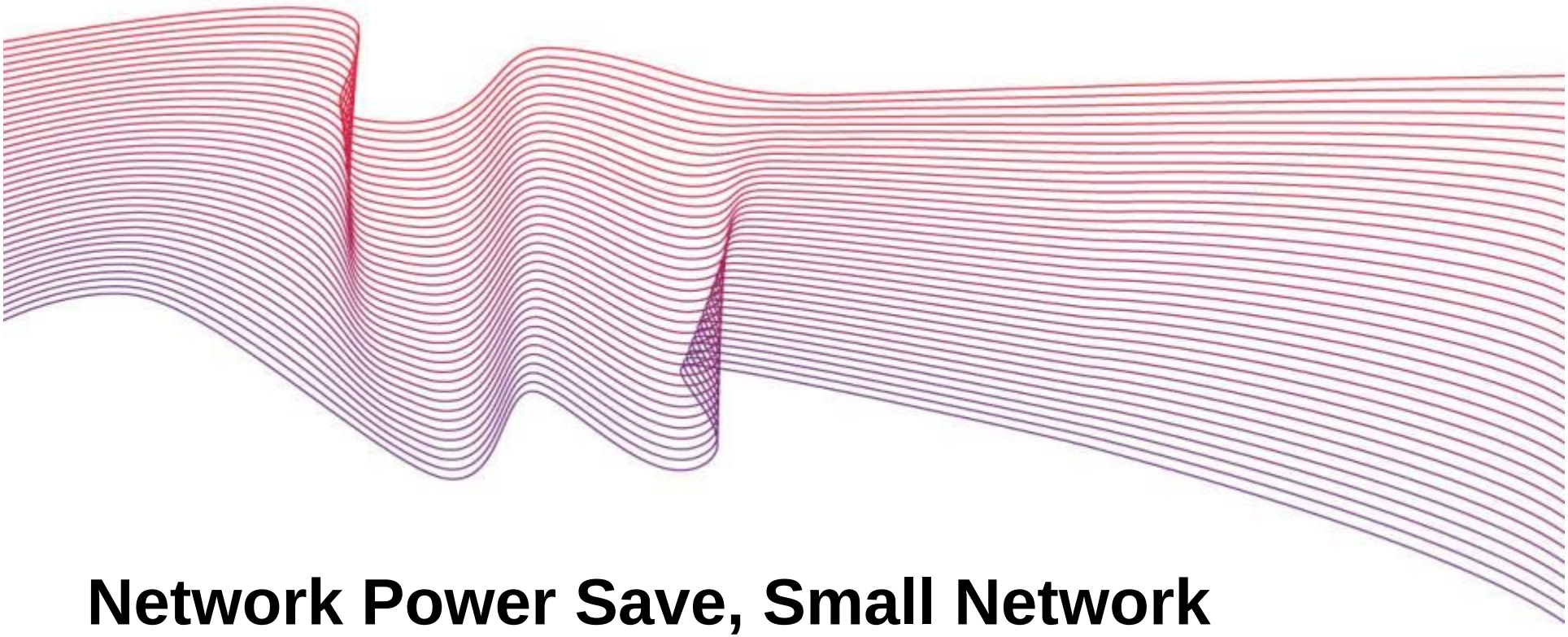


Network Power Save, Small Network Equipment, Network Extenders

Stephen Palm, Ph.D.

Senior Technical Director

Broadcom Corporation

CAUTIONARY STATEMENT

This presentation may contain forward-looking statements within the meaning of the federal securities laws, including the Private Securities Litigation Reform Act of 1995. These forward-looking statements may include the potential growth of the markets in which we compete and the development status and planned availability of new products. In fact, all statements that we make or incorporate by reference in the presentation, other than statements or characterizations of historical fact, are forward-looking statements. It should be clearly understood that these forward-looking statements, and our assumptions about the factors that influence them, are based on the limited information available to us at this date. Such information is subject to change, and we may not inform you when changes occur. We undertake no obligation to revise or update publicly any forward-looking statement to reflect future events or circumstances.

Forward-looking statements are not guarantees of future results and are subject to risks, uncertainties and assumptions that are difficult to predict. Therefore, our actual results could differ materially and adversely from those described in the statements you hear today as a result of various factors. We refer you to our 10-Qs and other filings with the SEC, including our 10-K ,which discuss some of the important risk factors that could contribute to such differences or otherwise affect our business, results of operations and financial condition.

For additional financial and statistical information, including the information disclosed in accordance with SEC Regulation G, please see the Investors section of our website.

About Broadcom

A **Global Leader** in Semiconductors for Wired and Wireless Communications

One of the **Largest Volume** Fabless Semiconductor Suppliers

2014 Net Revenue of **$8.43 Billion**

Broad IP Portfolio with More than **18,600** U.S. and Foreign Patents and Applications

Founded in **1991**

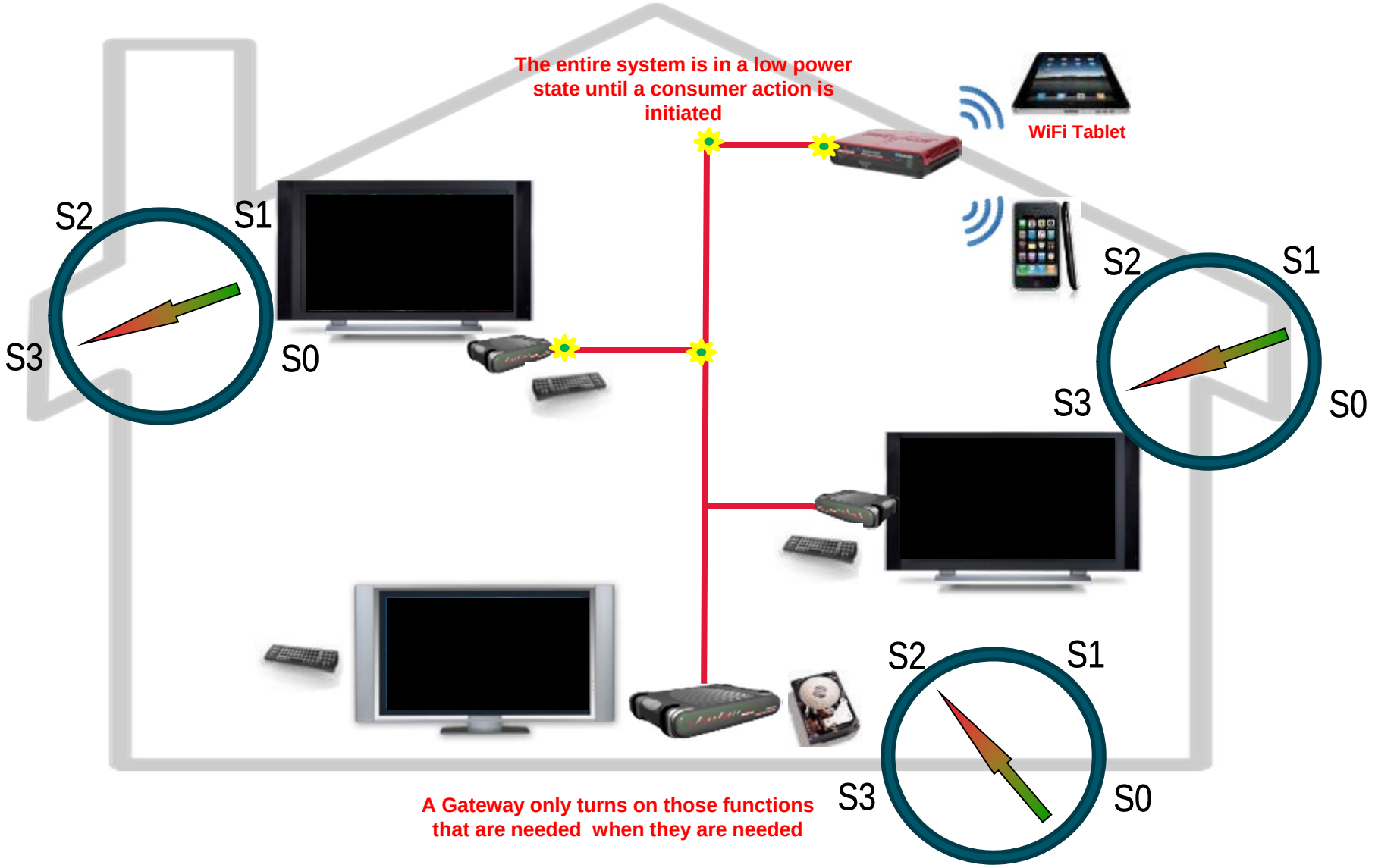
Initial Public Offering in **April 1998** (NASDAQ-BRCM)

~10,000 Employees Worldwide

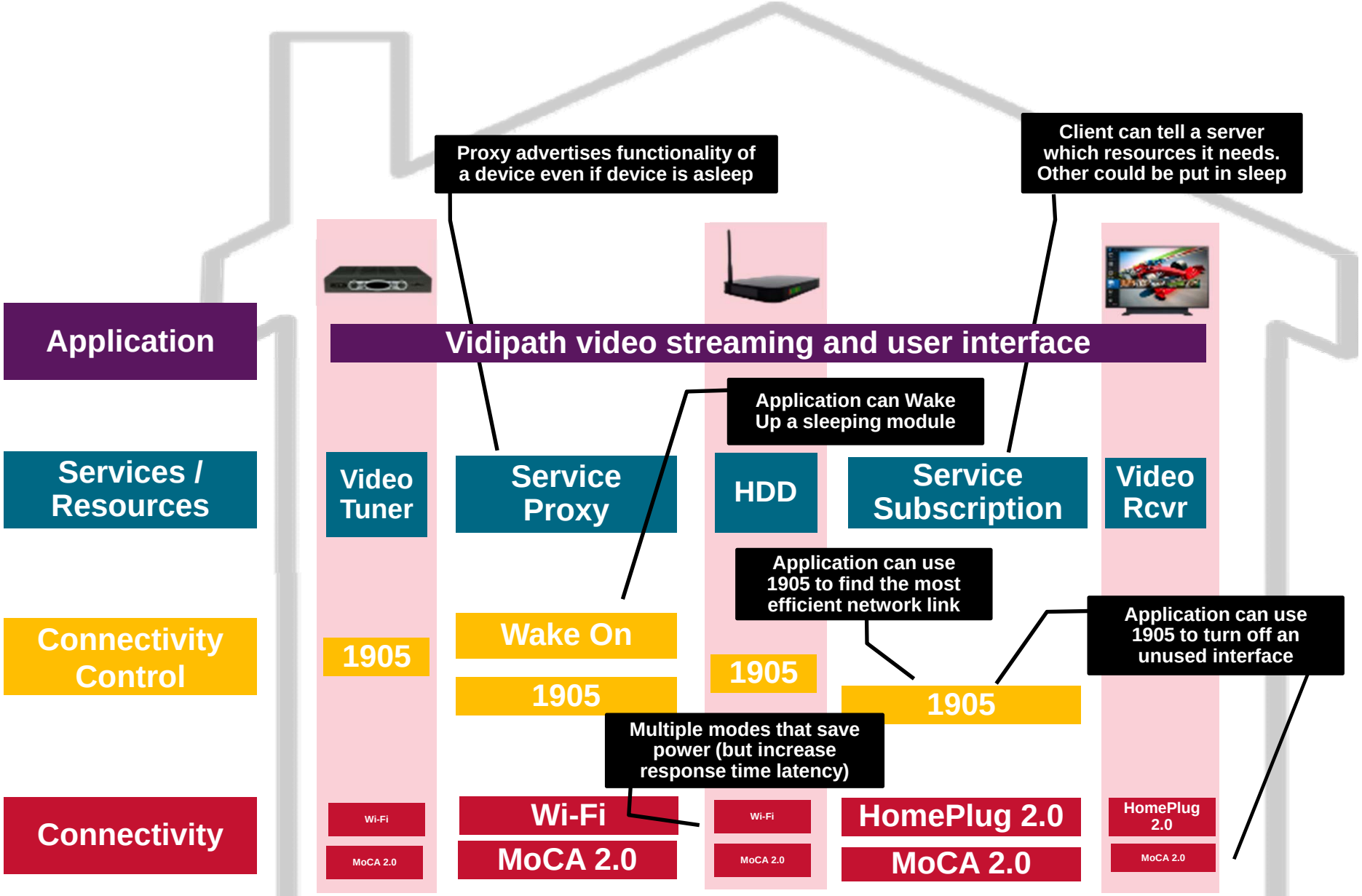
99.98% of the world's data traffic passes through at least one Broadcom chip

In-Home Video Streaming Background & Context

Whole Home Power Management



Network Power Saving Layers



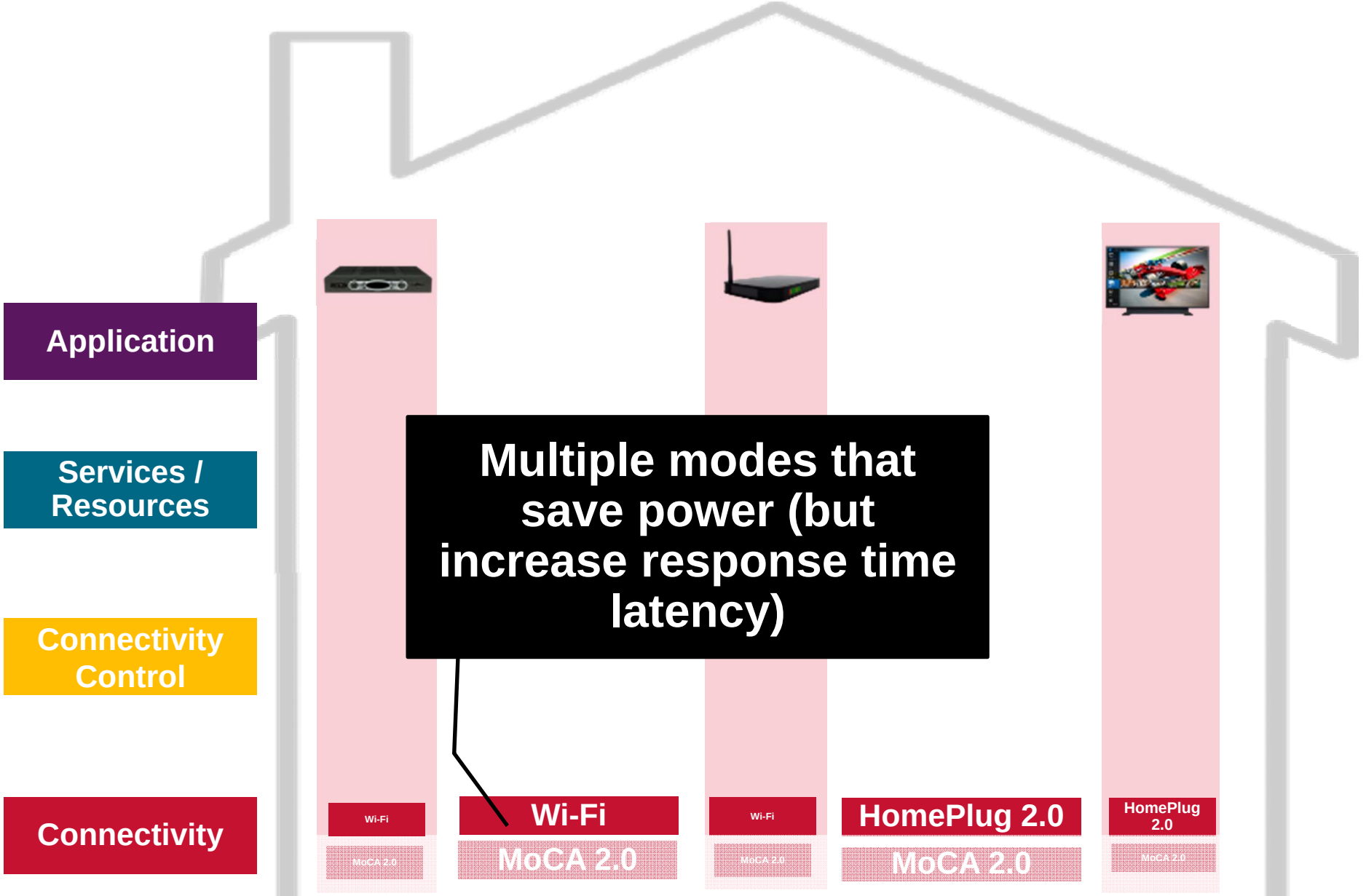
Link Connectivity 2.0 Power States

Deployed Home Connectivity Technologies

- **Energy Efficient Ethernet (EEE) is a part of the whole Home Networking solution**
  - Most homes do not have Ethernet (CAT-5/6) **between** rooms
  - Even if present, is not always in convenient location

- **So most service providers deploy "No New Wires" connectiviy technologies:**
- **Wi-Fi – no wires**
- **HomePlugAV 2.0 / Green PHY over electrical mains**
- **MoCA 2.0 over TV/Cable/Satellite coaxial cabling**

Connectivity Modes

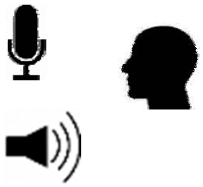


MoCA 2.0 Power States

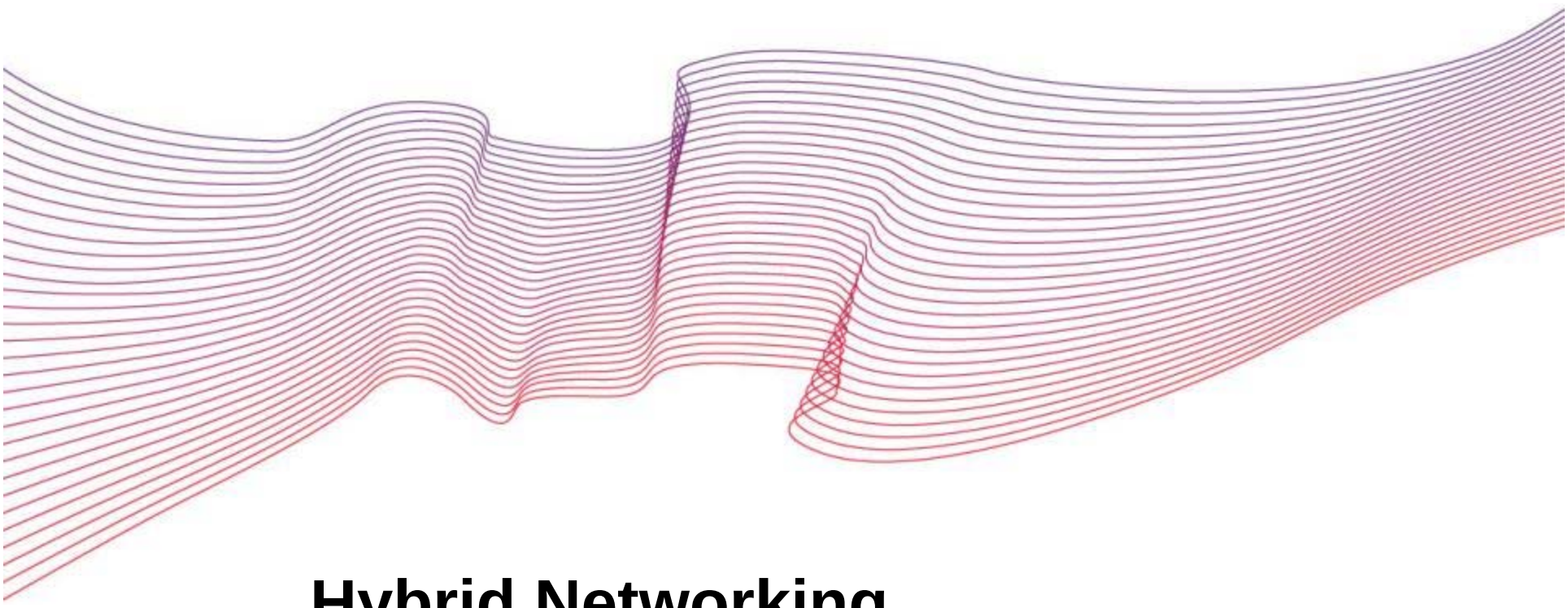
- **M0 (Active):**
  - **Normal Operating Mode**
  - **Full Functionality**

- **M1 (Low Power Idle):**
  - **Receive Only Mode**
  - **Node stays “ranged” on the network, but does not transmit data packets**

- **M2 (Standby):**
  - **Monitors Beacons every 10ms – 100ms**
  - **Minimal active state, but has a relatively fast path for readmission**



- **M3 (Sleep):**
  - **Issues Heartbeat every 1 – 255 seconds**
  - **Inactive state, but Network Controller reserves the Sleeping Node’s place on the network**

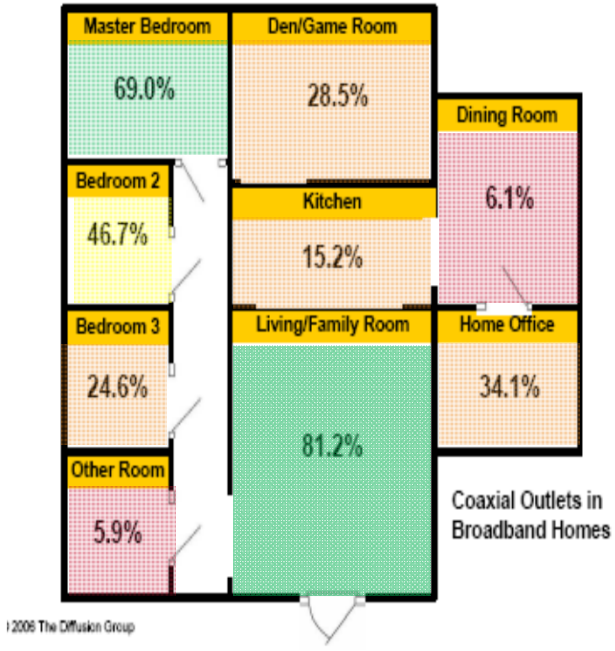


Hybrid Networking
IEEE 1905 nVoy

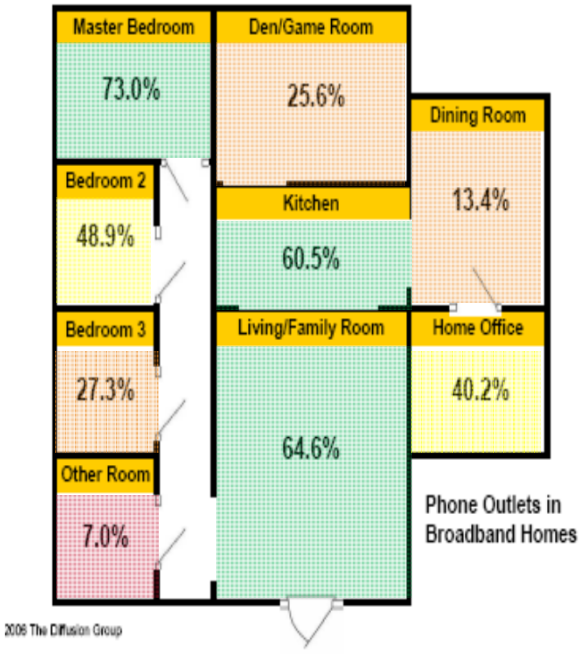
No Single Connectivity Technology Has 100% Coverage in Every Region in Every Home

- **Only 11% of homes have CAT5**
- **Part of a home may be on the other PLC phase reducing performance**
- **Wi-Fi coverage is dependent on construction and density**
- **Coax not in every room**

Coax Outlets



Phone Outlets

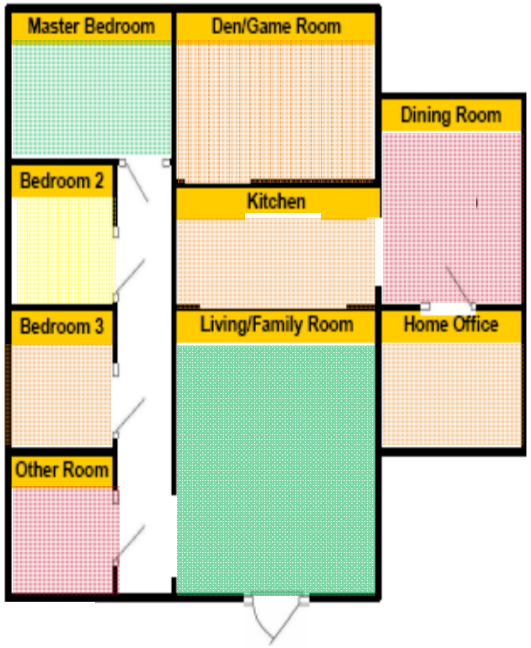


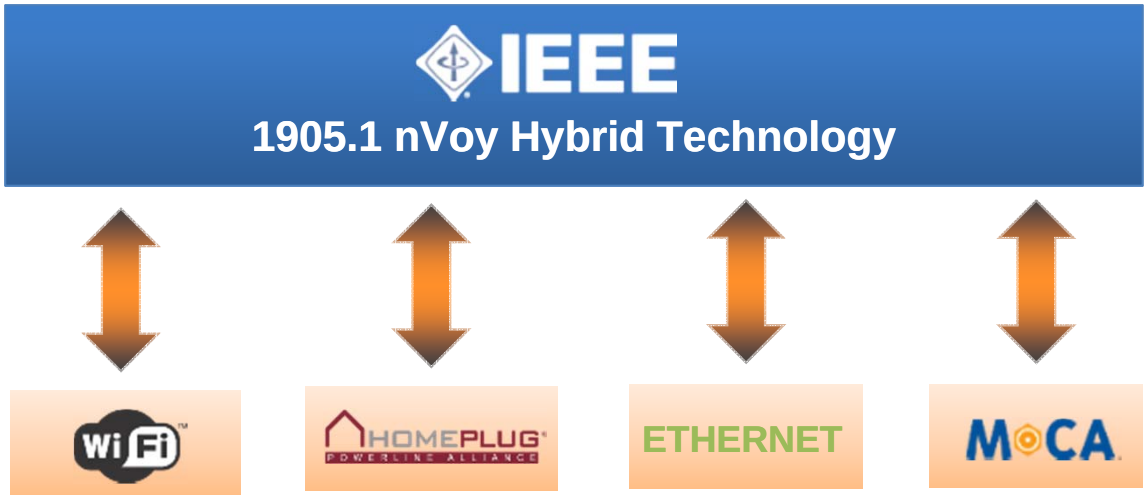
Single Wi-Fi Coverage

Combine the best

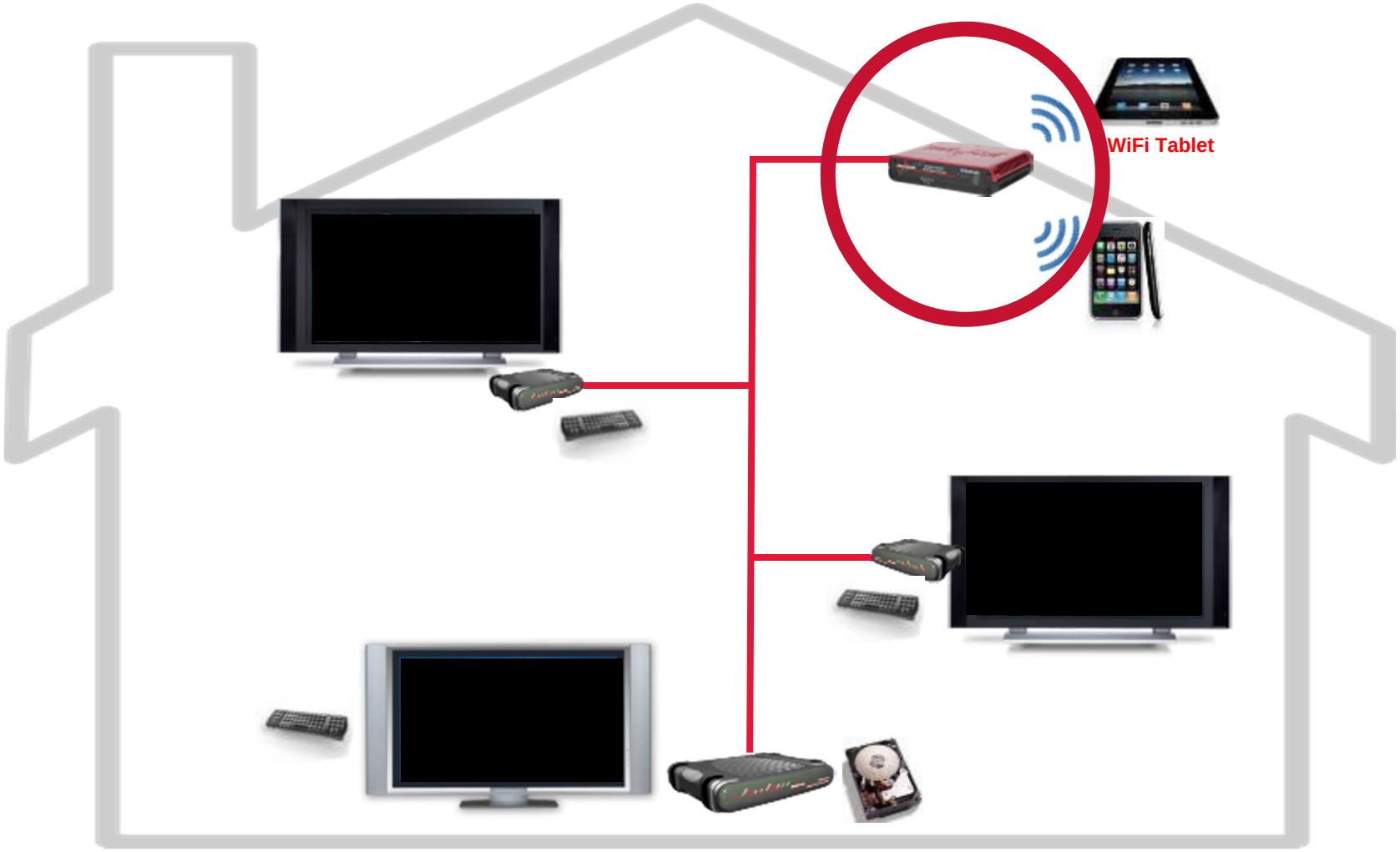
- **Combine the best coverage of each technology**
- **Add robustness and fallback**
- **Increase coverage**

Total Coverage

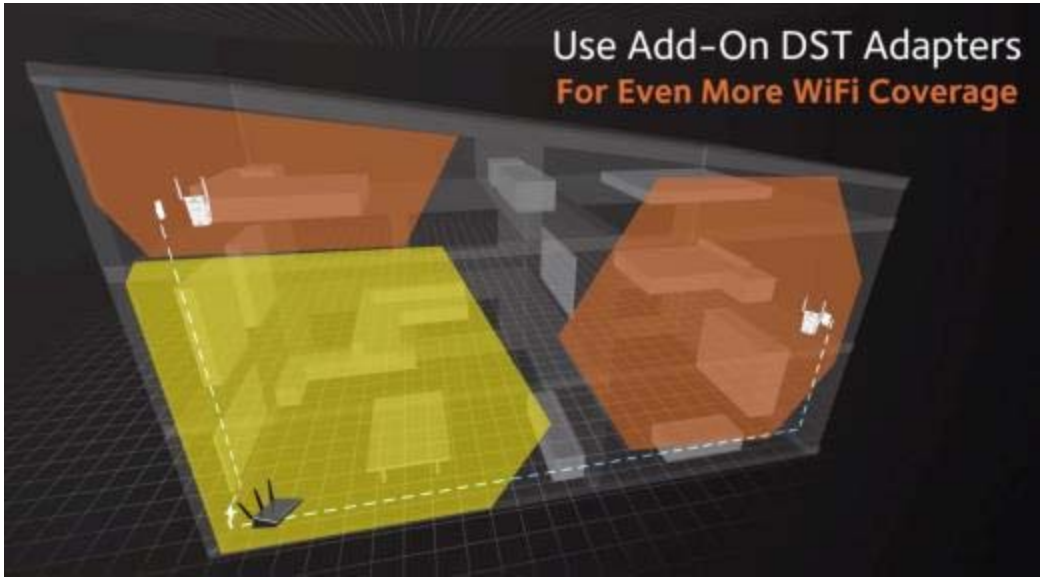




Network Extenders

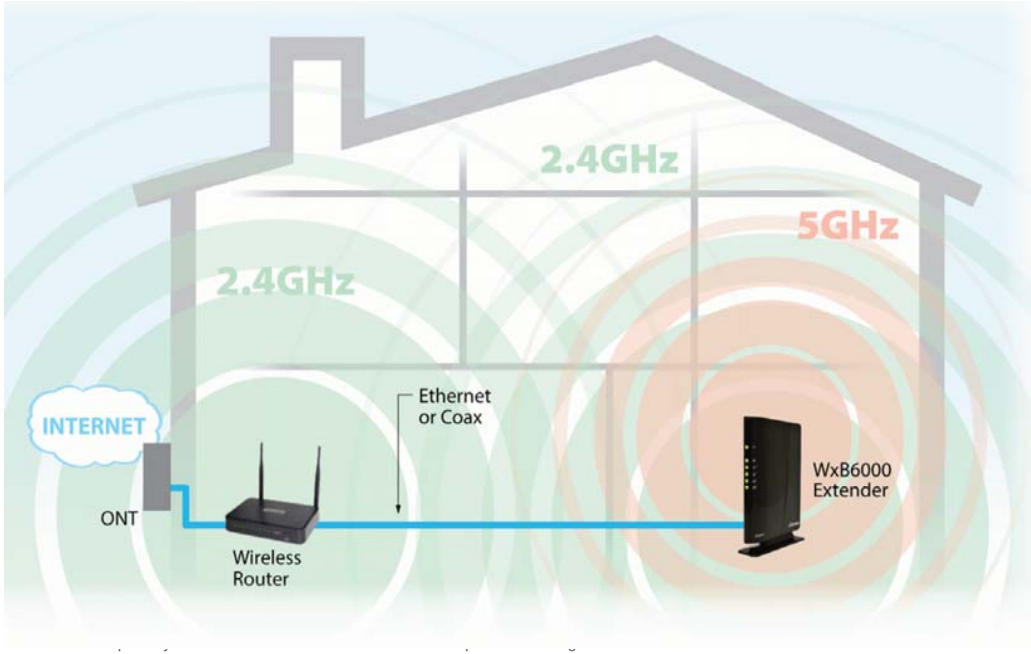


Extenders to Reduce Dead Areas



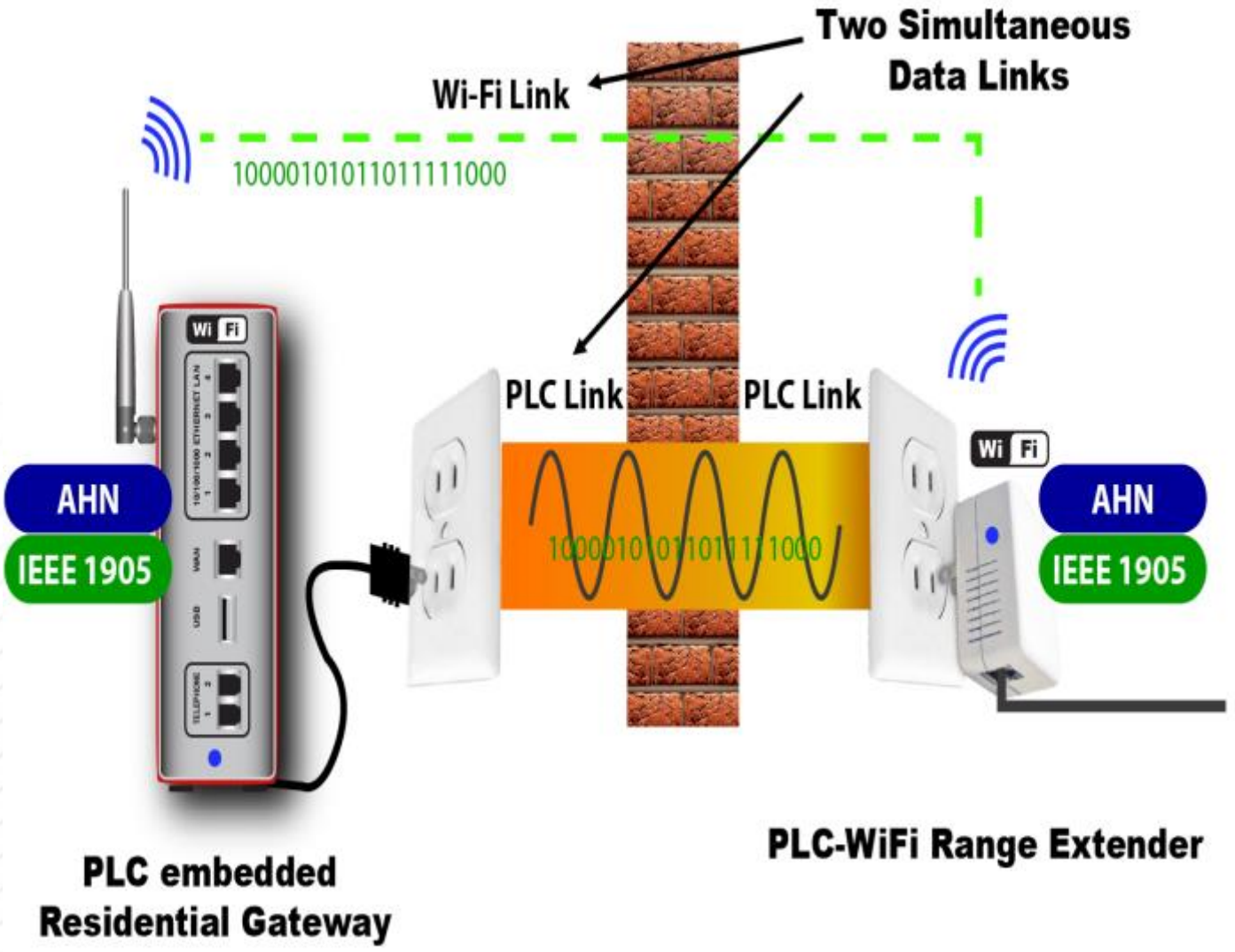
HOMEPLUG POWERLINE ALLIANCE

MoCA Multimedia over Coax Alliance



Hybrid Networking Features

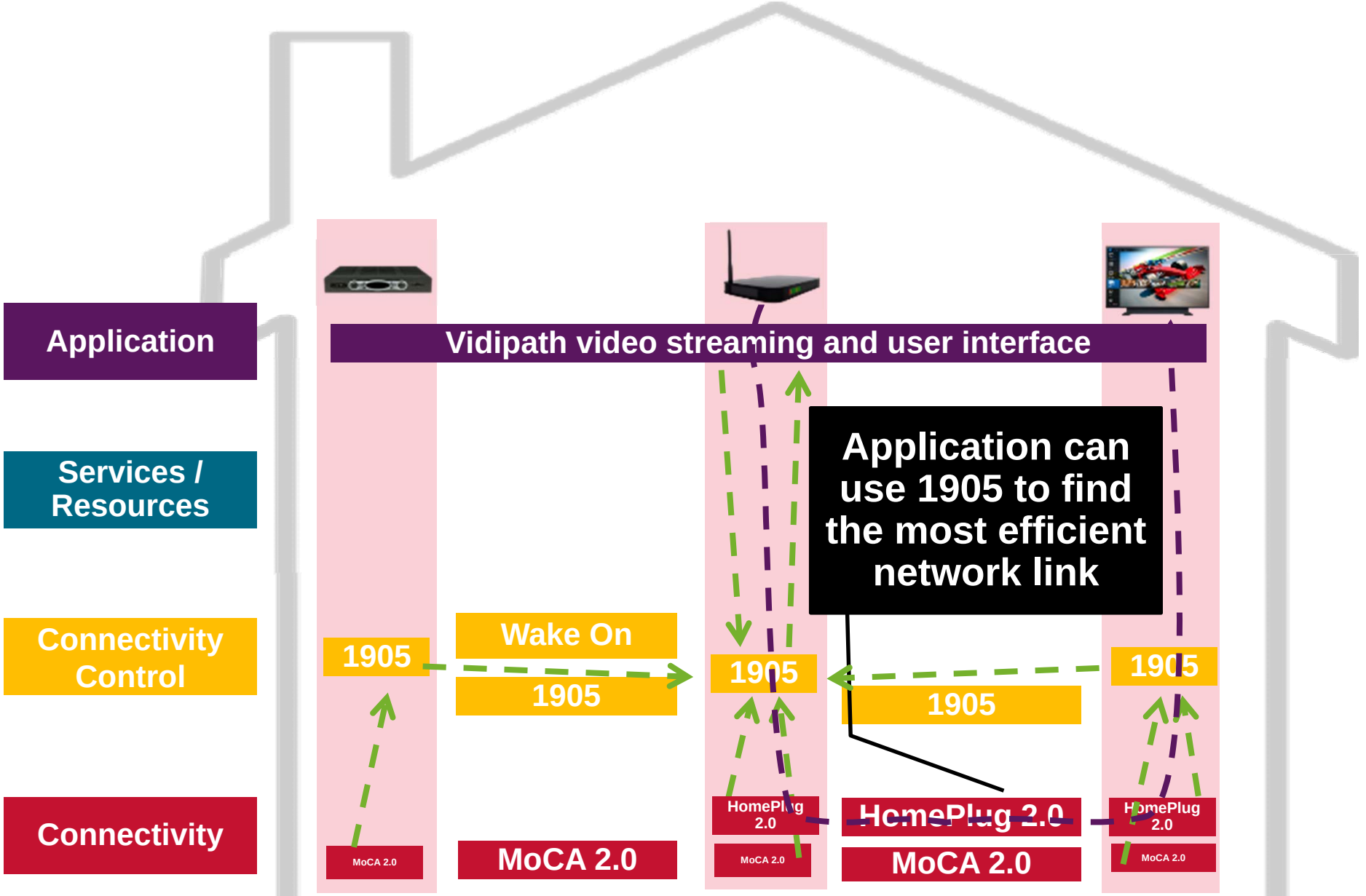
Best Path Selection, Link Aggregation, and Failover



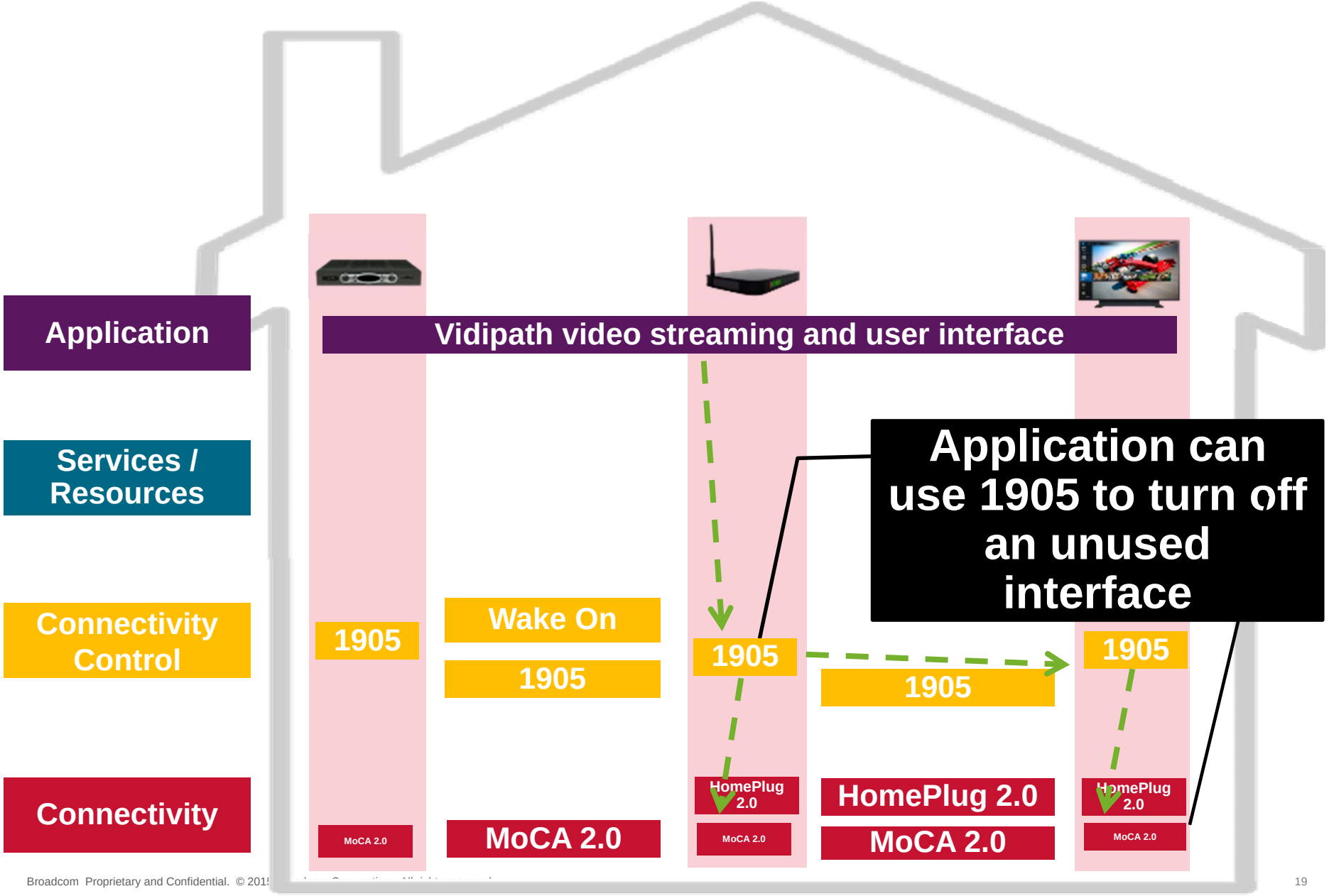
IEEE 1905 Key Features

- Topology Discovery
- Diagnostics via TR-69/TR-181
- Enabler for enhanced path selection
- **Enabler for enhanced power management (by optimizing network power usage across different technologies)**
  - Use the most efficient interface
  - Allows changing the state of one interface through another interface
  - Power state change - Turn off unnecessary interfaces
  - Turn on interfaces when needed
  - Report an interface in Toplogy even if off/saving power
- **Extensibility: Other network technologies are supported by an extensible mechanism using an IEEE OUI and XML formatted document.**
  - ZigBee, Bluetooth, etc can now be discovered in IEEE 1905
- **Higher Layer Reporting**
  - IPv4/IPv6 address(es) and server
  - Friendly Name

IEEE 1905 nVoy Connectivity Control



IEEE 1905 nVoy Connectivity Control



Future: The IoT Effect

- **IoT-enabled devices sense, monitor or control devices using a network connection.**
- **IoT devices add sensing and Ambient Intelligence to the power saving network.**
- **Being battery powered compels devices to keep the power consumption as low as possible.**
  - Sleep modes
  - Smart use of transmit/receive radio up time.
- **Examples**
  - Connected sensors can now tell when a user leaves a space while watching a show and can migrate that show to a nearby device, while putting the first device in a power save mode.
  - Hot water for a shower or coffee can be heated just as the user stirs from sleep, instead of keep the water hot at all times.
- **IoT standards will be the first to benefit from network power save from the beginning.**

Connect and Manage IoT Devices from Gateway

Home Security, Health, Automation Devices Integrated into Gateways and STBs

- Connect Wi-Fi, Bluetooth and ZigBee devices directly to local STB to save power and increase coverage
- Reuse existing Gateway and STB hardware to deliver additional services
- Control devices locally for low latency
- Aggregate data into the cloud
- IEEE 1905 nVoy discovers all devices on home network

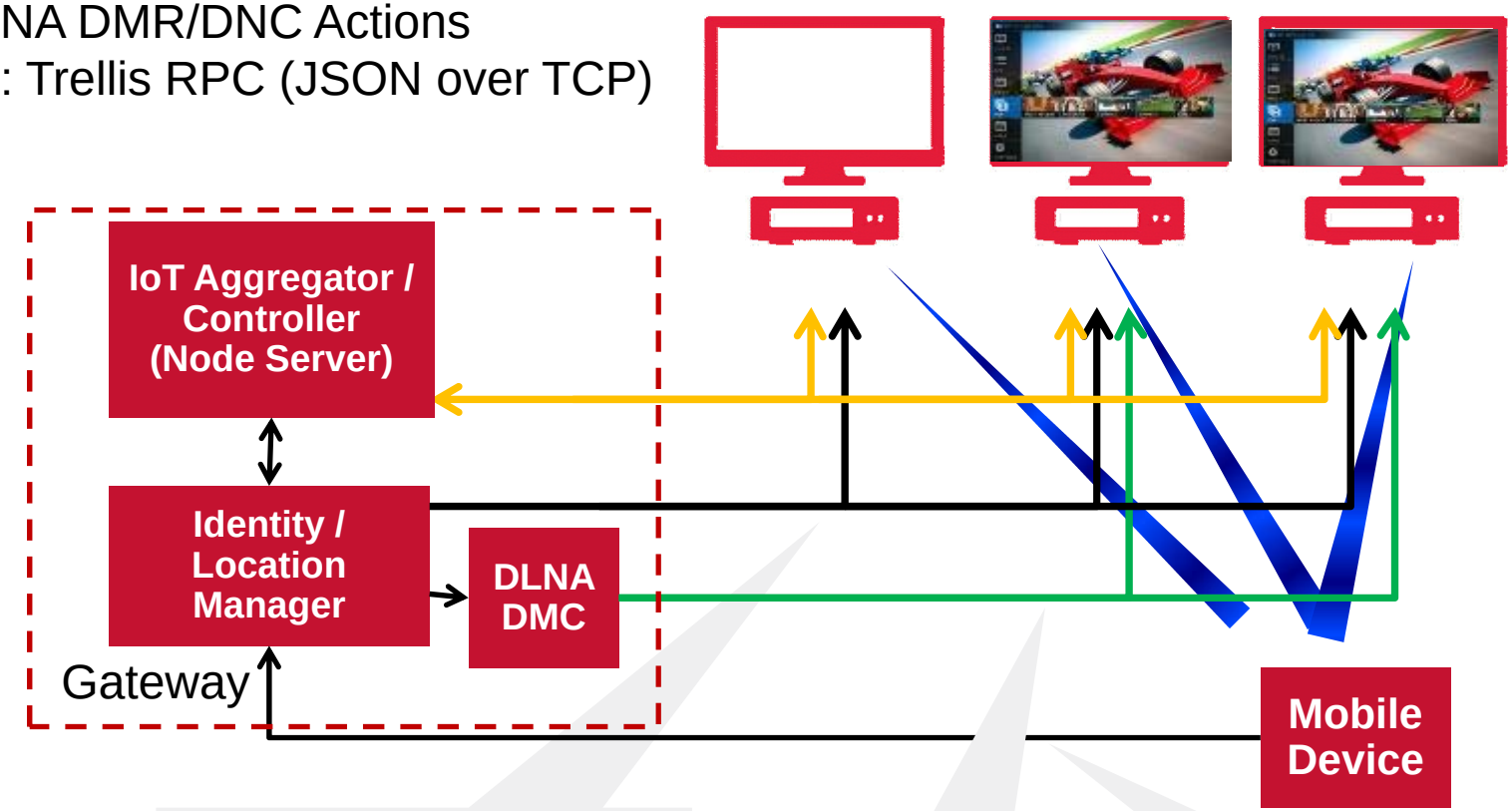
Use Presence to Personalize

Detect Individuals to Provide Personalized Content Choices and Preferences

- BLE Beaconing to smartphones determines content choices, user interface and customization
- Phones and wearables indicate user presence to STBs
- Discover and track location of all devices beaconing in the home
- Personalize content choices and preferences
- Connect primary and secondary screens

Ambient Intelligence

Orange: REST Commands
Blue: Bluetooth Beacons
Green: DLNA DMR/DNC Actions
Black Line: Trellis RPC (JSON over TCP)



Trellis RPC call instruction to display notification and stream security camera

DLNA Action to stream movie

Bluetooth Beacon information and NFC tag verb sent over Wi-Fi

Open Standards for AV Network Power Saving

- **MoCA 2.0, HomePlug AV2, Wi-Fi**
- **DLNA Low Power / UPnP EnergyManagment Service**
  - http://upnp.org/specs/lp/energymanagement1/
- **IEEE 1905.1 nVoy**
  - http://grouper.ieee.org/groups/1905/1/
  - http://nVoy.org

Thank You