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Multihoming for Sensor Networks
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Abstract

Different sensor networks are getting more common. A home or in-building sensor network may be monitored and managed by two different parties - the home owner/person living in the home, and the energy company. This may lead to a situation where both of the administrators would need or want to have their own Internet connection. This might require the sensor network to be multihomed. This paper discusses why this scenario may be possible, and how can this scenario be dealt with.

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1. Introduction

Certain utility companies are looking at using 802.15.4 wireless technology as their local network technology for various sensor networks. One example of such a network is a home or a building electricity network, where the energy meter, and some electrical devices are connected to the a single sensor network.

In this example case, the sensor network may have nodes owned by the building or home owner and nodes that are owned by the energy company (for instance light bulbs are owned by the building owner and the electricity meter belongs to the electricity company).

Especially in this kind of a case, the network itself may have the following dual-use characteristics.

- o For the utility company to monitor, manage, possibly control sensors in a home or other building,
- o For the home or a bulding owner to monitor and control the building or the attached sensors.

The utility company can be connected to the sensors either the whole time, or just when needed.

Obviously, the easiest way to solve this is to have one Internet connection for the network, and both the owner of the building and the utility company could use that connection to address the network. However, there may be multiple reasons why this is not as straight forward as it first seems. A couple of possible reasons could be the following.

- o The utility company does not want to provide or use Internet

connectivity, but just connection to the energy company management network. Therefore, the home/building owner cannot connect to this network through the connection provided by the utility company.

- o The energy company does not trust the home broadband connection for quality or resilience reasons. For instance, the company does not want rely that the home broadband connection is paid for and up and running.
- o The home owner wants to connect the sensor network to the local lan to monitor and control it directly regardless of the connectivity provided by the utility company.
- o The home/building owner does not want that her/his Internet connection is used by the utility company.

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These are just examples. There can be multiple other reasons, and scenarios why a sensor network could or should be multihomed. However, this document will not dwell further into those. Instead, we will look what kind of possible scenarios may have to be supported, and analyse these scenarios. The first section below describes the scenarios, and the next section then tries to analyze what requirements are implied by the scenarios.

2. Description of Example Scenarios

This section describes two possible multihoming scenarios, which most probably will need to be supported.

2.1. Fixed Multihomed Network

The <Sensor_network_I> shows a multihomed sensornetwork setup with two fixed Internet gateways.

Preamble text - can be omitted or empty.

```

\|/ (to utility company)
|
|
| Cellular |
| Gateway |/ \ / \ / \|
|          | | Home | /
|          | | Gateway |/
|          | |
+-----+ +-----+ WAN
```

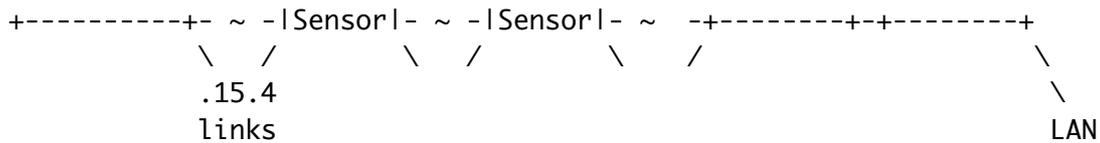


Figure 1

The sensor network is connected by 802.15.4 links. There are two wide area connections, a cellular connection to the utility company on the left (which might or might not be connected to the Internet), and a home broadband Internet connection on the right.

The sensors are accessible from either network. The services provided by the sensor network to utility company and the home/building owner can either be the same or different - e.g. the utility company might be allowed just to monitor some sensors, where as the home/building owner might control equipment connected to the sensor (such as lights).

The two connections are here assumed to be from two different providers and therefore having two different prefixes. It is assumed

that neither of the connections run BGP.

The WAN links may have different bandwidth and latency characteristics.

2.2. Intermediately multihomed network

The Figure 2 shows a setup where there is just a single persistent Internet connection. However in addition, a cell phone with a second wide area connection (Internet or an "intranet" connection), sometimes roams and connects to this network. Obviously, a similar case would be the first scenario described above, but either of the connections would not be persistent.

An example of such a setup would be a maintenance person visiting a site, and creating a connection for the the maintenance company network to access this sensor network.

(preamble)

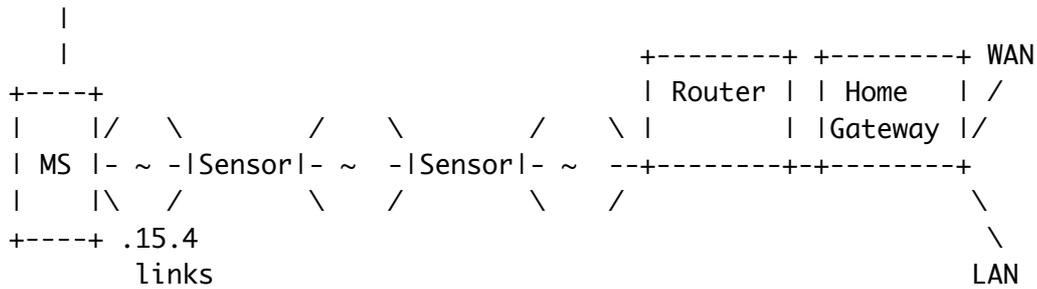


Figure 2

3. Analysis of the Scenarios

The two scenarios are very similar - except, the second scenario brings also dynamicity to the mix. The requirements for such scenarios are the following.

- o Support multihoming for two different networks
 - * The different networks may be connected to each other - or not.
 - * The two WAN links may be asymmetric
 - * They may be financed differently

- o The sensors have to be able to talk to either of the outside networks.
 - * The traffic from the sensors need to be routed to the right network.
 - * Traffic cannot pass through the other network while going to the other.
- o The WAN connections can come and go
 - * The network has to converge if a new WAN connection appears.

- * It has to do it rather quickly (seconds, not minutes, hours, days).
- o There has to be a discovery mechanism to find the sensors - both locally and from the outside network.
- o Security has to be considered.
 - * Setting up has to be secure.
 - * Discovery has to be secure.
 - * Using the services has to be secure.
 - * Basically, there has to be a way to authenticate anybody accessing the sensors

4. Conclusions

As mentioned earlier in this document, it would be easy just to limit the Internet connection to one. However, it is not possible to get the easiest solution here. As described there are clear reasons why multihoming, and possibly (rapid)renumbering are needed.

In addition, the applications for sensor networks have other requirements as well. These include security and access control.

5. IANA Considerations

This memo includes no request to IANA.

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6. Security Considerations

This document has no security considerations

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