Perytons
Network Visibility

# Internet of Things – The Münchhausen Trilemma

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## Abstract

With Internet of Things becoming a reality, companies tend to underestimate the challenges hidden in the local communication networks (HAN/PAN) assuming the chipset and software stack vendors will be able to guarantee the needed interoperability and by adopting the 'Münchhausen trilemma' assumes that the management and monitoring messages embedded into the protocols will be enough to support and maintain these complex networks.


## Background

People have been talking about the Internet of Thing (IoT) for a long time. The dream (or nightmare) of letting your refrigerator and espresso machine communicate with each other and automatically place an order with the supermarket for missing ingredients, has been raised more than a decade ago.

But now it seems that the IoT is finally catching up. Vertical markets for smart energy management, home & building automation and healthcare are merging into IoT, while new markets and applications are added in. This includes smart cities, commercial building automation, wearable computing and many more exiting applications.

Internet of Things is about connecting many sensors and devices together through the internet, letting the user or corporate control things remotely and building wisdom out of all this huge amount of data to make automatic decisions and provide the user with the conclusions. For example, the public transportation system reports the train and busses location, the wisdom system adds up the user location and planned meetings from his (or her) calendar, and along with the current weather and traffic conditions, notifies the user when exactly should he leave his work in order to get to the bus station in the right moment.

Cisco expects the number of devices that will be connected to the internet by 2020 to be 50Billion. With such an enormous opportunity every big corporations has a IoT strategy. Some examples are IBM looking into the wisdom segment, Cisco into the communications segment (routers, IP addressing), Intel targets the wearable computing, Apple into the home entertainment and indoor location identification infrastructure, Broadcom and Texas Instruments are looking to provide the chipsets and development tools for the HAN/PAN communication segment and many more.

In Q4 2013 IoT was one of the hottest investment segments in the Silicon Valley funding more small companies with exciting elements and applications for the IoT eco system.

## The IoT Segments

Although IoT covers many different markets and segments, all the IoT systems share similar elements or building blocks:

- The sensor/end-devices component

  This includes the end-device that has some sensing capability. It can be a very simple device - e.g. heartbeat monitor, temperature sensor or proximity detector - or a sophisticated device such as Google Glasses. The sensors are typically low energy and low foot print devices.

- The PAN/HAN segment

  This is the short range communication segment (wireless or wire-line) connecting the sensors/end-devices with each other and with a nearby communication gateway, creating a PAN (Personal Area Network) or HAN (Home Area Network).

- The WAN segment

  The communication gateway connects to the sensors through the HAN/PAN, over the WAN (wide Area Network) and from there to the Internet cloud. The WAN may use wire-line broadband connection, cellular data network or a proprietary communications infrastructure.

- Data storage and processing

  This component is responsible for collecting data from a large number of sensors and storing it, usually in databases of comprehensive format.

- Wisdom and big data processing

  This segment is responsible for processing the data from one or many IoT networks and generating conclusions and user information.
  The resulting conclusions are evolved using sophisticated algorithms that take relatively simple data entries and elaborate them towards a service-oriented, through-through action suggestion.

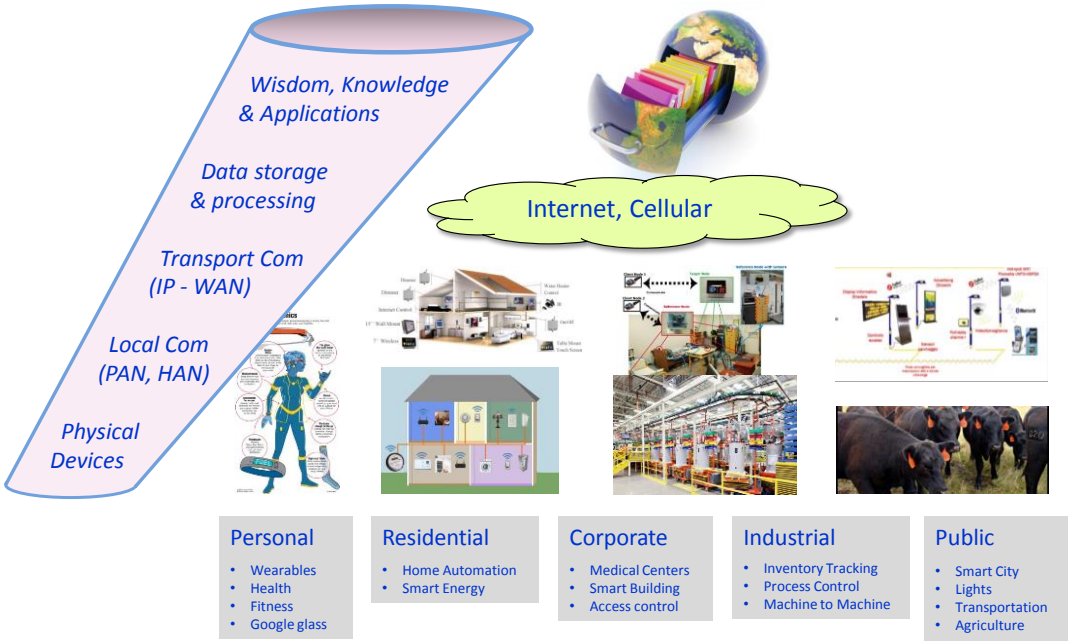
- User component

  Provides the users with the sensors information or wisdom system conclusions. This will typically is the user smart phone or personal computer (for consumers) or the organization control center (in case of a large corporation, city management etc.).

In order for an IoT system to function correctly, all segments needs to operate well, there should be well defined end to end protocols and applications, and an excellent user experience.

## The IoT HAN/PAN Communication Component

Information from the IoT connected devices is just 'expected' to be available and up-to-date. But actually for the data to get to the cloud it should be transferred from different networks using multiple/still-evolving protocols and implemented by a variety of vendors - interoperability in the lab can not address all issues.
The HAN/PAN communication segment connects the sensors with the WAN communication gateway. The technologies used today for this segment include ZigBee (mainly for Home Automation and Smart Energy), Bluetooth Low Energy (Wearable Computing, Home Automation) Z-Wave (Home Automation), WiFi (some industrial applications), Narrow band PLC (Smart Energy) and proprietary protocols.




Some of these protocols implement proprietary transport and application layers (for example Z-Wave), some use standard protocols (such as ZigBee, MQTT) and some use IP protocol.

By nature the HAN/PAN component includes a large number of vendors, evolving protocols, and dynamic topology (each home may have a different network structure, different elements mixing different protocol versions, multi vendors and protocols).

The standardization bodies as well as the protocol groups (e.g. ZigBee alliance, Bluetooth SIG, G3 alliance, etc.) are doing a lot of work to make the protocol as fail proof as possible, predict all possible scenarios and conduct interoperability events. Yet these can never resolve all scenarios and/or equipment/protocol version combinations.

In some cases the end user is the actual system integrator. He may buy different type of equipment from different vendors, put it together and hope for the best: that it actually works... If it doesn't, there is not much he can do.

But in many other cases, there is a service provider that is responsible for the equipment installation and maintenance, For example O2 in the UK Smart Energy project, AT&T in Home Automation projects, Comcast in the Home Security vertical and many others.
As the initial party facing the end-user, these integrators or service providers find themselves responsible for the IoT challenges in general and for the HAN/PAN challenges specifically.

While some IoT application issues may be identified and resolved using the built in management and control features of the IoT system itself. This is like an episode taken from the Baron Münchhausen, where he and his loyal horse sink in a swamp. Münchhausen gets out of the swamp by pulling himself out by his long hair.

This kind of maneuver is only possible in tall tales or in the IoT case if the HAN/PAN communication segment is functioning correctly (since such quality of service and analysis features are integrated within the IoT protocols and communications components). If there is a sensor with PAN communication problems due to a protocol version, security keys problems, or vendor interoperability failure, this can't be resolved with such internal integrated features and in some cases there is no way to know that a problem exists until a user complains.

Baron Munchausen's remarkable leap
Painted by Alphonse Adolphe Bichard

**Perytons Network Visibility – the Out of Band approach**

In order to address these PAN/HAN challenges, Perytons introduced the Perytons Network Visibility.
The solution is based on a monitoring agent API implemented into the communication gateway. This agent is capable of sending the row PAN/HAN data (directly from its PHY level) to the Perytons monitoring & troubleshooting center over the WAN. This agent is also capable of sending additional info (such as communication channel load or interferences), or perform control actions back to the PAN/HAN (send message into the local network) upon instructions received from the center.

Having the monitoring agent API implemented in the PHY level, the local agent is transparent to most protocol interoperability problems in the local network. It can pass the row data to the center where it can be analyzed according to the relevant protocol.

This analysis allows the Perytons Monitoring & Troubleshooting operator to analyze protocol problems and application problems in each of the remote WAN/PAN networks.

Since typically the local HAN/PAN has low bit rate compared to the WAN, it is possible to send ALL local data to the Monitoring & Troubleshooting center continuously. If this is done, the data can be stored in the center and automatic analysis based on operator created scripts may be performed periodically.

version.

This enables detecting problems (e.g. interference issues, interoperability problems etc.) before the user calls to complain hence increasing user satisfaction and meet their SLAs. It also allows the call center personal to remotely fix some of the problems (for example initiate a key exchange with a problematic device, suggest a channel change when wireless interference is identified, etc.).
An additional immediate result of having all data recorded in the center is the option to enable data auditing and back-office information inspection.

## Summary

The Internet of Things revolution is already here and is taking substantial leaps towards large scale implementations.
In order to have a robust system that is multi-vendor integrated but yet which end-users in the private and commercial sectors will be confident to rely on with their critical and non-critical applications, service providers need to be prepared to address the challenges that the IoT solution brings with it.

The Perytons Network Visibility helps to meet the communication segment challenges by addressing the multi-vendor, rapid protocol evolutions and interoperability issues with an Out-of-Band flexible solution.

For more information visit http://www.perytons.com/network or contact us at sales@perytons.com.