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Position Paper
Home Control in a consumer's perspective

Background

Today, home control is a market for enthusiasts. Products are too expensive and most systems are too complicated. Only a few home control systems can actually be installed by the average home owner.
At the same time, existing home control systems use proprietary application protocols which do not interoperate.

Current chip costs are less than $5 so it is definitely possible to produce consumer products for home control. A chip is a complete system on silicon; including radio, CPU, RAM, non-volatile storage and peripherals.

Migration

As the invitation to this workshop says:
"Some devices have been connected in various legacy ways in the past but are now migrating to the use of the Internet Protocol, sharing the same communications medium between all applications and enabling rich communications services."
This is an important step - but not the only one. Home control and building control has been around for decades. Having an installed base measured in millions of devices means that any new solution must be integrated with existing ones.
Several organisations have defined transparent IP gateways. The transparency allows for the introduction of new features without constant updates to gateways.

The need for interoperability

It is not possible to have a Z-Wave motion sensor control a BACnet lamp despite the use of IP for transport of the application commands. To make the market flourish, things must be interoperable.
For cost and operational reasons, it is undesirable to have multi-protocol translation in all gateways interfacing to legacy gateways
Some stepping stones are needed; Some "home and building Esperanto".
CoAP could be one such stepping stone. CoAP could define a subset of

commands that cover most of the features offered by today's legacy technologies. A Z-Wave sensor would then send a "Basic On" command to a BACnet lamp. Leaving the Z-Wave network, the command would become a CoAP "/light/state=1" command traversing the backbone. Entering the BACnet network, the command would be translated to "BinaryOutput.State = 1". Only BACnet experts should worry about the best translation to and from BACnet. The same applies to the other legacy technologies represented in the field.
An Internet Draft [vanderstok] also considers using CoAP in Building automation environments.

The Future

In a bright future, all new devices shipped will only speak the global language for home control devices. CoAP was suggested above as one such candidate. There may be other candidates. In CoAP terminology, some standard paths must be defined. Those paths should not be mandatory as a vendor decides how much functionality to put into a product. But the structure of the paths must be mandatory. M2M systems cannot analyze paths. They can detect and use. Most likely, CoAP will have to collect inputs from different players from different market places. Whether a client requests the light level from a home control dimmer or the temperature from a professional ceiling fire detector and extinguisher, the attribute should be "level". M2M support is the keyword.

Battery operation

During its evolution, IP has moved from watercooled mainframes to mobile phones than can run for days on battery. Sensor networks once more raise the bar for IP. Urban pollution sensors or home control temperature sensors must run for years on a small battery. Yet, it must be possible to reach such sensors to adjust calibration constants or re-define control thresholds. Such nodes sleep for more than 99% of the time. A sleeping node requires a network component, e.g. a border router, to host a mailbox for IP packets queued up for that sleeping node. The border router must be aware that it should not transmit to sleeping nodes unless receiving wakeup notifications.

An even more challenging node type is waking up frequently; typically a few times every second. If nothing is received from the air such a Frequently Listening Node (FLN) returns quickly to sleep. Examples include electronic door locks and drape controls. Several solutions exist for reaching FLNs but they do have in common that the most nearby repeater - or the routing protocol - or the border router must be aware that a special transmission method must be used to reach the FLN.

An FLN node requires tight coupling to the link layer.
As of today, no IP routing protocol supports the abovementioned

requirements.
One particular absent feature is the obviously missing ICMP message "Destination Responding Slowly" that a router may return to an IP host in order to make it not retransmit application commands in response to not receiving application protocol acks. That ICMP message could carry the expected delivery time for the application to display a (somewhat) reliable progress bar.

Heterogeneous network environment

Due to different physical layers, advanced home control installations employing multi-vendor products may often be constructed using multiple gateways each providing access to one subnet.
Subnets and backbone networks may use ULA subnets to provide zero-configuration for installers setting up the system.
When connecting to the Internet, such subnets may need to be aligned with a static/56 subnet allocated to the premises.
DDNS based remote access solutions may prefer to do subnet mapping from the access router to ULA subnets to avoid having to re-assign IP prefixes everytime the internet provider changes the access line prefix.

Service discovery

Todays consumers are used to the plug-and-play feeling. When a printer is attached,it just pops up in the PC.
Todays users will expect that they can browse their home control network: Just click the "Discover" push button (or shake your iPad) and all home control objects start popping up in the floorplan of the house. Want to control a lamp from a motion sensor? No problem. Just drag the lamp onto the motion sensor in the GUI.

But how did the motion sensor show up during discovery? Existing discovery mechanisms, e.g. DLNA, depend on multicast and link-local addresses. This is not enough in this environment.
Several building blocks are needed:

* Cross-subnet discovery
  Border routers must be able to participate actively in the discovery process

* Battery node discovery
  Border routers must be able to represent battery powered nodes

* Bandwidth-friendly discovery
  mDNS is powerful in a link-local domain. Multi-hop mesh networks are not link-local domains. A multicast message that spawns into many messages has a significant risk of causing RF collisions when it comes two hops down in the distribution tree. Coordination is not

  possible. This makes the discovery slow and unreliable.
  One option is that border routers represent all LLN nodes when it comes to discovery.
* Zero-configuration
  The discovery mechanism in its most basic form must not require the presence of DHCP server, DNS server, etc.
  A consumer must be able to hook up any two off-the-shelf border routers and start managing the network from an arbitrary management system downloaded from the Internet.

Many of these Discovery requirements are described in an Internet Draft on CoAP Discovery to be presented at IETF-80 by Anders Brandt.

Conclusion

So where should the IETF focus?

To kickstart the home control market, systems must be brought together. Discovery across subnets with caching support for representation of sleeping nodes is another task.

Routing to battery operated nodes is an obvious task to be lifted by the IETF.

The IETF already hosts the homegate initiative. The home control domain may provide additional guidance to recommended features for consumer-space routers and access routers; e.g. default local routing between ULA subnets in customer premises.
A new ICMP message is proposed but is there a need for even more ICMP messages in the area of LLN applications?

The interoperability of existing systems is a requirement for this market to grow. With that in place, we can start discussing which protocol to use for routing over existing MAC/PHYs.

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