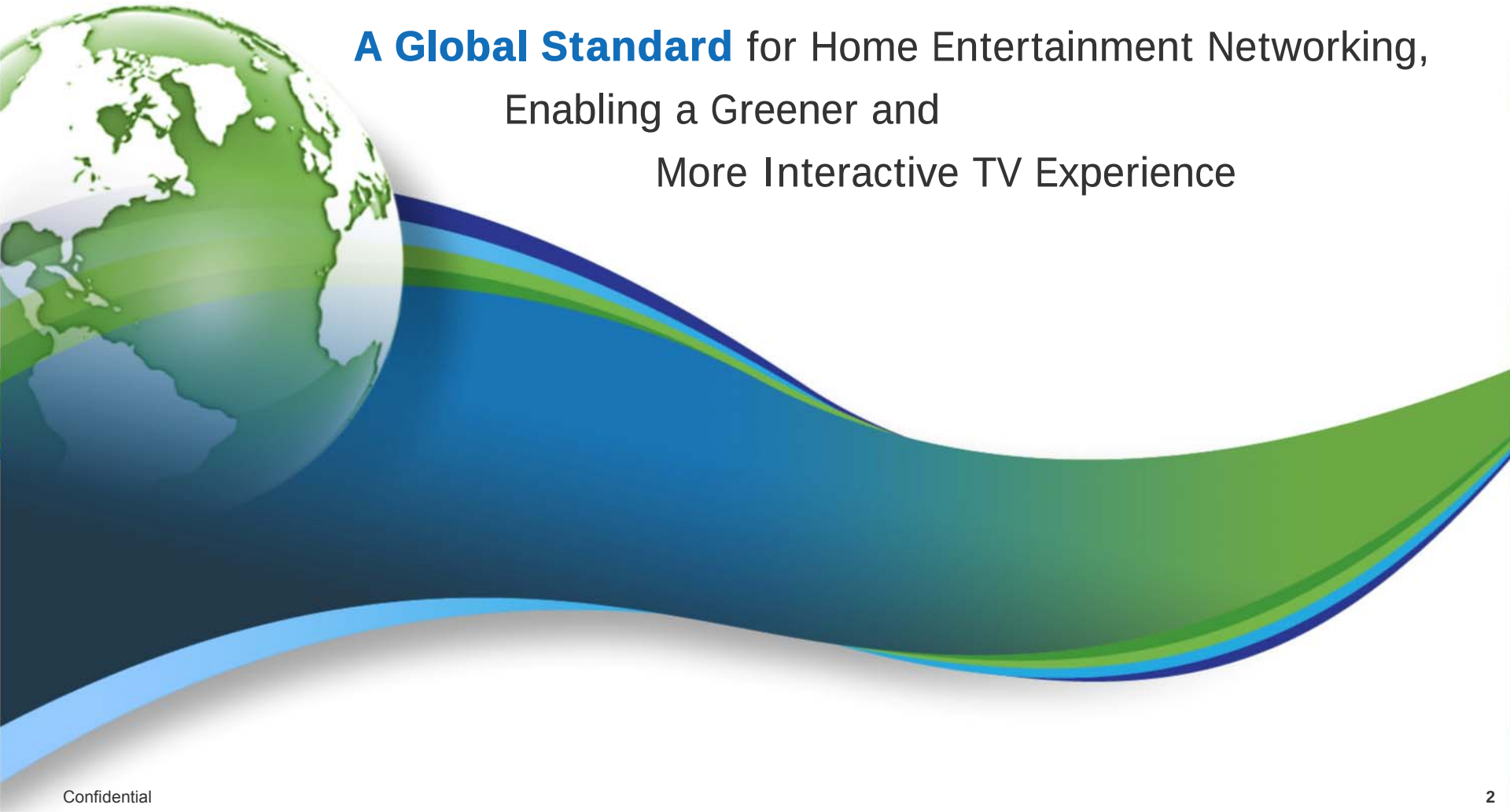
The Home Entertainment Networking Standard

Enabling Consumers to Experience Interactive HD Everywhere

December 2009

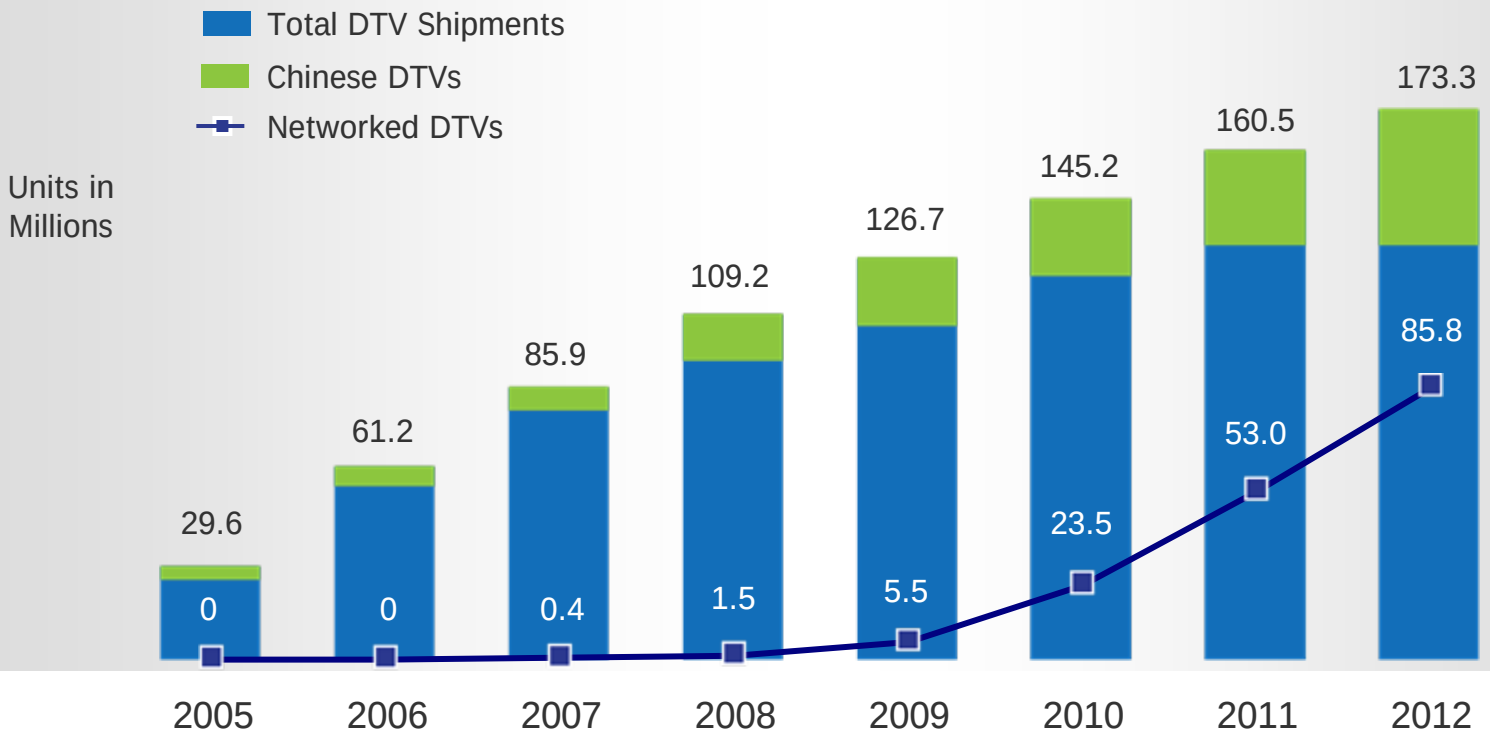


A Global Standard for Home Entertainment Networking,
Enabling a Greener and
More Interactive TV Experience

DiiVA Momentum – Promoters and Contributors

Accelerating Demand for China & Networked DTVs

Worldwide DTV Shipments



Source: HP, DisplaySearch, Synerchip Internal Forecast

DiiVA Delivers Interactive Content and Conserves Energy

Interactive and Easy to Use

- Routable USB, Routable Uncompressed AV and Gb Ethernet in a Single CAT6 Cable
- Easy to Set Up and Use Networked CE Devices

Open Platform Architecture

- Promotes Innovative Consumer-Friendly Applications
- New Business Models for CE Manufacturers and Content Owners

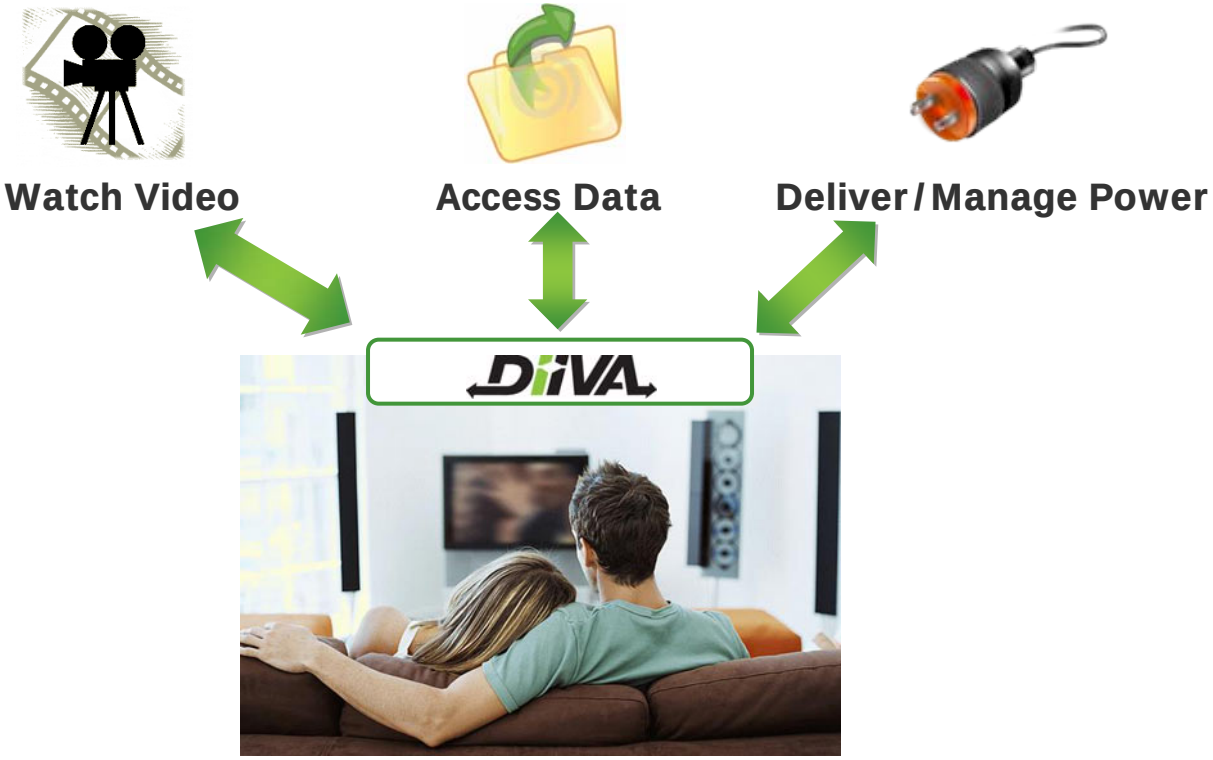
Green Technology for Home Entertainment Network

- Devices Share Resources Efficiently to Conserve Energy
- Devices Adjust Energy Consumption Based on Content

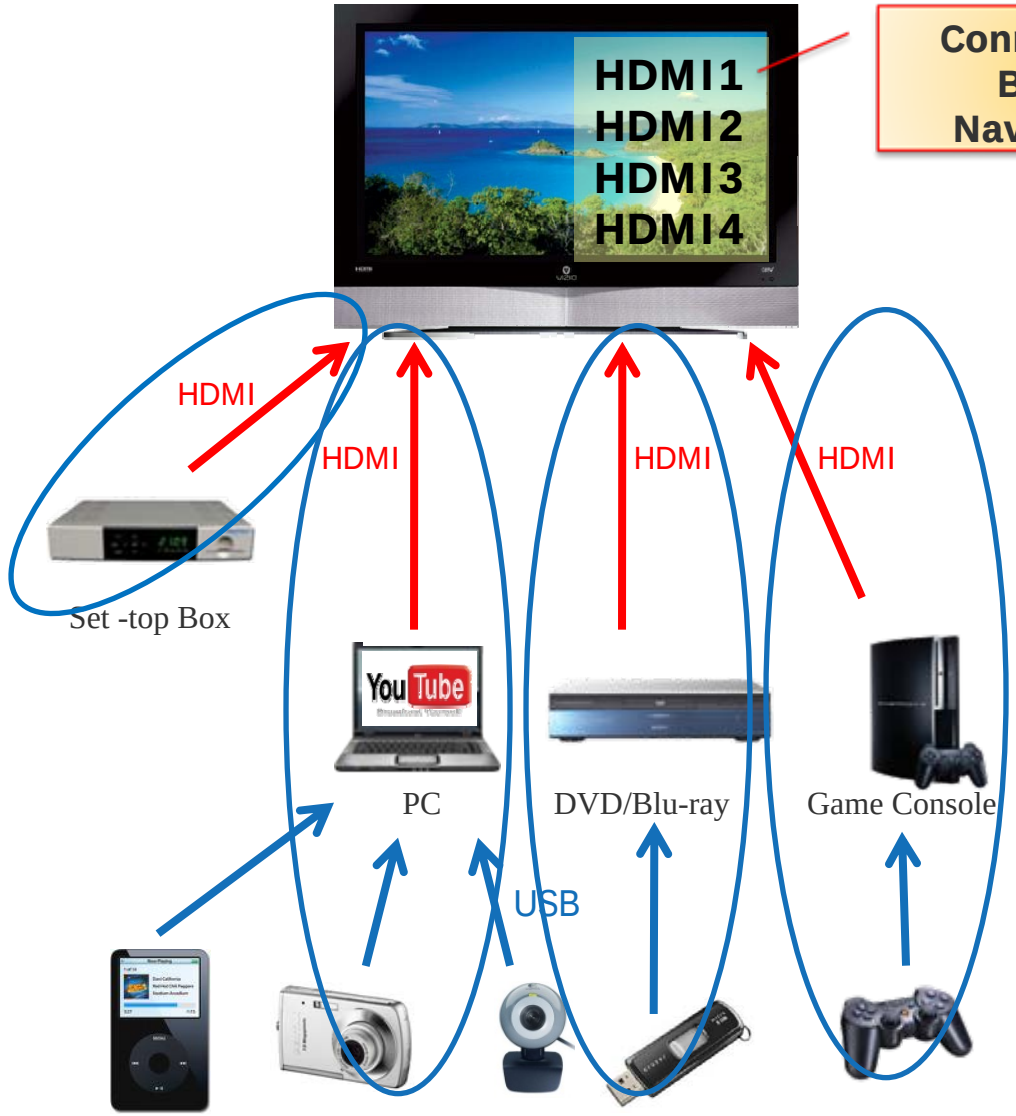
DiiVA for Home Entertainment Networking

DiiVA: Unification of 3 Packet Types

	Video	Data	Power
Packet Type	Uncompressed Video & Audio	Virtual Data Packet Switch & Routing	Power Delivery & Management
Topology	Point-to-Point	Any-to-Any (Ethernet) Point-to-Point (USB)	Point-to-Point
Interface	HDMI	Ethernet, USB	USB



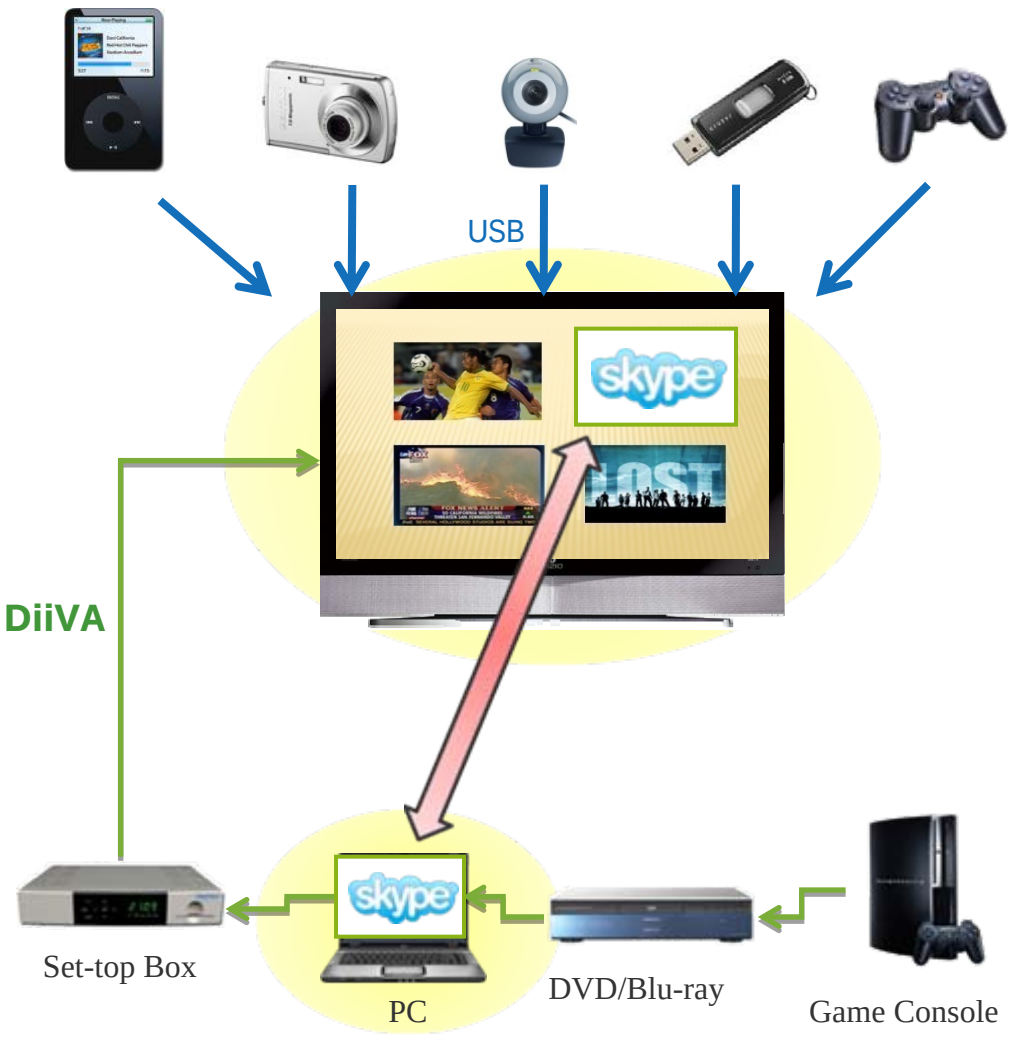
Challenges with Point-to-Point Interfaces

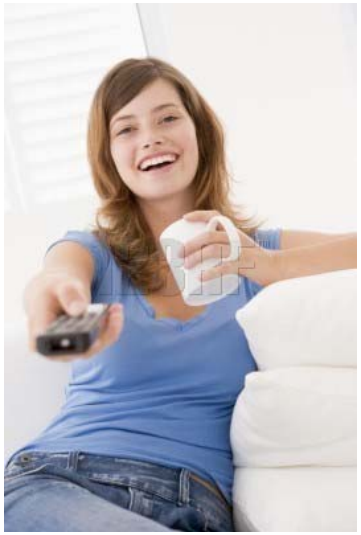


End-User Confusion

- **Devices are Islands**
  - Devices are unaware of each other
  - User must interact with each device separately
  - Each device can only rely on its own compute resources
- **Difficult to Navigate**
- **Limited Topology**

DiiVA Solution:
Networking Designed for Consumer Electronics



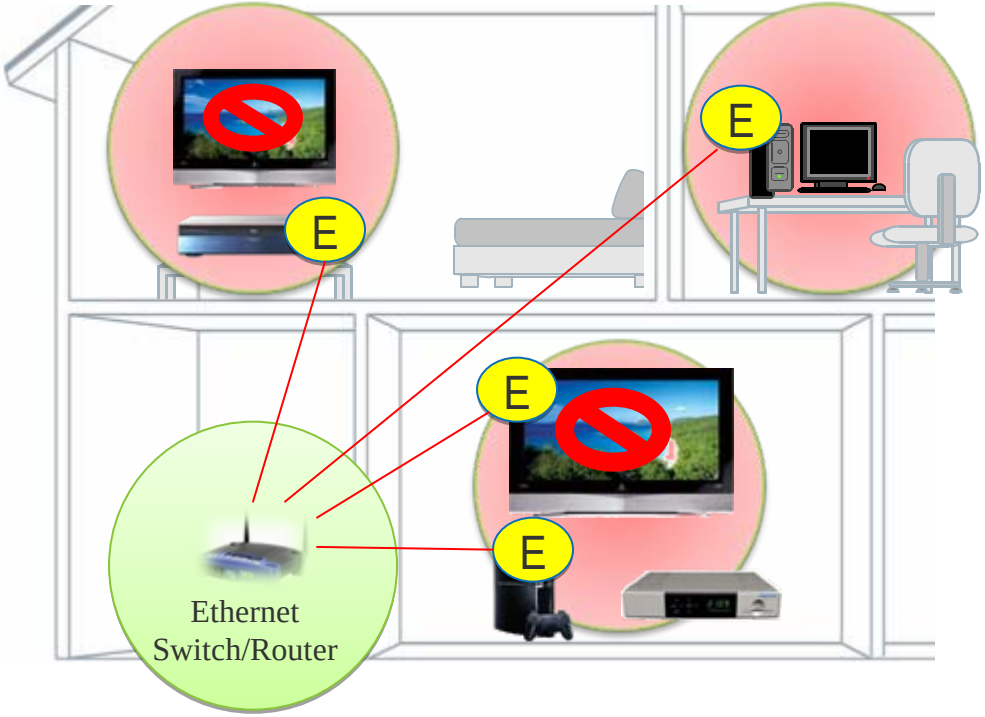


Simple, Flexible & Powerful

- **TV is Center of Home Entertainment Network**
  - Devices are aware of each other
  - Enables power management
- **Easy Thumbnail Navigation**
- **Create Synergy Between Devices**
  - Share compute resources
- **Topology Independent**

Problems with Ethernet in Consumer Electronics

Ethernet is Good for Data, Bad for Video & Audio

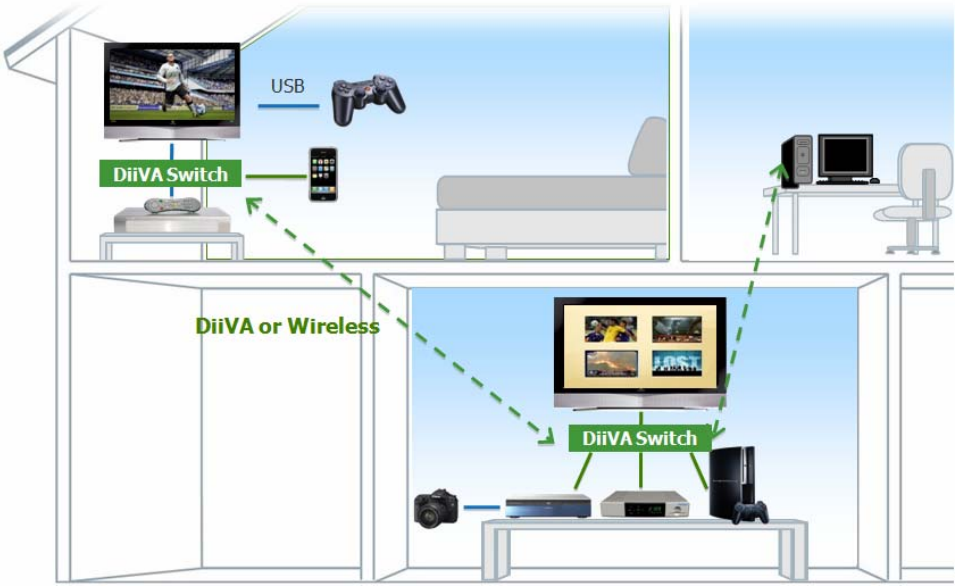


Video over Ethernet is Constrained by Bandwidth

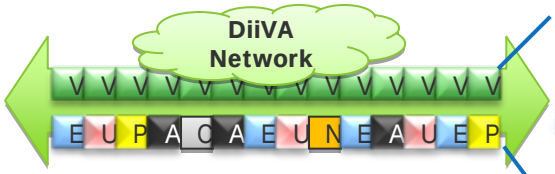
- **Video is Treated Like Data**
- **Codec Support is Problematic**
- **Problem with Islands**
  - No uncompressed A/V for multi-room
  - Ethernet data is independent from HDMI (uncompressed A/V)
  - Must interact with each device directly (e.g., can't play PS3 from other room)

DiiVA Home Networking Solution

Any DiiVA Display Can Access and Control Any DiiVA Source



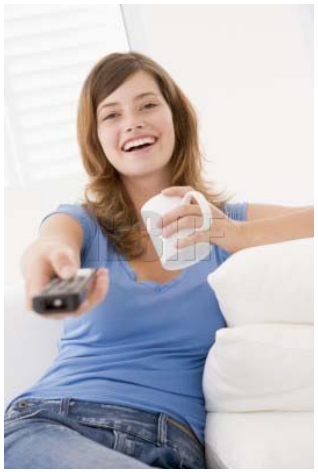
Display



Video Link- (13.5Gpbs)

Source

Hybrid Link- (4.26Gbps)



Packet Independent

- Uncompressed Video is Circuit Switched
  - Guarantees bandwidth
- Packetized Hybrid Data Channel for
  - Audio
  - Ethernet
  - USB
  - Network Management

Topology Independent

- Network Discovery Handled by Interface
- All DiiVA Devices can Route Packets

New CE Usage Models Enabled By DiiVA

- **Thumbnail Navigation**
  - By sending video & data over same interface, devices can send thumbnails to TV user interface
  - Makes navigation easier
- **USB Peripheral & Ethernet Sharing**
  - USB peripheral connected to TV can be routed to any source
  - Ethernet connection is shared by multiple devices
- **Distributed Application Processing / Local Grid Computing**
  - Use DiiVA API remote procedure calls to launch apps on other DiiVA-network CPUs
    - Example: Use TV as front-end GUI, applications are run on PCs
- **Enhancement to DLNA**
  - In case codec is not supported by TV, different device's codec can be used
  - Network can decode any file
- **Power Management**
  - Ability to intelligently power down devices not in use

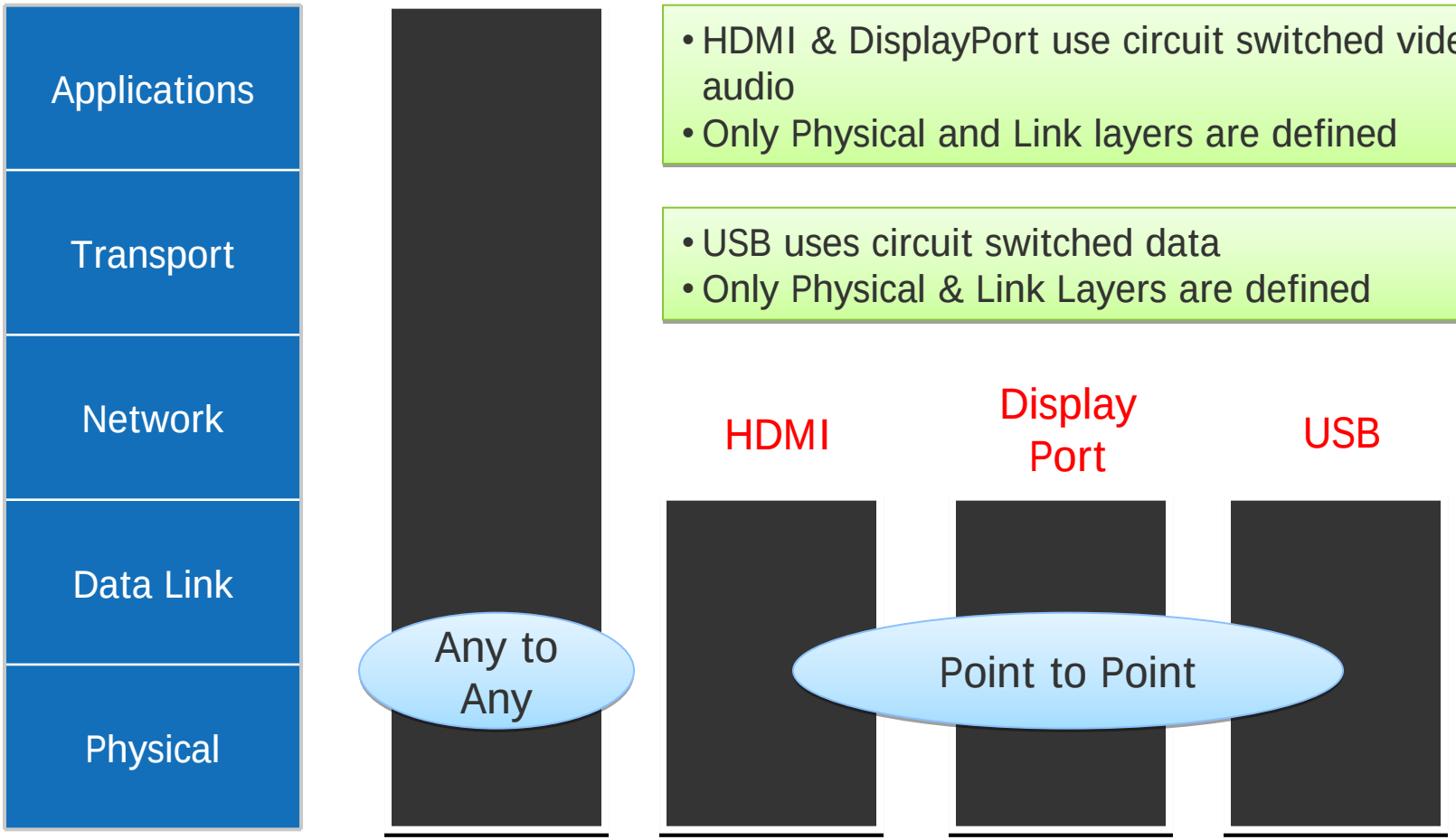
Competitive Positioning

Networking Overview: 5 Layers

- Ethernet is packet based data only
- All 5 layers of network are defined

- HDMI & DisplayPort use circuit switched video & audio
- Only Physical and Link layers are defined

- USB uses circuit switched data
- Only Physical & Link Layers are defined



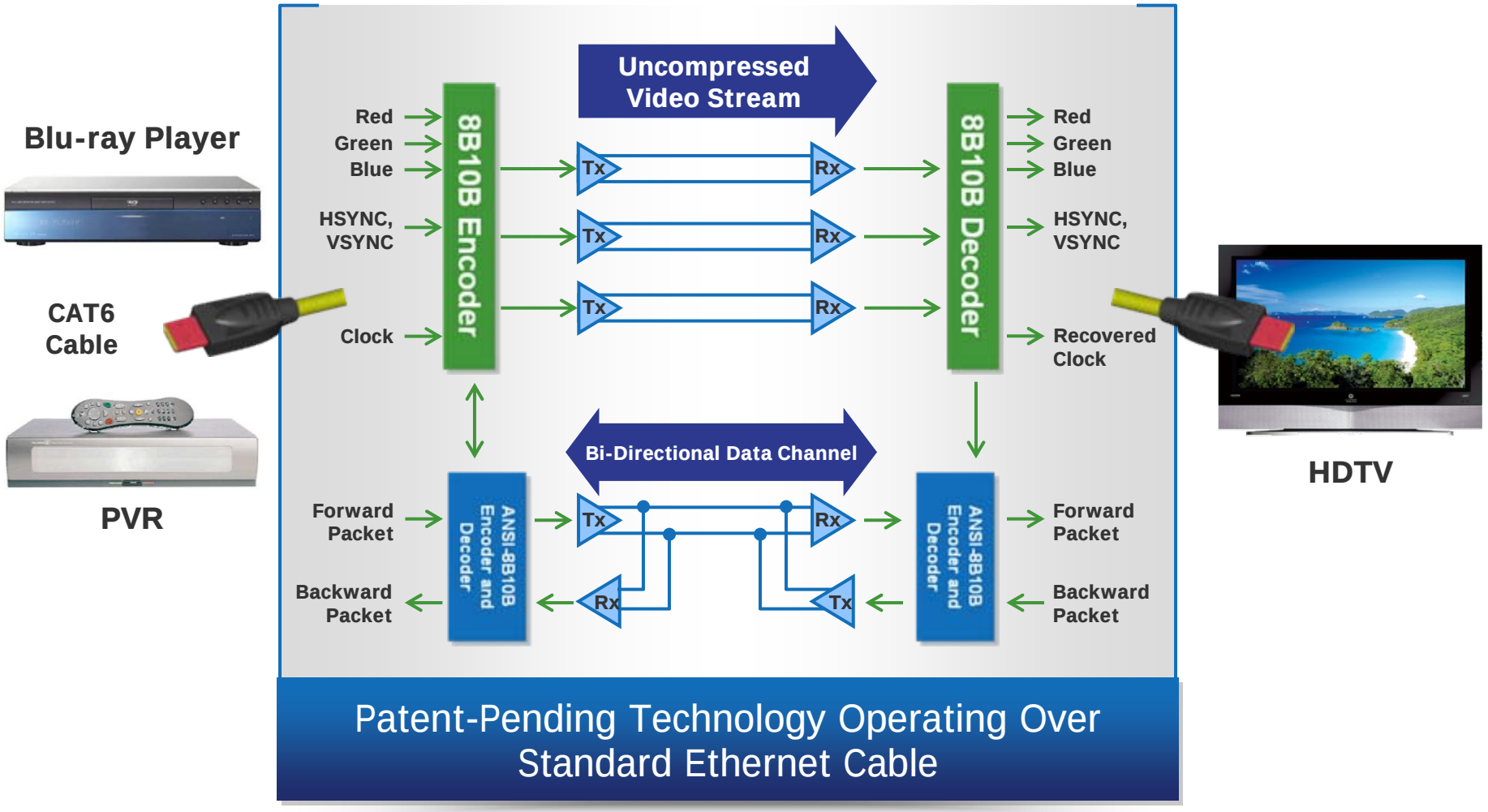
Connection Comparison

	HDMI 1.4	USB 2.0	Ethernet	DiiVA 1.0
Uncompressed Video	Point to Point	None	None	**Any to Any**
Uncompressed Audio	Point to Point	None	None	**Any to Any**
Data	Point to Point	Point to Point Host Tree	Any to Any	**Any to Any**
USB	No	Yes	No	**Yes**
Ethernet	Yes	Yes (Ethernet over USB)	Yes	**Yes**
Content Protection	HDCP	None	DTCP	**HDCP, DTCP**
Charging Power	No	Yes	No	**Yes**

DiiVA is a 'Any-to-Any' network connection that can route Video, Audio, USB, Ethernet, Commands, Power from any point to any point on the DiiVA network

Architecture Overview

DiiVA Architecture: Physical & Link Layers

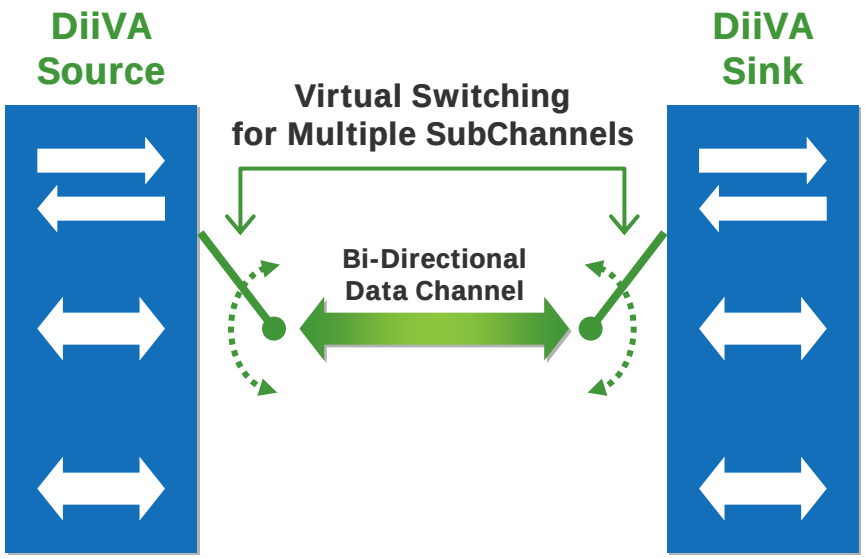


Bi-Directional Data Channel

Audio SubChannel
A Forward Digital Audio Stream
A Backward Digital Audio Stream

Command SubChannel
Commands for
Content Protection and CE Control

Data SubChannel
Multimedia Bulk Data Stream
(Ethernet, USB)



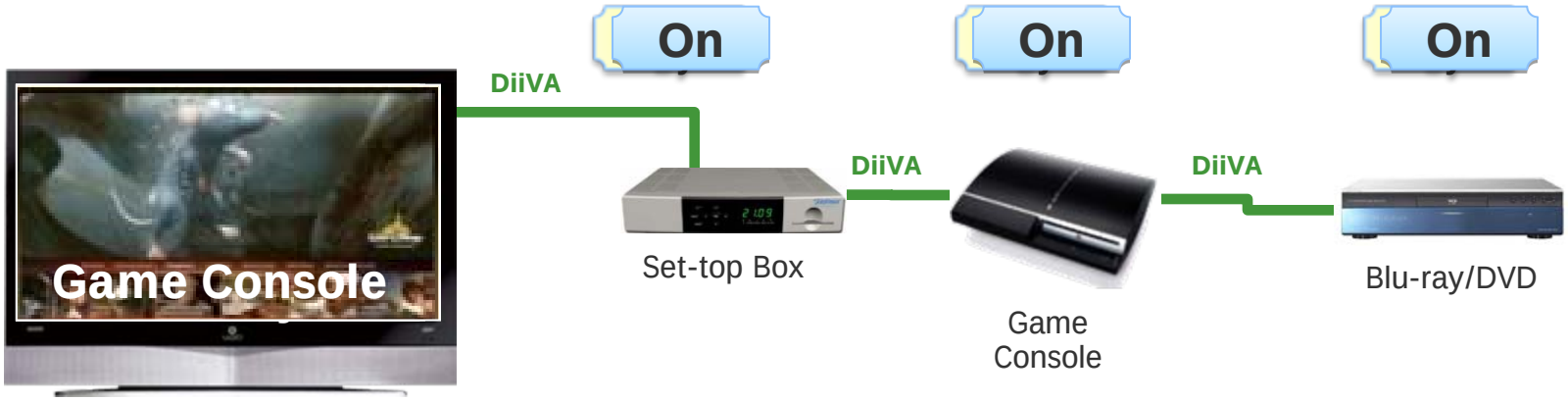
High-Speed	4.26Gbps (2.13Gbps, Bi-Directional) Using 8b10b, Embedded Clock
Bi-Directional	Advanced Protocol to Optimize Channel Efficiency
High Reliability	Error Detection, Packet Re-Transmission
Network Support	Ethernet Over Hybrid Channel
USB Support	Networked USB
Protocol Agnostic	DiiVA encapsulation enables transfer of any data type within network

DiiVA is a Complete Networking Interface Purposely Built for CE

	DiiVA	Purpose
Applications		SW Applications
Transport	**DiiVA Layers** **Video (1-3 Lanes)** / **Hybrid (1 Lane)** / **Power over DiiVA** DiiVA Control Layer (DCL) / DCL for Power	End-to-End Connections Flow Control & Reliability
Network	DiiVA Hybrid Packet Protocol	Logical Addressing, Routing
Data Link	Device Discovery Address Assigner MAC for VideoLink / MAC for Hybrid Link	Physical Addressing
PHY	8B10B DiiVA Phy / 1A @ 5V over 4 twisted pairs	Transmission Method

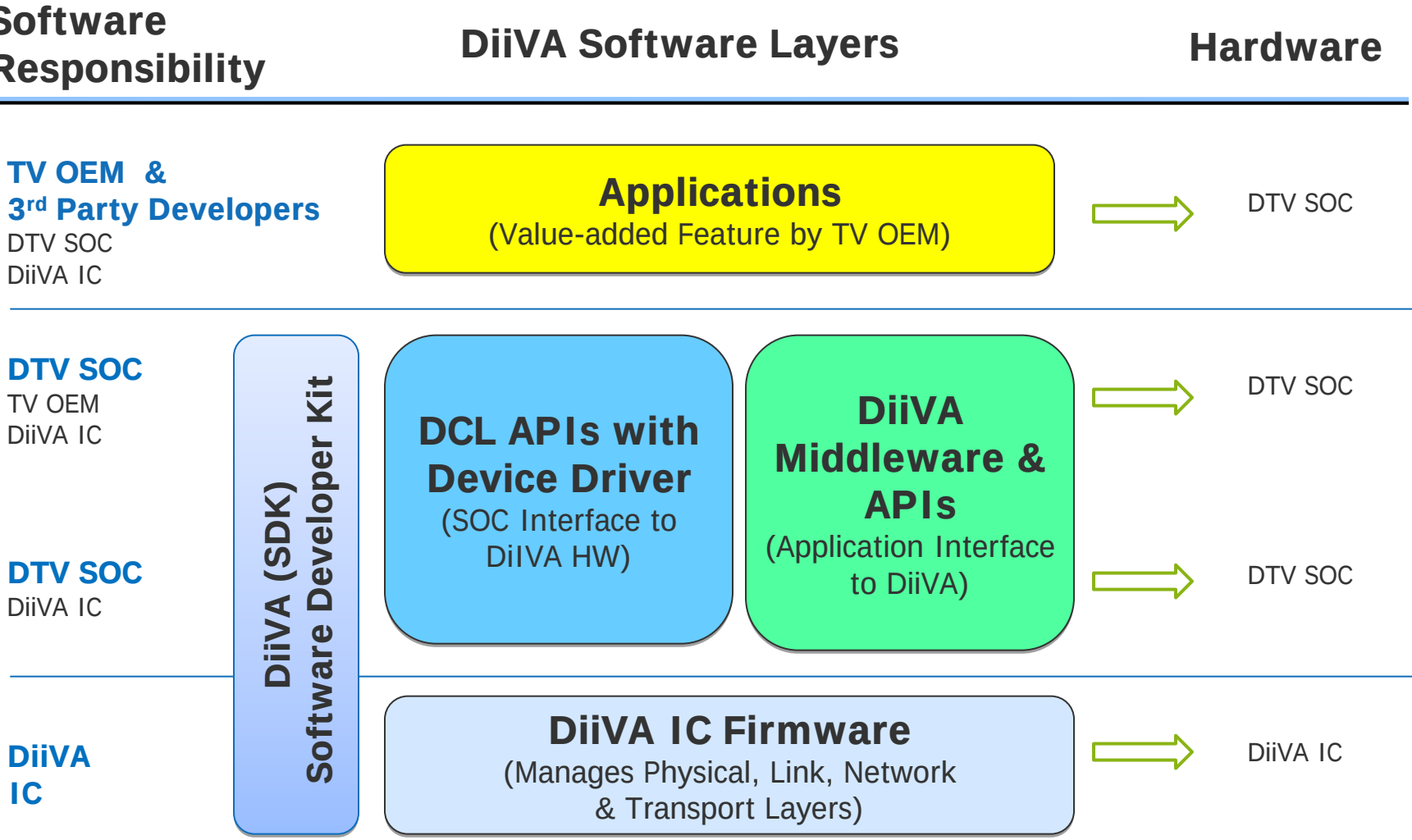
DiiVA is a complete networking interface that makes separate provisions for video, data & power

Power Management & (PoD) Power over DiIVA



- **Dynamically Power Up & Power Down Devices over DiiVA Network**
  - Power on and standby commands can be sent from device to device
  - Intermediate devices can be powered down to standby mode to conserve power
- **Power over DiiVA (POD)**
  - Interface can deliver 5W (1A@5V) to the chain
  - Can power PHY of intermediate devices so systems can be left in standby

DTV DiiVA Software Layers and Responsibilities



DiiVA Links DTV Software to Source Software

DiiVA DTV Software

- Send/Receive Commands
- Send/Receive Data
- Select Input
- Receive Video

Applications
(Value Added Feature by TV OEM)

DCL APIs with Device Driver
(SOC Interface to DiiVA HW)

DiiVA Middleware & APIs
(Application Interface to DiiVA)

DiiVA IC Firmware
(Manages Physical, Link, Network & Transport Layers)

DiiVA Hardware

DiiVA Source Software

- Send/Receive Commands
- Send/Receive Data
- Activate Output
- Send Video

Applications
(Value Added Feature by BluRay/DVD OEM)

DCL APIs with Device Driver
(SOC Interface to DiiVA HW)

DiiVA Middleware & APIs
(Application Interface to DiiVA)

DiiVA IC Firmware
(Manages Physical, Link, Network & Transport Layers)

DiiVA Hardware

DiiVA Network

DiiVA

Set-top Box

DiiVA

Game Console

DiiVA

Blu-ray/DVD

New Business Opportunities for TV Manufacturers and Content Owners

DiiVA Enables Recurring Revenue for TV Manufacturers i.e. TV Manufacturer's Apps Store

DiiVA Home Network

Internet Cloud Computing

End User Applications

TV Maker's Web Portal

Content

Apple®

Thank You!

Backup Slides

DiiVA for Mobile & Portable Applications

Interface Challenges for Mobile Devices

Interfaces on Phones Exist to Support 3G Voice/Data Plans

- **USB**
  - Data/file transfer
  - Power
- **A/V or HDMI**
  - Uncompressed video & audio
- **WiFi**
  - Internet access

DiiVA Solution:
Enable Mobile Device to Connect to Home Network

Simple, Flexible & Powerful

- **Show uncompressed content from Mobile Phone on TV**
  - Content from camera
  - HD Content downloaded from 3G network
- **Allow Device to Charge While Playing Content**
- **Sync with other DiiVA Devices**
- **Use TV as Interface to Applications on Mobile Phone**

New CE/Mobile Usage Models Enabled By DiiVA

- **TV Control of Mobile Devices**
  - TV Applications can link to mobile devices
  - Once connected to TV, mobile devices are connected to DiiVA network
- **USB Peripheral & Ethernet Sharing**
  - USB peripheral connected to TV can be routed to any source
  - Ethernet connection is shared by multiple devices
- **Distributed Application Processing/Local Grid Computing**
  - Use DiiVA API remote procedure calls to launch apps on other DiiVA-network CPUs
    - Example: Use TV as front-end GUI, applications are run on netbooks or smart phones
- **Power Management**
  - Ability to charge mobile devices

Result: DiiVA Enables Mobile Devices to be Used More Often