currently reviewing their mandated Power of Choice (PoC) meter rollout. While they claim their PoC meters address future needs there are challenges:

- Installing the multiple meters required to make individual measurements is very expensive
- Flexible control must be more nuanced than the crude turn on/off supported by their meters

There is a cost effective alternative to installing more meters. This article discusses the advantages of interoperable protocols. One protocol in particular is already in use in Australia and shown to support greater visibility and control of consumer owned energy assets. It can support our clean energy future. Something installing more PoC utilities meters does not.

Points discussed in this article

The Australian Energy Market Commission (AEMC) is currently reviewing its Power of Choice (PoC) metering mandate. The AEMC is faced with a decision. Do they want their Power of Choice (PoC) meters to support the transition to a clean energy future?

If the answer is no, then they are acknowledging PoC meters will continue to only support billing and there is nothing further to consider. The AEMC can continue to provide access to the non-real time data their remotely read dumb meters collect.

If the AEMC wants their meters to support our clean energy future then they must address inherent limitations. The installation of one meter at the property boundary does not provide sufficient visibility of multiple consumer installed sources of generation and flexible load. Their current proposal involves forcing consumer to install multiple expensive meters.

The AEMC clearly fails to understand the importance of being able to control consumer installed generation and flexible load. Their meters are only able to turn entire circuits on or off, presenting an unacceptable risk to consumer acceptance, comfort and convenience.

Rather than continuing to make the PoC meter responsible for all measurements and control, the AEMC should consider allowing consumer installed appliances to deliver the required capabilities.

Advantages of this approach include visibility of individual appliances (type of appliance, connection status, energy use, etc) and the ability to utilise flexible appliance control options (which are far less likely to impact consumer comfort and convenience than dumb turn on/off). It is also likely to be possible at significantly lower cost.

For the removal of doubt: It is not being suggested the PoC meter be removed. PoC meters are unfortunately here to stay and the existing rules can support validation of the flexible measurements and control offered by individual consumer installed appliances.

Historically the AEMC's policy has been to leave the market free to offer a range of different (non-interoperable) solutions. Recent trials show this is highly inefficient (and not in the long term interest of consumers).

It is noted the AEMC already recognises the significant benefits of mandatory interoperable protocols. They require all market participants use an interoperable protocol to share the meter measurements used to bill consumers.

Despite recognising the importance of interoperability the AEMC then fails to provide any standard means to share the (limited) measurements and control offered by existing PoC meters. Given the increasingly important role of these non-billing items it is suggested there is an increasingly urgent need to support an interoperable protocol.

There are options for the selection of a suitable protocol. The AEMC could continue to develop their own unique protocol or they could choose to adopt an existing international protocol. This article suggests adopting an existing international protocol (with enhancements) delivers the required capability at a lower cost and in a shorter timeframe than attempting to develop their own unique protocol.

What do we require from our meters?

Historically meters have been used for billing and the PoC metering reforms chose to focus on this single application. PoC meters are required to make detailed measurements of electricity use. PoC rules document interoperable access to these meter measurements (unfortunately this does not include consumers).

Australia (and the rest of the world) is transiting to a renewable energy future. To date this transition has primarily involved consumer installations of solar systems. PoC meters support solar billing using a single measurement of the net energy flow storing net imported energy separately from net exported energy. This is no-where near enough.

The AEMC's PoC meters fail to support efficient network management. For example network operators monitor voltage and power factor to ensure the safe and reliable supply of electricity. PoC meters are required to make these non-billing measurements but the rules fail to provide access. Instead the AEMC assumed network operators would pay to access the data. This proved prohibitively expensive because unlike billing data, the AEMC failed to specify an interoperable format for any of these measurements.

The dictionary definition of meter includes "*regulate the amount*". Since the early-1960's distributors have offered to control various consumer loads in exchange for lower energy costs (off-peak electricity use). The PoC rules fail to support this increasingly important application. Even when installed third parties have no guaranteed access, and even when made available, there is no interoperable means of accessing the capability.

This brief introduction has identified three roles for metering. The problem is the PoC only address one:

- ✓ Energy Measurements (settlements)
- ✗ Network Measurements (stability)
- ✗ Regulate the Amount (demand management)

It is asserted the missing roles can be supported more cost effectively by selecting a suitable interoperable protocol rather than trying to enhance existing PoC meter requirements.

What are the benefits?

The PoC rules were supposed to support our future metering needs, for example when a consumer installs a solar system the PoC meter records imported and exported net energy flows separately. While this supports billing, the measurements do not support network stability.

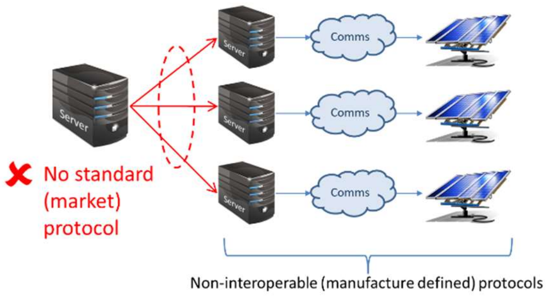
Current PoC meters also promote undesirable network outcomes. The measurements only allow consumer bills to show the credit they receive for solar generation sent to the network. This encourages consumers to try to maximise the amount of energy sent to the network potentially increasing the negative impact on network stability.

In fact the value of a solar system to a consumer increases when they *use* their solar generation. The true value of a solar system cannot be shown on consumer bills *because the PoC meters do not make the necessary measurements*. Critically these missing measurements are the same ones network operators are increasingly demanding to manage high penetrations of consumer installed solar.

The South Australian (SA) Government's attempts to address the failings of PoC meters provides valuable insights into future requirements.

The SA Government introduced separate rules intended to provide the market operator with both visibility and control of consumer installed solar systems. The ill-conceived initial approach provides several valuable lessons:

Lessons from South Australia
<u>Non-interoperable</u>



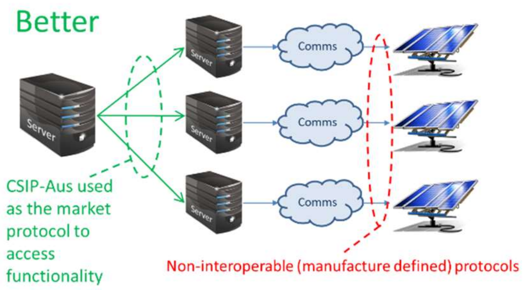
The requirements ensured consumers provided the market operator with access to a command to shut down solar systems. The problem was the rules failed to provide an interoperable command to achieve this. Within months of introducing the rules the market operator was faced with trying to implement 50 different non-interoperable methods of accessing this single command! The lack of interoperability meant the cost to shut down solar systems was unacceptable.

> The lesson is clear. Defining requirements and even providing access, is insufficient. Requirements must include interoperable access.

The SA Government must be commended for moving quickly to address the issue. They worked with industry to agree an interoperable means of regulating solar system output. The impressively short time for this development was achieved by adopting the existing international demand management standard IEEE 2030.5. Rather than start from scratch they could focus on agreeing a number of Australian Specific extensions as documented in the Common Smart Inverter Protocol-Australia (CSIP-Aus).

IEEE 2030.5 supports the missing interoperable access as shown in the following figure:

Lessons from South Australia
<u>Interoperable (market protocol)</u>

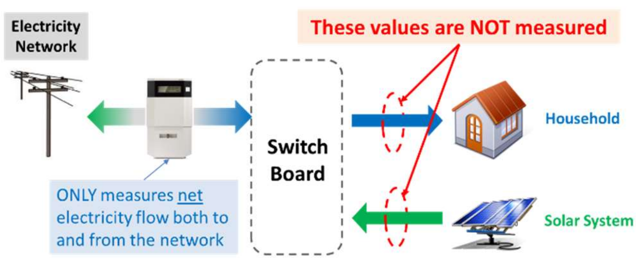


The development of CSIP-Aus enables the market operator to access the desired functionality from all providers using exactly the same protocol.

There are further advantages. IEEE 2030.5 supports compliance certification. Each provider can have their implementation of CSIP-Aus tested to show it correctly implements the protocol. This ensures the market operator has interoperable access to the new commands.

At the same time the SA Government introduced rules intended to regulate the amount of solar generation, they also introduced additional requirements for meters installed at sites with solar generation. The new requirements are an acknowledgement the single measurement of energy flow to and from the network made by PoC meters is insufficient to support network stability.

Measurements made by PoC meters only show net energy flow, the difference between household use and solar generation as depicted in the following figure:



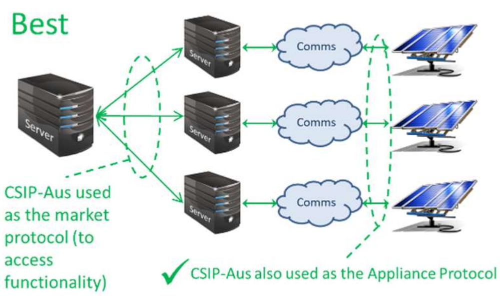
In an attempt to address a lack of visibility the SA Government introduced requirements consumers install additional metering making separate measurements of household energy use and solar system output. The current solution does not meet our far more flexible future monitoring and metering requirements.

Installing additional PoC meters is expensive. Hence the SA Government rules only apply to small consumer solar systems. Consumers choosing to install large (poly-phase) solar systems do not have to install additional metering, despite these larger systems being more likely to adversely affect grid stability.

As consumers increasingly install battery storage and flexible loads (including Electric Vehicles), there will be greater need to separately monitor and control each appliance. The lesson from SA is this cannot be cost effectively delivered using only PoC meters.

The international demand management solution IEEE 2030.5 offers a cost effective solution to this problem. It already supports the collection of energy measurements directly from appliances.

Lessons from South Australia
Interoperable Appliance Protocol



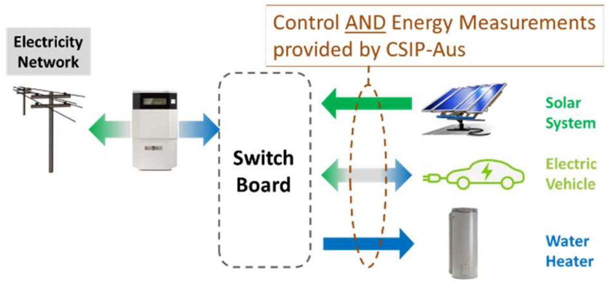
The difference between the above figure and the earlier one is communications with the solar inverters is two way. Rather than being limited to sending shut down commands to solar inverters, the system operator can also request individual energy measurements directly from each solar inverter.

Note the use of an interoperable protocol addresses deficiencies in the SA Government's current solution. Energy measurements can be obtained from all solar inverters, both small and large. Since it uses the existing communications path it is also less expensive (and flexible) than the current solution based on multiple PoC meters.

The SA Government provides other valuable insights into a desirable future destination. They recognise the importance of controlling not only the output of consumer installed solar systems, but also controlling major consumer loads. From mid-2023 all air-conditioners installed in SA must support demand response. Soon afterwards the legislation will be extended to cover electric water heaters and Electric Vehicle (EV) Supply Equipment.

Disappointingly the SA Government has failed to learn the lessons from their earlier solar system mistakes. They have mandated the unique Australian demand response standard AS4755. There are several problems. AS4755 only supports the inflexible shut-down commands (which provide unpopular when mandated for new solar systems) and more concerning AS4755 does not support any interoperable commands to shut down the appliances (which quickly proved unworkable).

An interoperable solution exists. IEEE 2030.5 (and CSIP-Aus) support interoperable control of the same appliances covered by AS4755 that is air-conditioners, water heaters and EV supply equipment.



The SA Government decision fails to learn from their earlier initiatives. Efficient demand management programs require interoperable access. Mandating AS4755 fails to provide this interoperability.

The following sections explore how to provide interoperable access.

Providing interoperable access

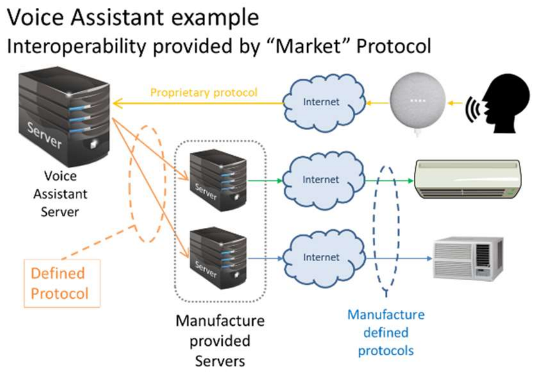
There are numerous ways interoperable access *could* potentially be realised. A review of earlier attempts helps clarify the important points.

The SA Government's first attempt to control the output of domestic solar systems left the market free to choose the solution. Similarly the AEMC PoC metering reforms leave the market free to choose how to implement non-billable measurements. In both cases leaving the market free to choose failed to deliver cost effective solutions. A lack of interoperability quickly proved unworkable. The lesson should be leaving markets free to choose is unlikely to maximise consumer and network benefits.

Choosing an interoperable standard protocol raises further questions. "Where is the interoperable protocol to be used?" The National Energy Market

(NEM) use a tightly defined interoperable protocol to support market settlements. This protocol *only* applies *in* the NEM. There is no requirement PoC meters use the protocol.

To introduce this possibility we first examine how smart Voice Assistants work:



The above figure depicts a consumer using their Voice Assistant to turn on their air-conditioner. The voice command is first sent via the internet to a server provided by the manufacturer of their Voice Assistant. This server processes the command and if recognised a command is sent to the air-conditioner manufacturer's server. The air-conditioner manufacturer's server then sends a command to the consumer's air-conditioner.

Interoperability is achieved by the use of a defined protocol between the various servers. This protocol is defined by the manufacturer of the Voice Assistant, with different protocols offered by Google, Apple and Amazon. Point to note: smart functionality ceases if any of the internet links are disrupted.

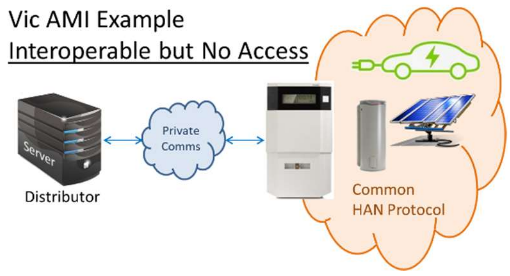
Each air-conditioner manufacturer is free to choose the protocol they use to talk to their air-conditioner (including proprietary protocols). While this may appear attractive it creates potential issues. After purchasing a smart appliance the consumer may find it is has been rendered dumb if the manufacturer ceases to support the tech titan provided 'market' protocol or worse shuts down their server.

The risk posed by a large number of previously controlled appliances suddenly becoming uncontrollable should be highly relevant to the Energy Security Board's (ESB's) and AEMC's future two sided market. For example a demand aggregator bids a demand reduction into the market but then fails to deliver the promised demand reduction due to an appliance manufacturer's server being unavailable.

Equally concerning is a manufacturer permanently turning off their server (e.g. Hive in the UK). While it may be theoretically possible to restore the smart appliance status this requires someone prepared to develop and offer a new server. The replacement server must have detailed knowledge of the manufacturer chosen (potentially proprietary) appliance protocol. Also because the server Internet Protocol (IP) address is hard coded into appliances the original manufacturer will need to give the new service provider rights to use the IP address or continue to reroute requests. Possible but highly unlikely.

There are also lessons to be learnt from the Victorian Advanced Metering Infrastructure (Vic AMI) rollout. The Victorian Government's functional specification set mandatory performance levels. Meeting these performance levels required distributors to use locally hosted servers along with distributor owned and operated robust fault tolerant communications.

Vic AMI also included an interoperable Home Area Network (HAN) offering the possibility of controlling various appliances. Its failure to provide meaningful demand management needs to be explored. The following simplified figure depicts the meter and HAN.



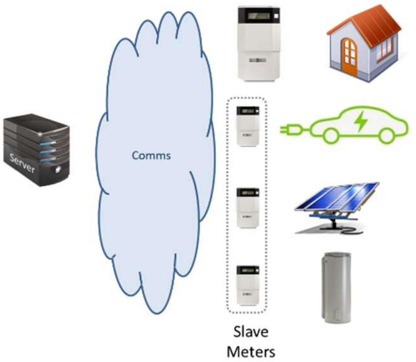
In the above figure all communications with appliances attached to the HAN occur via the electricity meter. While the HAN offers an interoperable protocol, the problem was the lack of access. Connecting devices to the HAN proved too difficult. Consumers were forced to register each device on a distributor provided portal hoping the meter would eventually connect to the HAN device.

Victorian distributors limited the types of appliances they allowed to be attached to "their" HAN, primarily In Home Displays supporting local viewing of energy measurements. They did not allow consumers to install devices enabling remote viewing of energy measurements.

Unsurprisingly devices which are easily installed and send meter data directly to consumer mobile phones have rendered the restricted access offered by Vic AMI meters redundant (e.g. PowerPal).

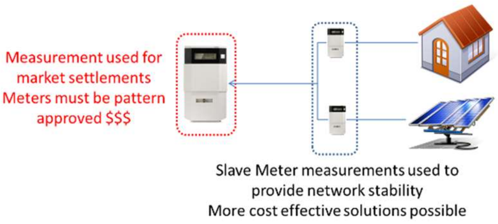
Addressing the lack of visibility of consumer installed distributed energy assets is a key concern. e.g. the SA Government's decision to mandate additional metering. The following figure extends the SA solution with multiple slave meters installed on relevant consumer owned sources of generation and flexible load:

Separate metering of distributed assets



The slave meters provide (limited) visibility of loads and generation installed behind a (PoC) meter. The problem is they do not *sensibly* (or cost effectively) support control of energy use and/or generation.

The current proposal depicted above suggests all the slave meters meet the requirements of PoC meters. The issue is PoC meters are expensive to both install and monitor. The installation of multiple slave meters risks significantly increasing consumer metering costs. Case in point the SA Government's additional metering was only affordable for small solar systems.



Flexible Trading Relationships introduces a further complication. Australia's National Measurement Act legislates when measurements are used to bill consumers they must be made by approved devices. Approved devices have been shown to be acceptably accurate (and safe).

Recent updates to European metering standards (upon which all Australian metering standards are based) allows the approval of meters able to separately measure multiple different circuits. For example the following figure shows a meter with three external current sensors. This single meter could be installed in place of the three meters shown in the above figure.

While the new metering standard is an improvement it remains too inflexible. The current sensors must be permanently fixed to the meter (they are not allowed to be unplugged). Hence the installed meter supports a fixed number of measurements. Choosing too few and the meter will have to be replaced when the consumer installs a new appliance or circuit requiring separate measurement.

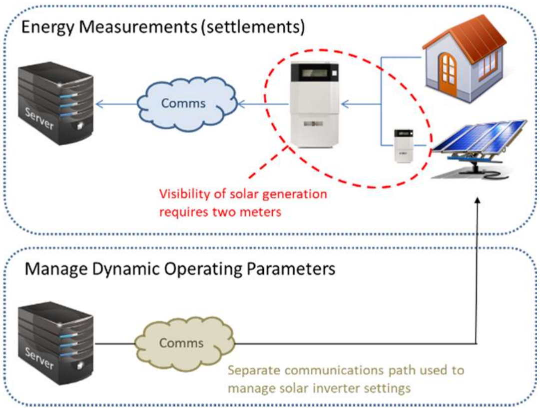
Even if the meter is installed with sufficient spare sensors there remains the expense of connecting the meter to the correct circuit and updating meter configuration details.

In SA the slave meters are _*not*_ used to bill consumers. Since they are not used for billing there is no requirement the measurements be made by expensive pattern approved (PoC) meters. The SA Government could have chosen to mandate far less expensive solutions.

There will always be a requirement an expensive pattern approved meter is installed at the property boundary. This approved meter can be used to monitor measurements made by non-pattern approved meters, including far less expensive meters inbuilt to appliances.

The SA Government has learnt shutting down solar systems was a ham-fisted approach to addressing a genuine problem. They have responded quickly and now offer a far better solution which adjusts domestic solar system output to fit within available network capacity. Referred to as Dynamic Operating Envelopes the benefits are clear. Consumers choosing to allow the output of their solar system to be adjusted can continue to use their own solar generation (not the case with the ham-fisted approach). A further consumer benefit is connection agreements allow the installation of larger solar systems if they are controlled, e.g. 10kW (if controlled) compared to 1.5kW (when uncontrolled).

Dynamic Operating Envelopes



The above figure reveals the management of Dynamic Operating Envelopes is completely separate to metering. The figure shows visibility of behind the meter energy flows is provided by two separate meters. The point is the cost of the separate solar meter could easily be avoided.

In Australia Dynamic Operating Envelopes will use the interoperable communications standard IEEE 2030.5 (with some Australian extensions defined in CSIP-Aus). IEEE 2030.5 already supports individual appliance energy measurements. Collecting energy measurements directly from the inverter is possible using the existing separate communications path so incurs virtually no additional cost. This avoids the expensive slave meter currently being used to separately measure solar system output.

More relevant to this discussion is future requirements can be met by selecting an interoperable communications standard.

Meeting future requirements

It is predicted electricity prices in our failed energy market will jump over 50% in the coming years. The price rise will stimulate even greater uptake of consumer installed smart energy technologies. The ESB's two sided market, which intends to reward consumers choosing to participate in demand management programs, also has the potential to increase consumer uptake of these technologies.

Our clean energy future includes electrification of transport. Electric Vehicles (EVs) present typically large and flexible load. It also appears likely EVs will support flexible generation through Vehicle-to-Grid.

The future sees less use of domestic gas for heating, particularly of water. This provides another flexible source of demand management.

The challenge of managing this rapidly increasing number of consumer owned loads and generation highlights the need for flexible and cost effective monitoring, metering and control.

Summarising the broad trends:

- Increased reliance on renewable generation and less use of fossil fuel powered generation
- Electrification of transport (EVs) and water heating supporting flexible demand management.
- Greater consumer uptake of flexible (smart) loads and generation
- Potential for millions of devices to be involved

South Australia (SA) has already moved to address these trends and provide valuable lessons:

- Greater visibility of consumer energy assets
- Control of these energy assets

Their first attempt left the market free to offer a range of technical solutions. This quickly proved unworkable with almost 50+ different and incompatible methods being offered. The chosen solution was to mandate an interoperable certified protocol.

Electricity utilities have grappled with non-interoperable protocols for decades. The solution involves spending hundreds of millions to develop and maintain protocol translators. The AEMC assumed every distributor could access the non-billing measurements made by PoC meters by implementing multiple different protocol translator (one for each meter provider). The cost of this inefficient approach is then passed on to consumers through higher energy bills.

The utility industry is moving to adopt interoperable protocols. This avoids the significant expense, complexity and errors caused by trying to use protocol translators to connect incompatible protocols.

Another issue is the delays required to agree necessary protocol extensions. These delays can be avoided by choosing an existing protocol. For example the decision to adopt IEEE 2030.5. While CSIP-Aus documents unique Australian extensions because it started from an existing protocol it took a little over a year. Compare this to the development of the unique

Australian demand response standard, AS4755 which is still on going after two decades (and does not even consider interoperable protocols).

Matter

Smart Appliances and Home Energy Management Systems (HEMS) promise consumers greater convenience, comfort and lower energy costs. Despite these benefits adoption has been low. One problem has been the lack of interoperable standards. Each major manufacturer offered a proprietary non-interoperable protocol. This lack of interoperability restricted consumer choice. This situation is about to change.

The major suppliers of HEMS and Smart Appliances, Apple, Google, Amazon and Samsung have published an open interoperable Smart Home standard called Matter. The first devices and appliances are already on the market with more soon to follow.

Controlling consumer installed solar systems is just the start. As consumers install more flexible loads and generation behind their meter the opportunities to maximise savings increases. Realising these benefits requires a standard interoperable means of controlling the various assets and of viewing their energy use/generation (in near real time).

The emphasis must be on affordability. For example a consumer bidding their air-conditioner into the ESB's two sided market is unlikely to recover the annual cost of $120 required for a PoC meter.

Existing interoperable communications standards provide a solution. IEEE 2030.5 supports both interoperable appliance control and energy measurement. Similarly the eco-system of Matter compatible appliances is anticipated to expand rapidly. Matter intends to add energy measurement functionality during 2023.

There are a number of other features required by the ESB's two-sided market which have so far not been discussed. The two-sided market foresees consumers offering millions of appliances to multiple demand aggregators. Unless the cost to register each appliance is extremely low it will kill the market. For example the PeakSmart program is designed to turn off 125,000 consumer installed air-conditioners. PeakSmart registration involves a licenced electrician visiting each site to install equipment and manually record the appliance details. Unsurprisingly the cost to register each PeakSmart air-conditioner is over $1000! Interoperable standards can significantly reduce this cost.

IEEE 2030.5 (and CSIP-Aus) document autonomous appliance registration. The interoperable standard avoids the need for site visits. Two way communications ensures demand aggregators can remotely determine the capabilities of each appliance and validate their ability to participate in any scheduled events.

The capability to autonomously register appliances becomes extremely valuable when considering the future management of Electric Vehicles (EVs). EVs are mobile and can connect at different locations and chargers. Trying to manage their charging using PoC meters is impossible since the meter cannot even determine if the EV is plugged in.

Another requirement of the ESB's two-sided market is the ability to accurately estimate and validate the amount of demand management bid into the market. The interoperable protocol IEEE 2030.5 supports this with standard status messages and near real time energy measurements. Contrast this with PeakSmart which sends a turn off command but there is no capability to estimate, validate or verify the actual amount of response delivered to the market.

It is also noted the use of a standard protocol and two way communications allows network operators to validate equipment settings. For example Australia's inverter standard, AS4777 describes programmable settings so inverters support autonomous grid stability out-of-the-box. These settings can be changed, suggesting periodic compliance checking may be added to future connection agreements.

Supporting consumers

The AEMC initially promised their PoC would "allow consumers to choose the metering they required at a price they were prepared to pay". Instead the PoC gives consumers absolutely no choice. The result is the vast majority of consumer benefits associated with smart meter rollouts are not being delivered.

At the top of that list of missed benefits are the energy savings arising from giving consumers the ability to monitor their energy use in (near) real time. The values should be available to consumer installed distributed energy assets highlighting the need for a standard interoperable protocol.

Comparing deployment models

The preceding discussions suggest a number of minimum requirements:

- Standard Behind the meter measurements
- Standard control of behind meter assets
- Solution must be affordable(*)
- Local monitoring of energy use/generation

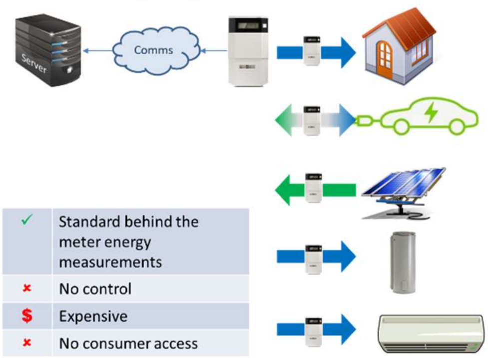
(*) Affordable includes the cost of appliances supporting the protocol, the cost of necessary systems capable of utilising the protocol and the cost to register appliances in (potentially) multiple demand management programs.

The following sections present three different meter deployment models to determine their ability to meet suggested minimum requirements.

Each metering option is shown with multiple (potentially) controllable consumer owned assets.

Meter Everything

In this model the AEMC continues to focus only on market settlements. PoC meters are installed on each appliance. Standards defined energy measurements are only made available to market participants.



This option ensures market participants can obtain energy measurements from behind the meter assets. Interoperability is achieved by the current market protocol used by all PoC meters.

While the measurements are primarily intended to support consumer billing they provide some visibility of local loads and generation. One issue is currently these measurements are only available the next day. While the PoC review intends to reduce this time frame to 6 hours, which is still far too slow. For example CSIP-Aus recognises the need to make these measurements available every minute (which will never be supported by PoC meters).

In SA this option proved prohibitively expensive. They were only able to justify its installation for small single phase solar installations. The above shows far more measurements highlighting this option is unrealistic.

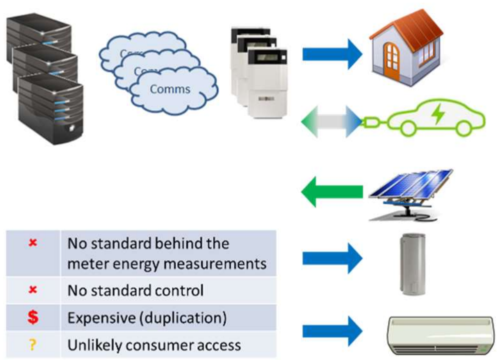
This option fails to provide consumers with visibility of their assets. Meter Providers state giving consumers real time access to meter measurements would significantly increase costs. Hence the above option does not allow consumer to monitor their energy use (trials show measurements provided the next day does not support the efficient manage of energy use).

The final failing of this option is it does not support appliance control. The only possible control would be the use of relays turning devices off / on. This lack of flexible control would be completely unacceptable to consumers.

Let the market decide

The AEMC have traditionally adopted this model. New and existing market participants are left free to choose their preferred solution(s).

The lack of standard access creates additional costs for participants. For example using the same model resulted in New Zealand consumers being charged for two smart meters. One installed by the retailer and one installed by their local distributor. Similar concerns for unnecessary duplication are depicted in the following figure:



Duplicating measurements and control makes this solution more expensive. The lack of standardisation makes it highly unlikely consumers will be able to negotiate a holistic view of all their energy assets.

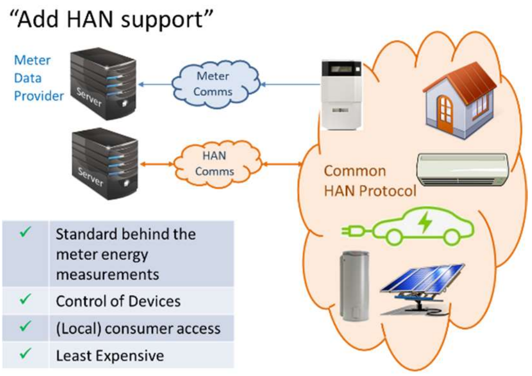
Alarmingly it also creates barriers for a competitive future two sided energy market with proprietary solutions reducing competition and locking consumers into vendor specific solutions. Consumers are unable to switch provider(s) without replacing the existing solution. Interoperable standards avoid this lock in allowing consumers to compare offers from different providers.

This option was recently tested in South Australia (SA). Leaving the market free to decide how to remotely shut down solar inverters quickly proved unworkable. They addressed the issue by adopting a standards defined interoperable protocol.

The obvious hypocrisy of leaving the market free to decide is even the AEMC recognises the lack of interoperable standards compromises market integrity. The AEMC therefore mandates an interoperable market protocol.

Add support for a Home Area Network

Earlier issues with the Victorian AMI rollout were discussed. The identified problem was in Victoria the meter was responsible for managing the Home Area Network (HAN) and all devices attached to it. Here the key difference is the meter is capable of being connected to a consumer installed HAN.



To avoid increasing costs the meter has no role in the HAN management. The PoC meter even retains its own dedicated communications.

The enhancement is limited to requiring the meter support connection to a HAN. Unlike the Victorian AMI rollout the meter is _not_ responsible for establishing the HAN (this is established by another device). The addition of HAN support has previously been stated to be in the range of $10 to $20 and (as will be discussed) potentially less.

Since the PoC meter is not responsible for managing the HAN, or other devices on the HAN, there are no further requirements. For example while the ability to view energy use of appliances connected to the HAN would prove useful this is not proposed. This deliberate decision is intended to isolate PoC meters from other AEMC market reforms.

The addition of the separate communications path to "HAN devices" is already widely used. For example many solar inverters now allow remote viewing of their output and smart appliances allow remote control. It is also noted the majority of solutions used to support remote solar system shut down in South Australia use a separate communications path to the inverter.

A vital step in realising this outcome is ensuring communications with the PoC meter can be established. This requires the selection of an interoperable standards defined protocol. The important requirements are:

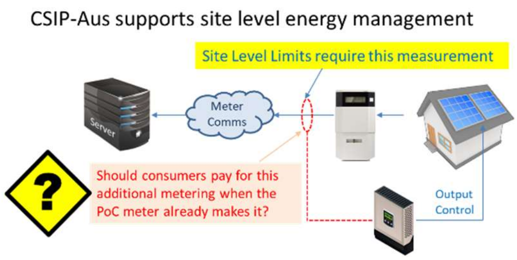
- The standard must not compromise the integrity of the meter (cyber-security).
- The standard must support both energy monitoring, measurement and appliance control
- The standard should be able to demonstrate industry support
- A highly desirable requirement is the standard should support third party testing and certification of implementations.

IEEE 2030.5 meets all the above requirements and has (sensibly) already been selected by Australia's energy industry.

An example of benefits delivered by adding HAN support to PoC meters

Support for Dynamic Operating Envelopes

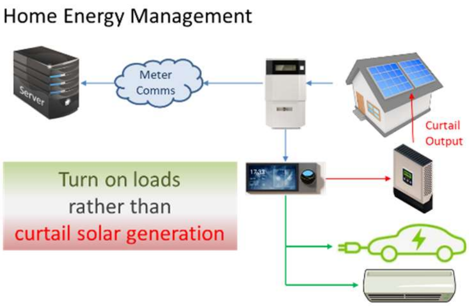
Australia has selected IEEE 2030.5 to support Dynamic Operating Envelopes. Protocol extensions defined in CSIP-Aus are intended to "manage site-level operating envelopes". The extensions allow a limit to be set on the amount of energy sent to the network. Site-level management requires monitoring of the net energy flow to and from the site.



Operation of the limit is relatively simple, when the amount of energy flowing to the network exceeds the set limit, the output of the inverter(s) is reduced.

While PoC meters monitor the net energy flow to and from the network the measurements are not made available to the solar inverter. Consumers wishing to take advantage of Dynamic Operating Envelopes must install additional monitoring equipment. The cost to provide and install this additional monitoring could be avoided if measurements already made by the PoC meter were made available.

The selection of an interoperable protocol supported by all consumer installed devices can support far better consumer (and societal) outcomes. When the limit is exceeded, rather than reducing solar inverter output, the HEMS attempts to turn on additional loads. The following figure depicts a HEMS using measurements made by the PoC meter to turn on various consumer loads to stay within set limits.

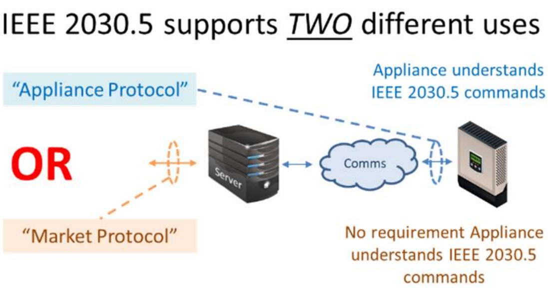


If sufficient loads are unavailable then (as a last resort) the HEMS reduces the output of the solar inverter(s).

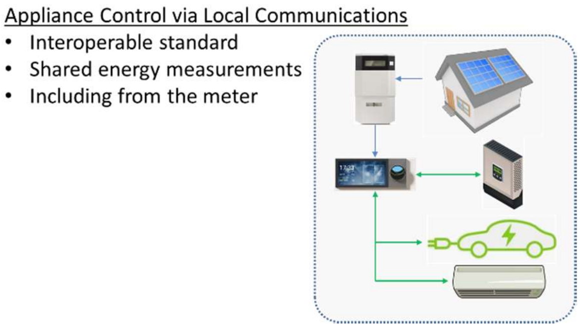
Before moving onto a discussion of how IEEE 2030.5 could support the visibility and control of behind the meter assets it is necessary to discuss two possible models.

Appliance vs Market Protocols

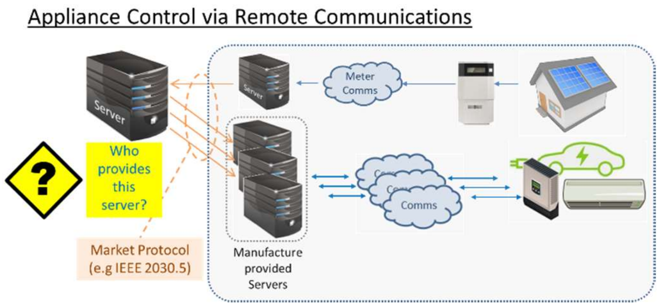
Aligning with current AEMC language we refer to the two possible models as an "appliance protocol" and a "market protocol". The following depicts the differences:



The "appliance protocol" requires individual appliances implement IEEE 2030.5. The advantage of this model is it supports *LOCAL* direct communications between devices on the HAN:



The "market protocol" removes the requirement appliances use the same protocol. Instead remote internet servers provide the necessary IEEE 2030.5 interface (with manufacturer provided protocol translators).



The SA Government intends to use the market protocol approach to implementing Dynamic Operating Envelopes. It is also how the AEMC currently supports access to meter measurements used for settlements.

The key difference between the two models is where decisions are made, either locally or remotely. To be clear, it is not suggested the meter be responsible for device coordination. That role falls to a separate device.

In the case of local communications the controller is installed on the local HAN. One advantage is this controller would be purchased and installed by the consumer. For example the controller required to implement Dynamic Operating Envelopes is part of the consumer installed solar inverter.

When using remote communications control services are provided by a server hosted somewhere on the internet. In the above figure 'Appliance Control via Remote Communications' the server has been labelled with a question mark asking "who provides this server?".

The earlier discussion of voice assistants revealed Google, Apple, Amazon and Samsung choose to host control servers. Here we extend the discussion to If This Then That (IFTTT).

> IFTTT was founded on the belief that everything works better together. Tech incompatibility has become challenging for anyone trying to build a smart home or create automatic routines in their life. IFTTT makes it easy.

IFTTT provide a server allowing consumers to use Applets to do smart things: e.g. a smart home Applet which uses the weather to adjust air-conditioner temperature settings (shown to reduce heating/cooling costs by almost 20%). It is not difficult to imagine an Applet monitoring net solar system export and turning on smart domestic loads to increase self-consumption (lowering consumer energy costs while simultaneously providing network benefits).

It is also possible for consumers to provide the management server. After loading and configuring appropriate software it could provide coordinated control of connected smart appliances. While possible this is currently technically challenging. Note even if the server is physically located in the household it does not communicate directly with any of the appliances. Instead all communications relies on communications to manufacturer provided servers, which via the internet communicate with appliances.

The new Matter interoperable smart appliance standard being promoted by Amazon, Apple, Google and Samsung may provide a potential solution. Matter supports direct communications with appliances. Matter devices can create a mesh network increasing the reliability of in home communications.

It is also significant to note consumers are relying on manufacturer provided servers. If a manufacturer decides to discontinue support for their server the connected appliance(s) are immediately turned back into dumb appliances. This should be viewed as concerning where control of the various consumer appliances is providing grid stability.

Another issue the AEMC choose to ignore is the huge difference between monitoring and metering. As discussed the AEMC's PoC only focussed on market settlements. For example the Minimum (PoC Meter) Services Specification makes no attempt to clarify the frequency of energy measurements. The "metering installation inquiry service" (Table S7.5.1.1(e)) requires PoC meters return a measurement of "the power (watts) as measured by the metering installation". Disappointingly the table fails to specify how long the measurement will take or how often this request can made.

Increasingly grid stability requires monitoring. Monitoring far more frequent measurements. For example utilities have invested in SCADA systems designed to continuously monitor critical network infrastructure responding immediately issues.

The Victorian AMI meters supported monitoring. Their specification indicated meter measurements should be made available every 10 seconds. A similar interval is being considered by European standards to support near real time metering requirements. This suggests the HAN connected meter should be able to provide energy monitoring at least every 10 seconds.

This provides a key point of difference between the Appliance Protocol and Market Protocol. Supporting Local access to meter energy measurements every 10 seconds adds around $10 to the cost of the meter.

While it is possible to support similar monitoring using a Market Protocol it is important to realise this places significantly higher demands on the meter communications. These high demands may exceed the capabilities of current (low cost) meter reading systems. This is confirmed with Meter Data Providers indicating placing *any* near real time requirements on meters risks significantly increasing metering costs.

This key point of difference suggests the best fit to the identified requirements is provided by meters supporting LOCAL access to energy measurements.

Consumers key to solution delivery

The Australian Energy Market Operator (AEMO) has indicated future enforceable connection agreements will restrict the size of uncontrolled domestic solar systems. Consumers can choose a large system, but only if they agree to allow its output to be adjusted to fit within available network capacity (using CSIP-Aus to implement Dynamic Operating Envelopes).

Similarly the ESB's two-sided market allows consumers to choose to participate in the wholesale demand response market. Those choosing to participate can expect to be required to meet certain requirements, for example appliances must support specific interfaces and measurements.

In both cases trials have shown a lack of interoperable protocols restricts consumer participation. For example in SA control of solar systems proved unworkable without an interoperable standard. Similarly air-conditioner demand response trials undertaken by ARENA/AGL and ARENA/PowerCor both failed because the chosen demand response standard (AS4755) does not support interoperability. These trials highlight the need and importance of selecting an interoperable protocol.

Despite failing to meet identified future requirements the current proposal is consumers choosing to participate must install multiple additional expensive PoC meters. The solution has already proved too expensive in SA and unlike interoperable protocols does not provide the required level of both visibility and control.

Consumers choose and pay for their appliances. Existing proprietary Smart Home and Appliance protocols are designed to lock consumers into a single vendor eco-system. This fragmentation also restricts consumer choice. Consumer participation can be enhanced by the selection of an interoperable protocol. Selecting a protocol supporting required visibility and control is entirely possible, today.

Conclusion

The Energy Security Board's (ESB's) 2025 vision recognises potential issues with the efficient transition to a clean energy future. High on the list of identified issues is the need to provide greater visibility and control of consumer installed sources of generation and flexible load.

The Australian Energy Market Commission (AEMC) halted its review of their Power of Choice (PoC) meter mandate 'to address the ESB's future vision'. Despite the 6 month delay the only change they appear to have made is to propose installing more PoC meters. The problem is installing more PoC meters does not meet the requirements identified by the ESB's vision.

This article has suggested existing interoperable protocols can meet the ESB's future requirements. One of these protocols is already being adopted for use in Australia. This protocol supports both visibility and control of consumer installed energy assets. It is a far better solution than installing more PoC meters.

Citation

It would be appreciated if all quotes from and references to this article include the author's name and the article title "We need Intelligent Monitoring and Control not more smart meters".

Comments or Questions?

The author is happy to receive comments or questions about this article. He can be contacted at martin@drmartingill.com.au

About Dr Martin Gill

Dr Martin Gill is an independent consultant specialising in the provision of consumer advice. This advice is based on a deep understanding of the Australian energy industry and strong analytical skills. As a consultant he has prepared advice for consumer advocates, government regulators, electricity distributors, electricity retailers, asset operators and equipment vendors.

Dr Gill is a metering expert. During the National Smart Metering Program he facilitated the development of a specification for Australian smart meters. Innovative metering products developed by his teams have been externally recognised with the Green Globe Award, NSW Government's Premier's Award and Best New Product by the Australian Electrical and Electronics Manufacturers Association.

He currently represents the interests of consumers on a range of Standards Australia working groups including metering, renewable power systems, battery storage, demand management and Electric Vehicles.