Mom and Pop Friendly Home-Centric Networking

Overview

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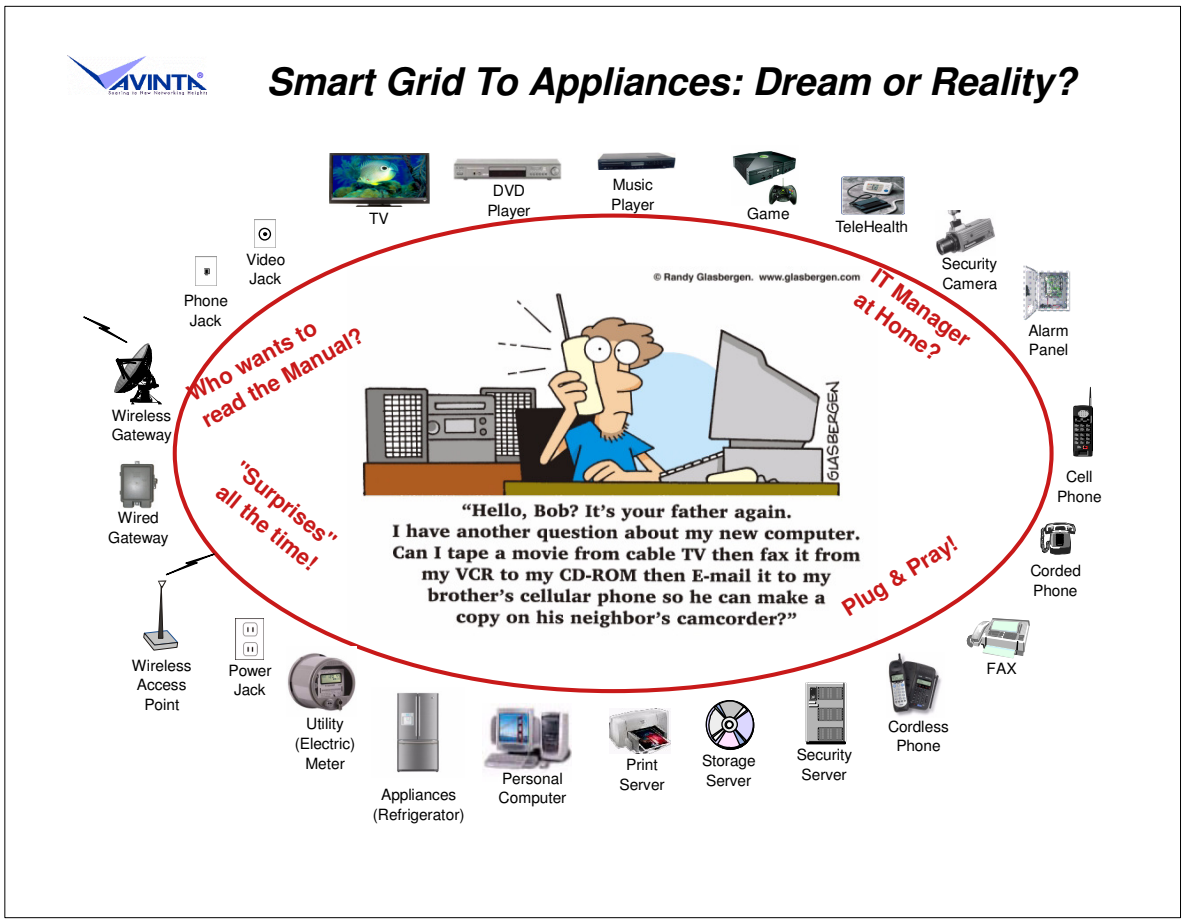
- Broadband has become deeply intertwined with daily life.
- However, to enjoy it as another utility in the same sense as the traditional four -
- Water, Gas, Electricity & Telephony,
- there seems to be a big hurdle in the way.
- The challenge is to deliver broadband in an intuitive and uniform manner, such that consumers may manage it by themselves and then mix and match their own application devices and services.
- This presentation describes a concise network architecture to establish an intuitive Home-Centric Network (HCN) for achieving this goal.
- HCN intends to provide native Ethernet connectivity (OSI - Open System Interconnection model Layer 2). It will be conducive to the current industrial efforts of deploying Digital / Connected Home toward ISO's HES (Home Electronic System).



- Most of today's networking solutions are driven by specific applications, making it difficult to have more than one broadband service to coexist on the same premises.
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- Even for each individual solution, the configuration tends to be end-to-end and Internet-driven. This packaged approach leaves premises owner hardly any control, leading to no flexibility.
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- A home-centric architecture will empower a home owner to manage his/her own network with confidence.
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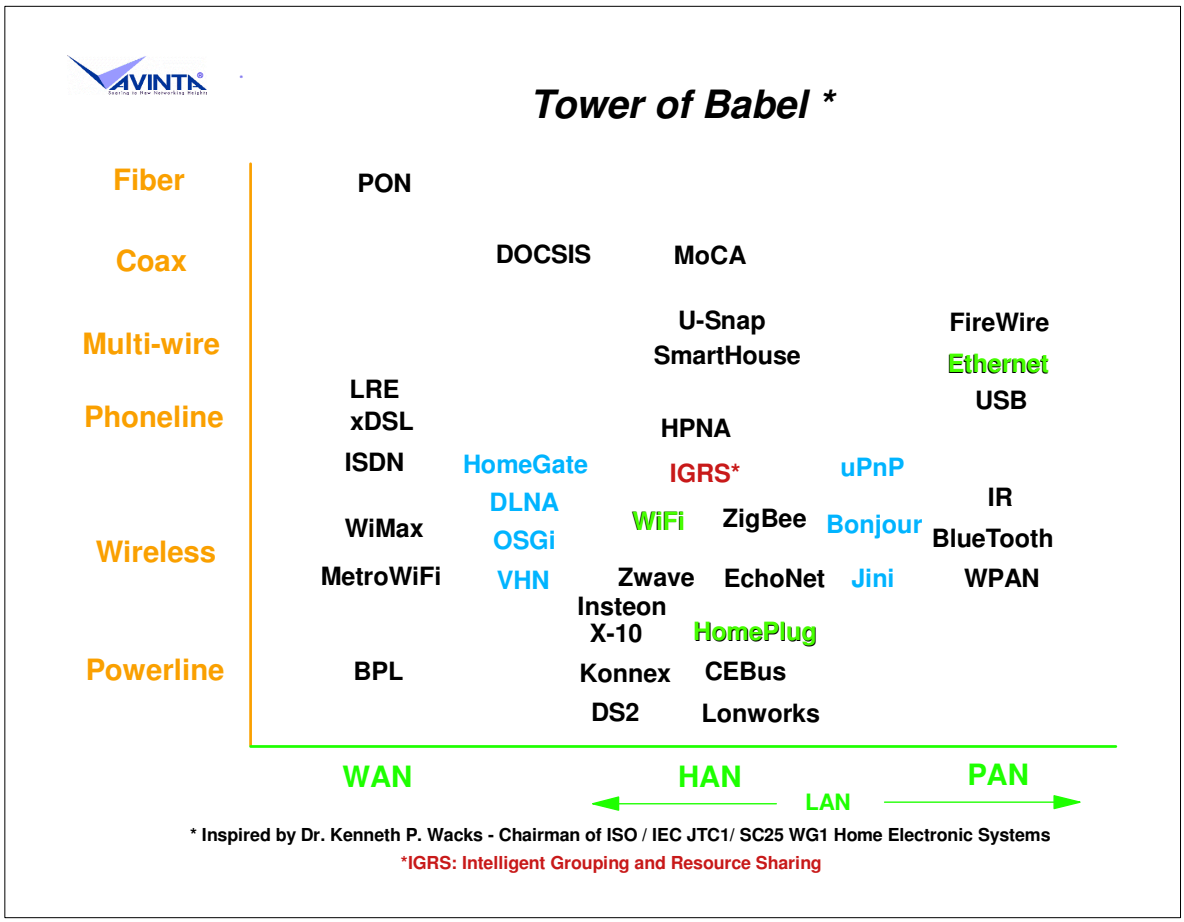
- End User Terminals (EUTs) associated with various applications can then be added and removed intuitively, very much like traditional appliances on existing utilities.



- This slide demonstrates the confusion in the HAN ecosystem due to the abundance of "standards". Currently, each occupies certain market segments, but independent of one another.
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- The blue-colored group of standards promote the idea of consolidating these technologies. Yet, each of them introduces another set of techniques and protocols. Moving along this trend, there is no hope to get a concise end-product to the consumer.
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- Through all this diversity, Avinta has identified a common thread, the Ethernet, for deriving a configuration that is uniform for consumers' sake.
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- Powerline is a good candidate as the backbone medium since it reaches almost every place that networking is desired.
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- Then, we can supplement this infrastructure with low power wireless where mobility is needed.
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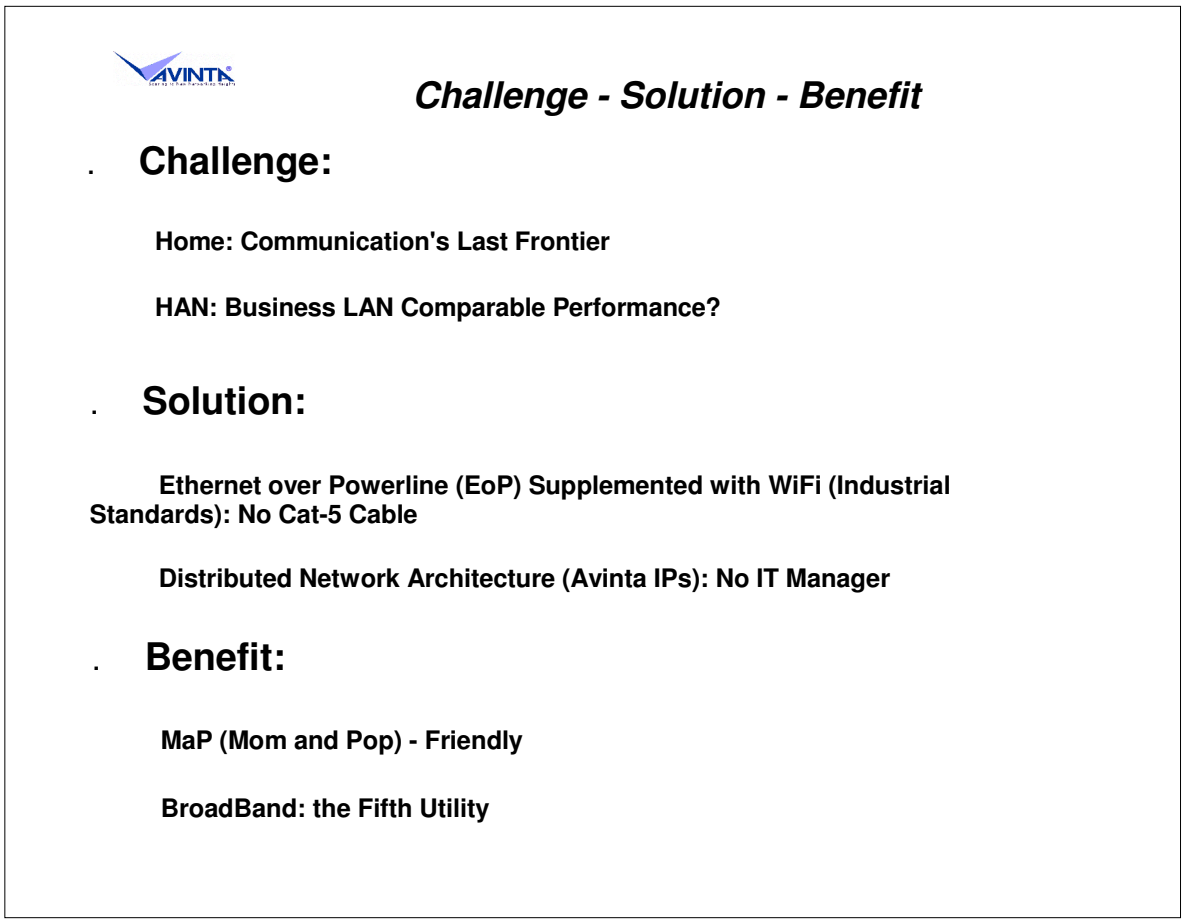
- By intuitively bridging other technologies into the Powerline backbone, a general HAN will be universally accepted by consumers.



- Challenge:
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- Because home is such a diverse environment, both in terms of equipment and user, a universal solution is extremely difficult.
- Furthermore, "My home is my castle" is a philosophical hurdle.
- Ideally, Home Area Network should provide similar level of performance (10/100 Mbps) as the Local Area Network at work.
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- Solution:
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- HomePlug AV is now able to deliver such performance. Since powerline reaches practically every spot where networking may be desired, there is no longer need to pull Cat-5 cables through the walls of a premises. Note that, even for wood framed houses, this task requires certain level of skills, not to mention brick or concrete buildings.
- For mobility and locations without electric outlets, WiFi may be utilized for connectivity.
- Distributed architecture reduces network building blocks to identical black boxes, empowering home owners to set up, diagnose and maintain the equipment. This eliminates the reliance on IT support staff.
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- Benefit:
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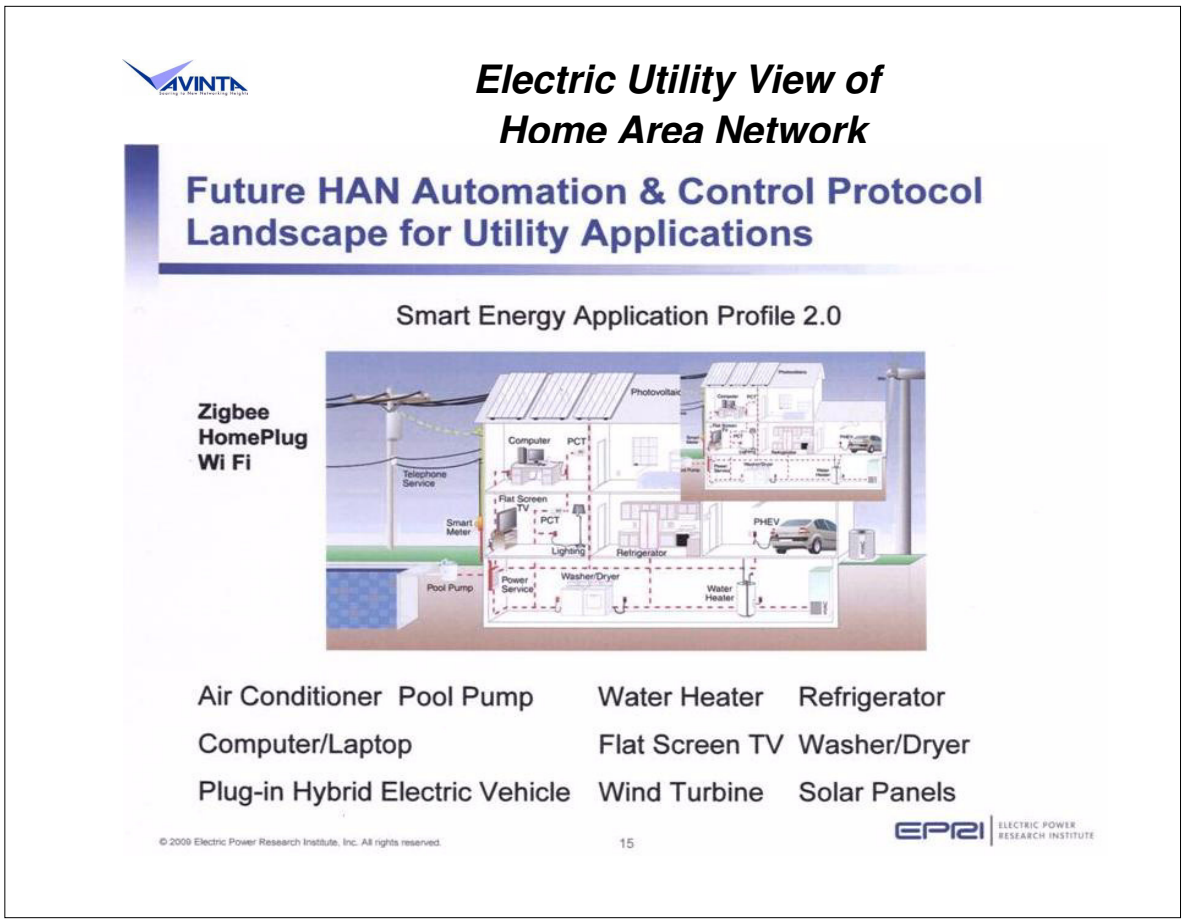
- With distractions and frustrations removed, HAN becomes Mom and Pop Friendly.
- And,
- Broadband may be enjoyed just like the traditional four utilities, Water, Gas, Electricity and Telephony.



- Since electric outlet is likely at where networking may be desired, it would be natural to make use of the powerline already installed in the walls as the infrastructure's backbone.
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- Among various Power Line Carrier (PLC) transport technologies, HomePlug provides a full range of performance characteristics that may be utilized by different applications.
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- For locations that powerline does not reach, or applications requiring mobility, low power wireless technologies may be utilized to supplement the coverage. This architecture is very much the same as "femto cell" in mobile phone terminology.
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- This technology consolidation view is in sync with HEMS (Home Energy Management System) efforts coordinated by Electric Power Research Institute (EPRI), as this slide shows.
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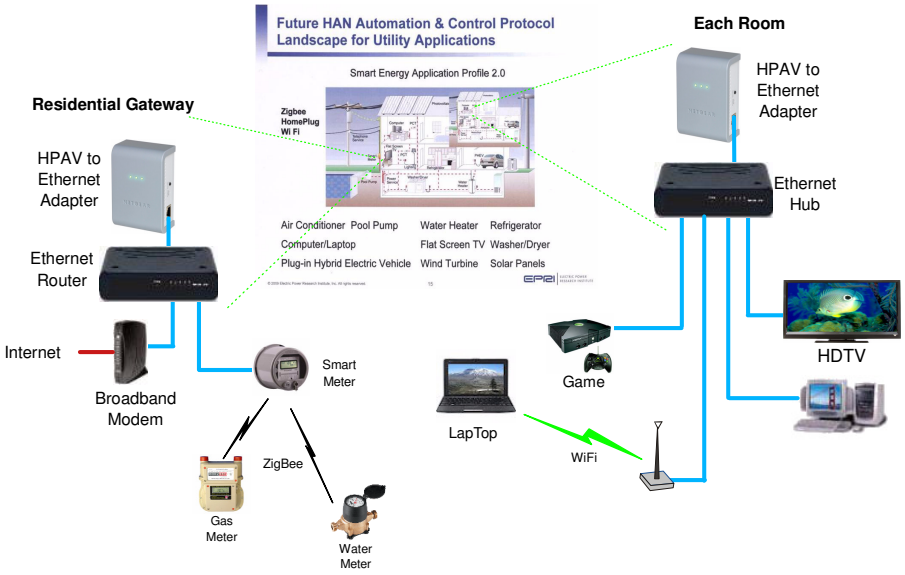
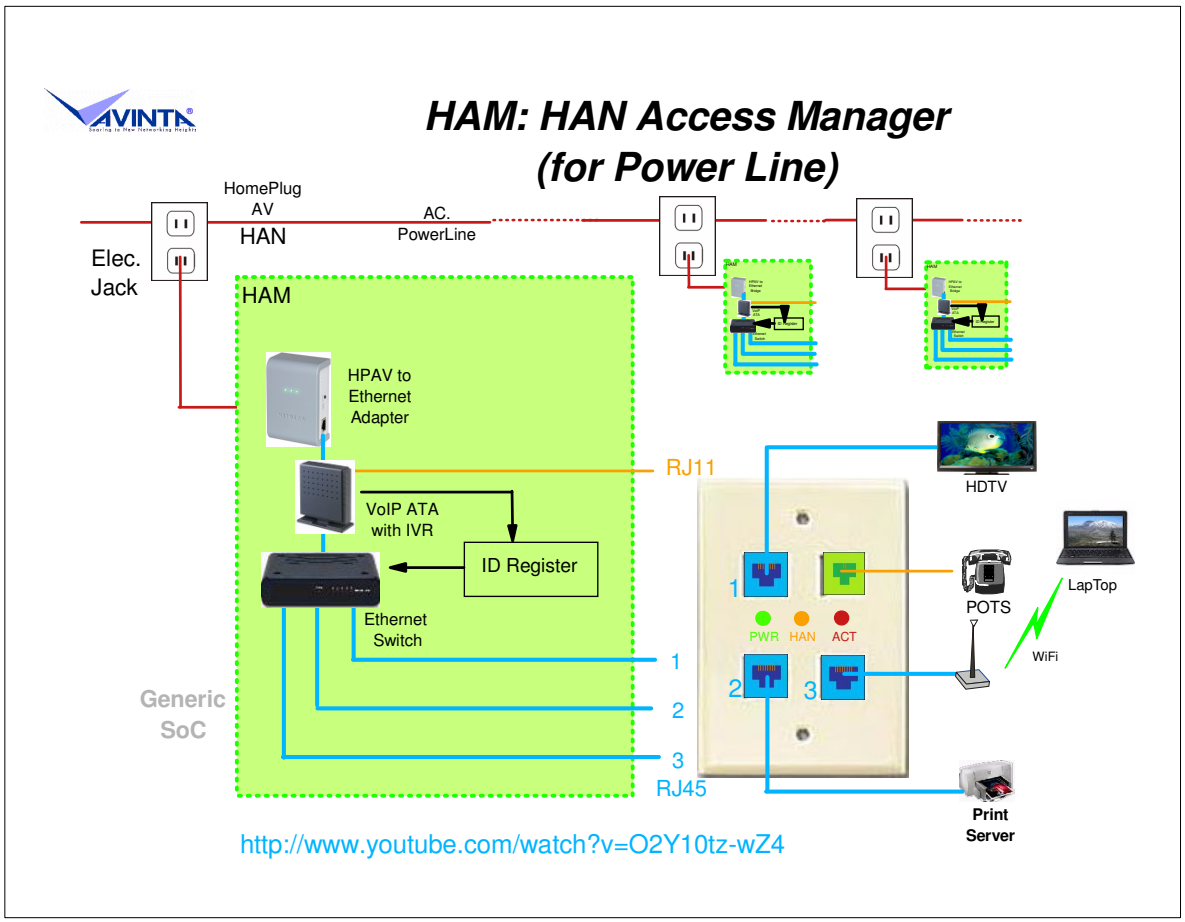
- However, the issues due to the current "Internet driven" HAN architecture remain.

Home Area Network Architecture (Current)



- At the entrance to a property, an RG consisting of a broadband modem, a Router and an Ethernet to HPAV Adapter puts Internet information onto the powerline for the premises.
- At each room, the signal on powerline is converted back to Ethernet by a HPAV to Ethernet Adapter then shared via a Hub among multiple application terminals such as PC, TV, Game, etc.
- ZigBee may be used for Home Energy Management System, and WiFi may be used where higher bandwidth is needed.
- Under this architecture, however, all intelligence is concentrated in the Router of the RG. It provides a rudimentary but crucial communication function of identifying each node via a DHCP server. The Adapter and Hub in each room have practically no intelligence.
- This is fine as long as everything is working normally. When abnormality occurs, which will happen sooner or later, such as conflicts or poor transmission between two nodes, the home owner will have a hard time to get diagnosis started, because s/he has never paid any attention to which node has what ID, nor how well it should perform under normal conditions.



- AvintaNET is a fully peer-to-peer HAN architecture requiring only one type of building block for deploying the system. A single-design, mass-producible black-box module called, HAM has been formulated.
- By inserting a VoIP ATA with IVR between HomePlug to Ethernet Adapter and Ethernet Hub, HAM is formed.
- The VoIP ATA with IVR (Voice over Internet Protocol Analog Telephony Adapter with Interactive Voice Response) distributes the intelligence of the RG Router to each HAM. This empowers a home owner to set up and maintain a HAN intuitively, with no PC, smart mobile device, nor networking knowledge.
- Note that the entire HAM may be made by a fully integrated SoC with pin count less than 50 ensuring the lowest cost possible.
- Deploying a HAM at each location desiring to be networked, Home-Centric Networking without centralized equipment nor Internet support becomes a reality.
- The hyper-link at the bottom of the diagram leads to a video clip describing how HAM provides the three essential Network Management tools for Provisioning, Connectivity and Throughput.

Unifying PAN (Proximity Area Network) Technologies

. MCU's SPI (Serial Peripheral Interface) to Ethernet Hardware with TCP/IP Offload Engine (TOE)

. Wired:
WIZnet W5200 IC - 48 LQFN ($3.69)
WIZ820IO Ethernet Module ($19.95)

. Wireless:
GainSpan:
GS1011SoC - 102 Dual Row QFN ($15.00)
GS1011M - Low Power Soldered on ($30.00)
GS1500M - Low Power Module ($37.00)

WIZnet:
WizFi210 - Ultra Low Power WiFi ($30.36)
WizFi220 - Ultra Low Power WiFi with External PA ($33.01)

. IHD (In-Home Display) with PoE (Power over Ethernet) interface

. Super - IHD:
GE Security: GEC-CCSCSTATECO
SmartCommand Thermostat ($290.04)

- To complete a MaP-Friendly Digital Home, all EUTs (End User Terminals) should be networked through preferably one, not more than two types of interfaces. The direct hardware IC adaptations from the SPI of a uC (Micro-Controller) to Ethernet (wired or wireless) are the most concise approaches:
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  - Ethernet:
    - WIZnet W5200
      - http://www.saelig.com/product/ICETH001.htm
    - WIZnet WIZ820IO
      - http://www.saelig.com/product/BRD032.htm
    - Digi Connect ME 9210 SoM (Solution on Module) ($199.00)
      - http://www.digi.com/products/wireless-wired-embedded-solutions/solutions-on-module/digi-connect/digiconnectme9210
-
  - WiFi:
    - GainSpan GS1011SoC
      - http://www.gainspan.com/gs1011soc1
    - GainSpan GM1011M
      - http://www.gainspan.com/gs1011mxx
    - GainSpan GM1500M
      - http://www.gainspan.com/gs1500m
    - WIZnet WizFi210
      - http://www.saelig.com/product/BRD027.htm
    - WIZnet WizFi220
      - http://www.saelig.com/product/BRD028.htm
    - Dig Connect Wi-ME 9210 SoM (Solution on Module) ($199.00)
      - http://www.digi.com/products/wireless-wired-embedded-solutions/solutions-on-module/digi-connect/digiconnectwime9210
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- A black box type of central controller for the entire HCN is preferable to a PC or a smartphone for avoiding the complication and frustration imposed on mass consumer due to the unnecessary sophistication of the latter types. The best starting candidate is an IHD:
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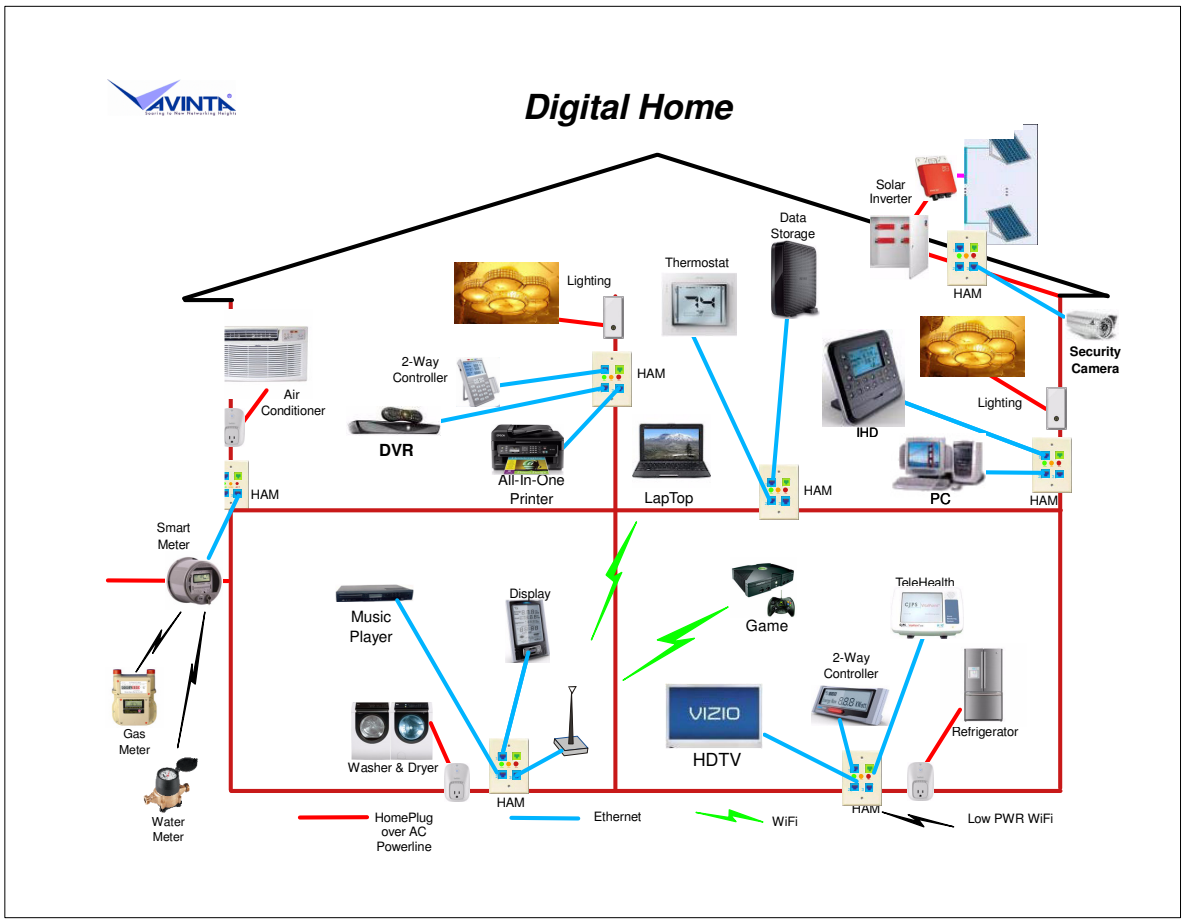
  - GE SmartCommand Thermostat
    - http://www.securitystoreusa.com/GE-Security-GEC-CCSCSTATECO-p/gec-ccscstateco.htm
    - http://4162558888.com/downloads/SmartCom%20brochure.pdf
    - https://www.pointview.com/data/2008/05/22/pdf/Gene-Goodell-3206.pdf



- Each HEMS may be started as an island, totally isolated from the outside world. Application terminals are plugged into HAMs to begin services. This may operate with only minimum information, such as seasonal ToU (Time of Use) tariff published by the utility company. Meter reading may be taken care of by utility's current practice.
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- Adding Internet access modem, not only remote meter reading can be easily performed, but also two-way communications in real time such as dynamic pricing and remote load balancing may be offered by the utility.
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- The RG could be as simple as a conventional Dial-Up modem for light duty applications.
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- With broadband RGs added, full range of application devices, such as data, audio, video, game, etc., may be plugged into the established HEMS to deliver Broadband as the Fifth Utility, whenever and wherever the home owner wishes.
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- This HAN architecture allows simultaneous access to multiple Internet channels, resulting in redundancy that facilitates easy comparison of services as well as smooth backup in case of primary channel abnormality.
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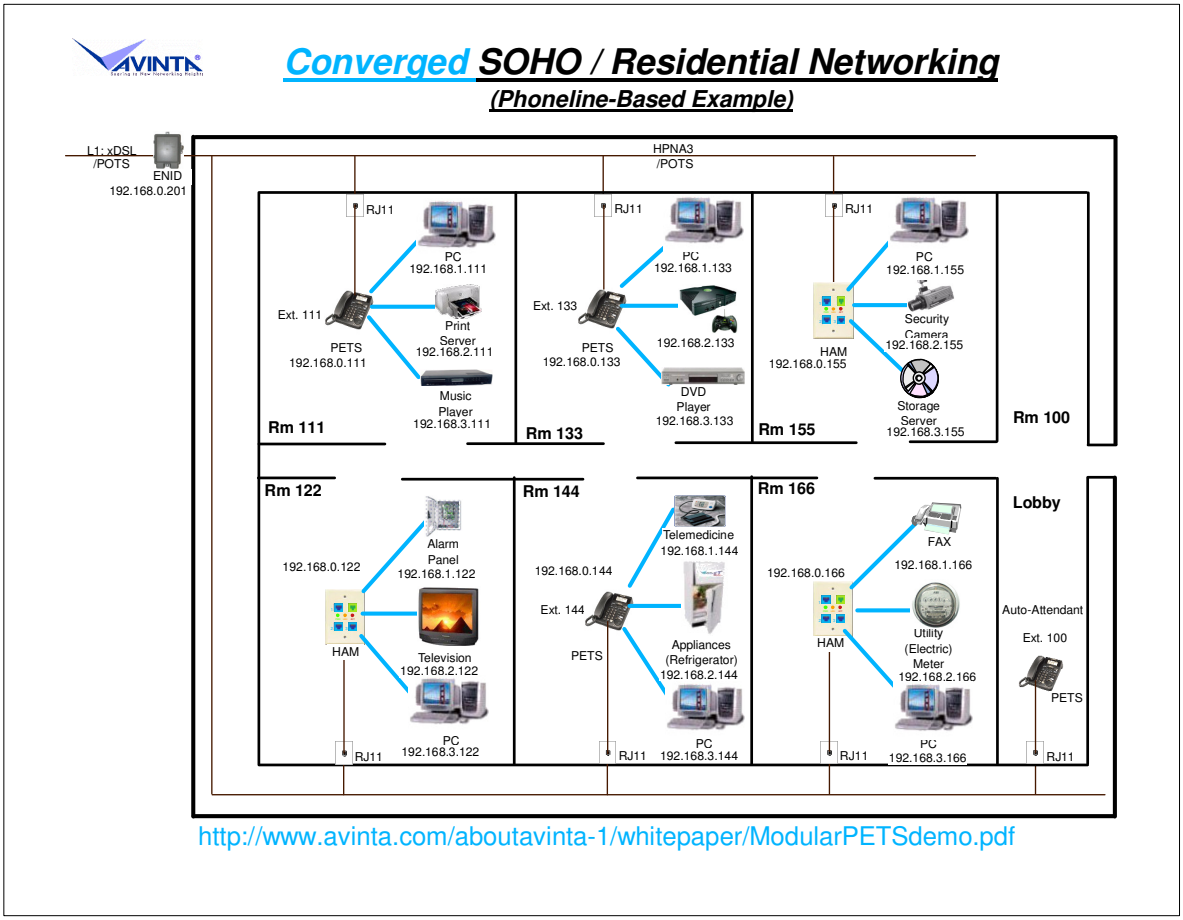
- Once the long range PLC for Internet access capability has achieved the bandwidth required by the premises applications, it may serve as the primary access facility. The other RGs may be configured as backups, or simply unplugged.



http://www.avinta.com/aboutavinta-1/whitepaper/ModularPETSdemo.pdf

- The HAM concept applies equally to phoneline based networking. Replacing HomePlug - Ethernet Adapter with the HPNA (Home Phoneline Network Alliance) counterpart, HAMs are ready to be deployed over phoneline as depicted in the setup in Rooms 122, 155 and 166.
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- Making use of the traditional POTS enclosure (It has been pretty empty since the internal circuitry was miniaturized to ICs a few decades ago.) to house the HAM electronics, the integrated module becomes an all-in-one communications module called, PETS (Plain Enhanced Telephone Set).
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- PETS in Rooms 111, 133 and 144, not only deliver broadband signals and provide network management functions just like in HAM configurations, but also have built-in telephony capability both in traditional analog and VoIP formats. Coupled with Avinta's dPABX technology, this configuration is ideal for communication / networking needs of a wide range of small office environments.
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- PETS configuration will also be applicable to settings such as a department within a business or a branch office of a large corporation, etc.
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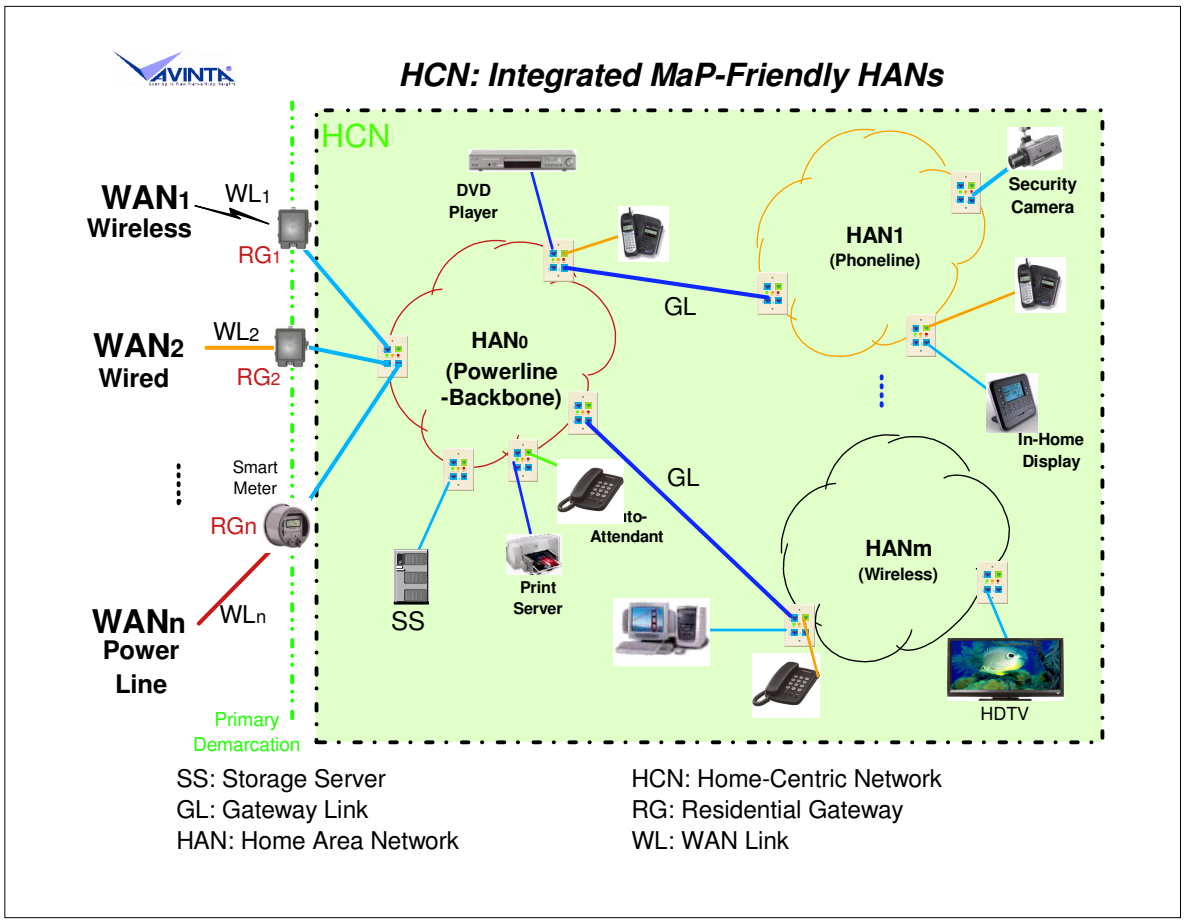
- The hyper-link below the graphics leads to a page of a PETS demo configuration and outline. Another hyper-link there further leads to a video recording of the basic PETS operation.



- Generalizing the HAM concept to other transport technologies, a heterogeneous home network may be deployed with homogeneous appearance to the home owner.
- Home networking backbone may get started from HAN0 with a technology having the widest coverage and most intuitive accessibility, such as PLC (HomePlug).
- Additional network such as HAN1 may be deployed over phoneline (and coax) for better performance.
- More HANs, such as HANm utilizing wireless may be deployed for mobility.
- Any or all of the above may physically cover the entire premises, thus overlapping one another.
- Any pair of these HANs may be cross-linked together by simply using an Ethernet cable (called Gateway Link) to connect RJ45 jacks on two separate HAMs, one on each HAN.
- The resultant HCN will behave as one single HAN. This is the same as interconnecting multi-lane state roadways by interstate highways. So that common vehicles, regardless of type or size, may travel from one point of the country to another without undue restrictions.
- Finally, communication with the outside world may be added as needed. The RGs will only need the broadband modem portion of the current equivalent products. This network establishment sequence which is opposite to contemporary "Internet Driven" philosophy is significant. It prepares a home owner to deal with Internet service issues, by first fully checking out the status of the HCN portion.