

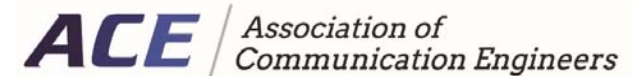


Customer Premise Update

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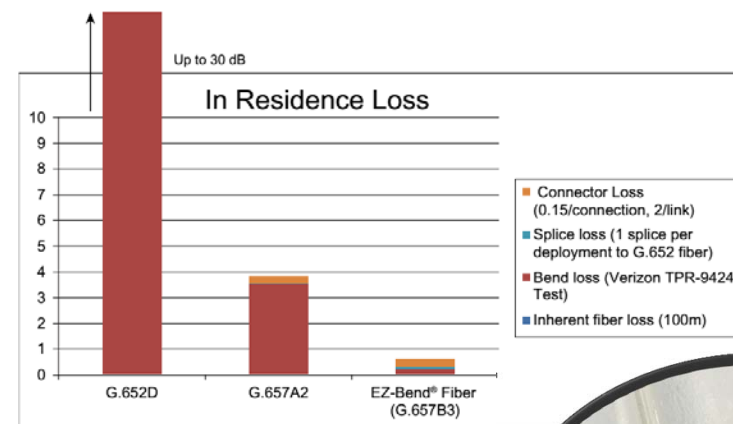


How is the Modern User Impacting Networks

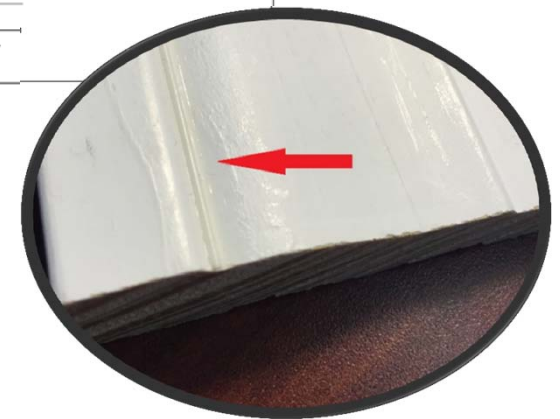
- Consumer Behavior
 - Demand for more bandwidth (UHDTV, Multiscreen experience, BYOD, Cloud Interaction, etc.)
 - Wireless without degradation of quality
 - Convenient and simple access to home devices and Internet services
- Technology Trends
 - Gigabit speeds to and throughout the home
 - Internet of Things – Smart Appliances and Smart Houses
 - Intelligence is pushed into the Cloud
 - Decoupling of hardware and software
- Residential CPE
 - Impact of indoor ONTs on the services within the home
 - New WIFI and Smart Home technologies
- Business CPE
 - Evaluation of business demarcation devices
 - Impact of NFV on the growing business service needs

Bring the ONT Inside, Why Don't You

- No grounding concerns
- More cost effective
- New fiber technology – it's no longer fragile
 - G.657A1 & A2 – bend insensitive (CO use)
 - G.657B2 & B3 (5mm bend radius)
 - Compatible with G.652D SM fiber
- Easier to replace batteries
- That's where other CPE is located



Source: OFS



Philosophy of Indoor ONTs

- Basic functionality ONT
 - Micro ONT, Compact ONT, Media converter
 - Allows for the use of external RG
 - Pros: Cost effective, discrete
 - Cons: Few ports, requires additional networking gear in the house



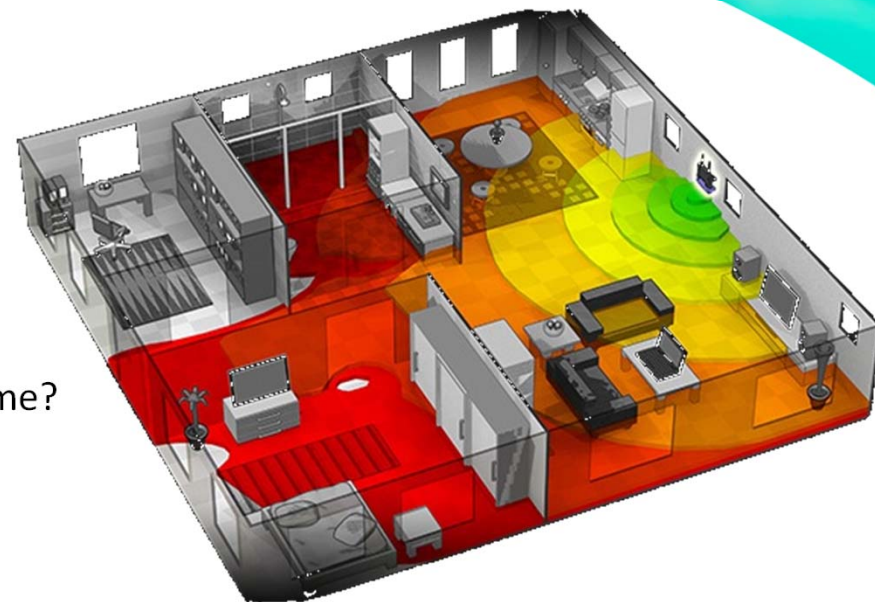
There is always a Hybrid option

- Feature full ONT
 - Residential Gateway - Router/Wireless AP
 - Externally managed via TR-69
 - Soon likely to support Smart Home wireless standards
 - Pros: One device to provide all networking needs, easy to support subscriber network
 - Cons: Larger investment to replace as the technology changes



So Ask Yourself...

- Who are your customers?
 - Expertise and desire to customize
 - Access to commercial networking equipment
 - Are they likely to use IoT solutions
- Do you want to offer home networking assistance?
 - Resources/expertise
 - Can you monetize it?
 - TR-69 solution
 - Home network design service
- Do you want to resell networking equipment?
- What kind of an investment do you want to make in the home?
 - RUS funding implications
- Where should the ONT be placed?
 - Outside fiber demarcation point
 - Central location = longer indoor fiber run
 - New wireless protocols can help

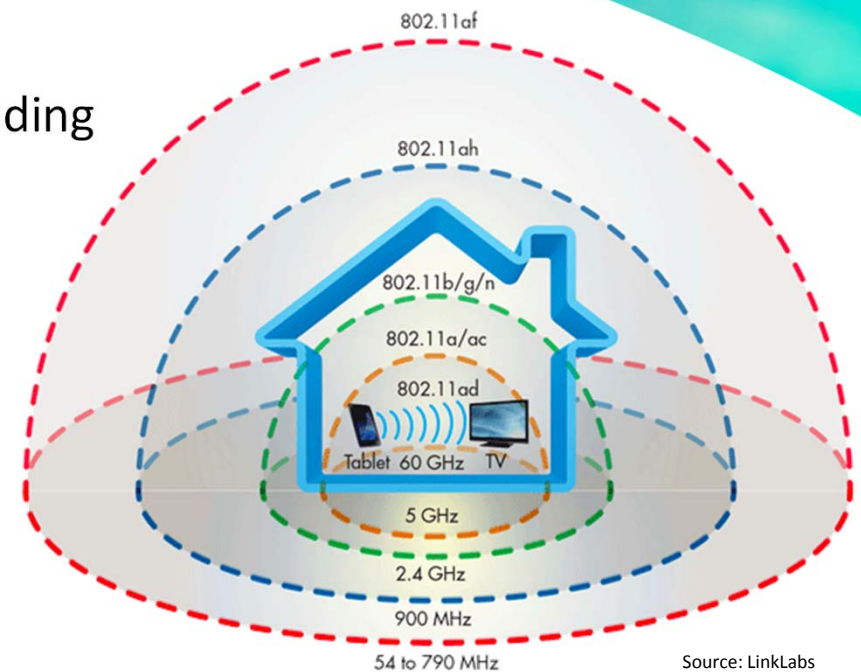


The Case for 802.11ac

- Speeds up to 1.3Gbps
- Operates in 5 GHz spectrum – wider band, less noise
 - Most devices support 2.4GHz for traffic separation and 802.11n compatibility.
- Bonded 80 MHz channels
- Higher modulation – 256 QAM
- MIMO and Beam Forming
- Layer 1 Aggregation: A-MPDU
- Wave 2 Upgrades
 - 3.4 Gbps throughput
 - 160MHz bonded channels
 - 4x4 and 8x8 MIMO
 - MU-MIMO
- Why – Residential Use
 - No need to wire the house
 - Wireless IPTV STBs
 - More flexibility in placing – no longer has to be centrally located
- Why – Business Use
 - Much needed capacity (BYOD)
 - Service separation
 - Media and Data in 5 GHz, voice in 2.4 GHz
 - Security

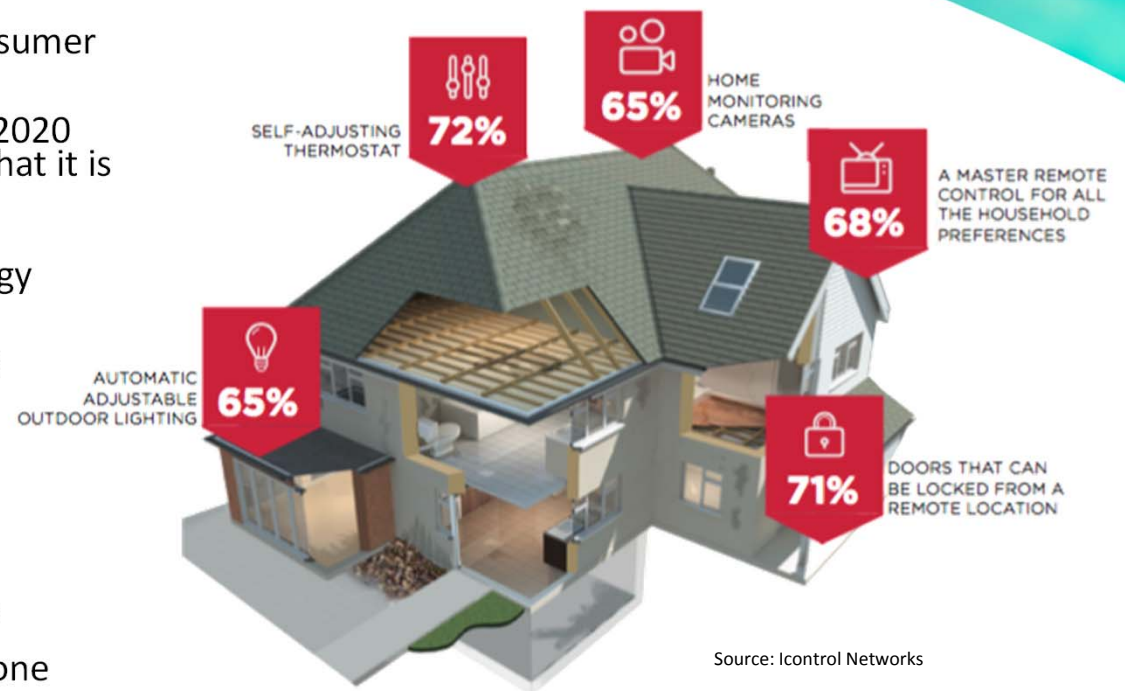
802.11ad is Coming

- Operates in 60 GHz spectrum
- Uses native 60 MHz channels – supports bonding
- Supports 16 to 32 antenna arrays
- Beamforming and MU-MIMO
- Up to 7Gbps speeds!!!!
- Issues:
 - Expensive
 - Small coverage – 60GHz will not go through walls
 - High level of reflection close to the base station
- Ratified in December 2012; chipsets already available



Get Smarter with the Internet of Things

- Gartner - Approximately 4 billion IoT consumer devices in 2016
- Accenture – up to 200 billion devices by 2020 and yet 87% of consumers don't know what it is
- Icontrol Networks – Smart Home Report
- Main reasons: 90% - security; 70% - energy savings
- Consumers are going to buy in next year:
 - Home Camera – 37%
 - Thermostat – 37%
 - Lighting Solutions – 34%
 - Door Locks – 34%
 - Appliance – 25%
- These numbers double in 25-34 category
- Security and data privacy is the number one obstacle



Technology Implication of Smart Homes

- Wireless dominates as technology, but WiFi is not the ideal solution
- Power efficiency, security, interoperability are main drivers
- Willing to give on throughput and range
- Four main competing technologies
- Requires a central Smart Hub to control devices
- Some devices may use WiFi for content delivery in addition to these control protocols
- More and more RGs support one or more of these wireless protocols

	Z-Wave	ZigBee	WeMo	Thread
Operating range	100 feet	35 feet	100 feet	100 feet
Data rate	9.6-100 kbps	40-250 kbps	Router-dependent	250 kbps
Frequency	908/916 MHz (U.S.)	915 MHz/2.4 GHz	2.4 GHz	2.4 GHz
Network type	Mesh	Mesh	Star	Mesh
Standard	Proprietary Standard	802.15.4	802.11 - proprietary	802.15.4
Technology Backers	Honeywell, ADT	GE, Samsung, LG, Logitech	Belkin	Google, Samsung, ARM

Food for Thought: Residential CPE

- 802.11ac allows more cost-effective placement of the ONT
 - AP may use newest technology, but the receiver may not
- If IPTV provider – place STB in separate spectrum and hide the SSID
- Pick your RGs carefully – Wireless and Smart Home technologies change quickly
- if RG==True : TR-069='Yes'
else: MicroONT
- HD Cloud-cameras are most popular devices – need that upstream
- Smart Home opportunities
 - Design and package
 - Security

Business Needs are Quite Different

- Smaller but more utilized data services
- T1s are giving way to Ethernet circuits
- Service assurance is becoming expected
- Heavily utilized, multi-AP WiFi systems
- Security is the number one concern
- Traditional ONTs are no longer enough
- More equipment needs to be located at the premise to address growing network functions

ONTs are Giving Way to Demarcation NIDs

- Generally available from myriad of vendors
- Traffic shaping and VLAN manipulations with traffic matching
- Turn-up testing (birth certificate) functionality
 - RFC 2544, Y.1564, RFC 6349
 - Test initiation vs. Loopback capabilities
- Performance monitoring
 - Y.1731 vs. proprietary protocols
 - SLA Portals
- Some do support T1s
- UNI ports and Micro NIDs
- Commoditized equipment

NFV Influence

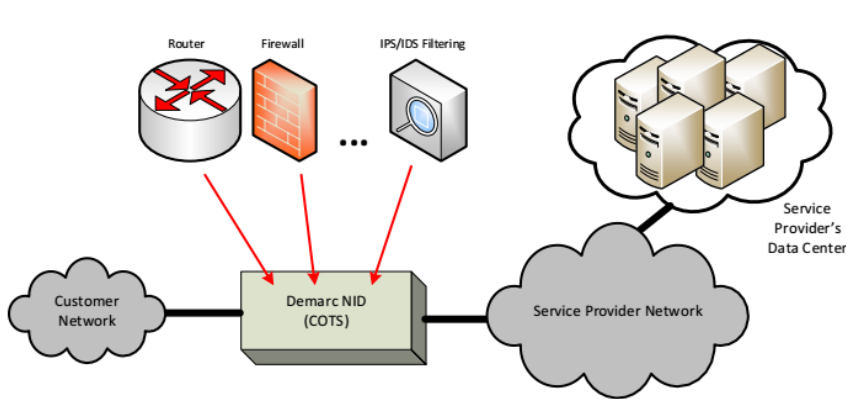
- NIDs solve connectivity and service assurance problems
- But what about other business service needs
 - Router
 - Firewall
 - IDS/IPS and filtering
 - Load Balancers
 - eSBC
- Service and equipment chaining
- If the NID is commoditized, why not commoditize network functionalities
- Virtualizing AP controllers
 - Access Point Controller in the Cloud

NFV

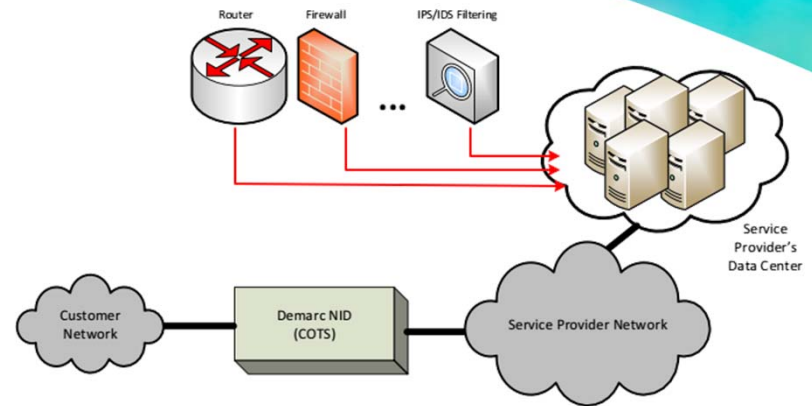
Virtual CPE

- Business vCPE is most common use case for NFV
 - NFV scales well for throughput and services needed in small and medium size enterprises
- Use Commercial Off The Shelf (COTS) devices for multiple network functions based on the software applications placed on them
- Three basic ways to deploy it:
 - Distributed/On-Premise Model – Software resides on the COTS device
 - Centralized/Hosted Model – Software resides in the data center with the network access to vCPE
 - Hybrid/Mixed Model – Software resides both on the COTS device and in the Cloud based on the specific need of the application
- Service chaining – single unit performing several VNFs

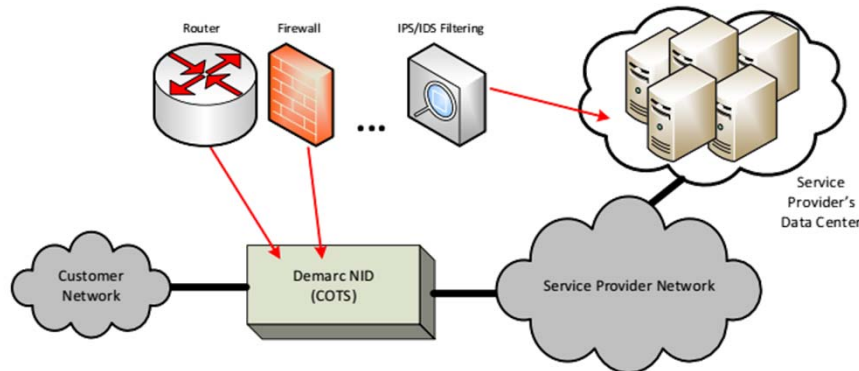
vCPE Deployment Models



Distributed/On-Premise Model



Centralized/Hosted Model



Hybrid Model

The Case for vCPE

- Pros:
 - Fewer networking elements to purchase and maintain
 - Decreased cost of networking device by economies of scale
 - Time to Market – network functions apps can be downloaded on demand by the customer in matter of minutes
 - Best of breed deployment – software functions from multiple vendors on the same box
- Cons:
 - Requires some level of virtualized environments
 - Finding the right mix of hardware platforms, hypervisors, orchestrators and network function apps
 - Software is still not “carrier grade”
 - Software licensing
 - Latency

Food for Thought: Business CPE

- Demarc NID is worth the money
- Certify your circuits but know what you are certifying
- Don't shy away from getting into the customer network
- Start building virtualized environment/Micro Data Center
- New network technologies may be scary, but they are powerful – embrace the change
- vResidential CPE – leverage the same infrastructure
- Security is a number one concern for all businesses

Questions?

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