

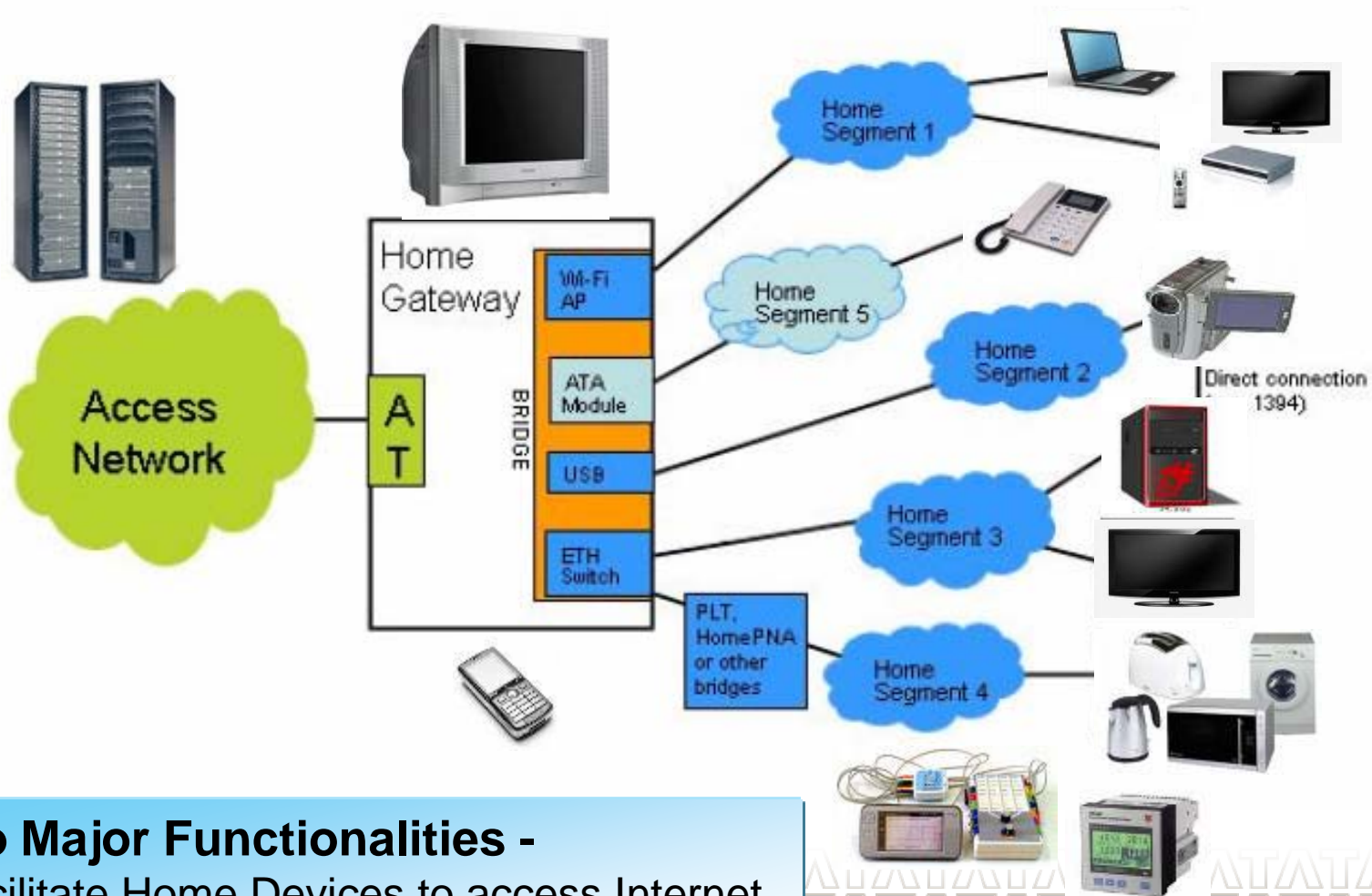
# Ubiquitous Requirements for Internet-of-Things

## - Case Study for Ubiquitous Home Gateway

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# IOT for Home – Need for Home Gateway



## Two Major Functionalities -

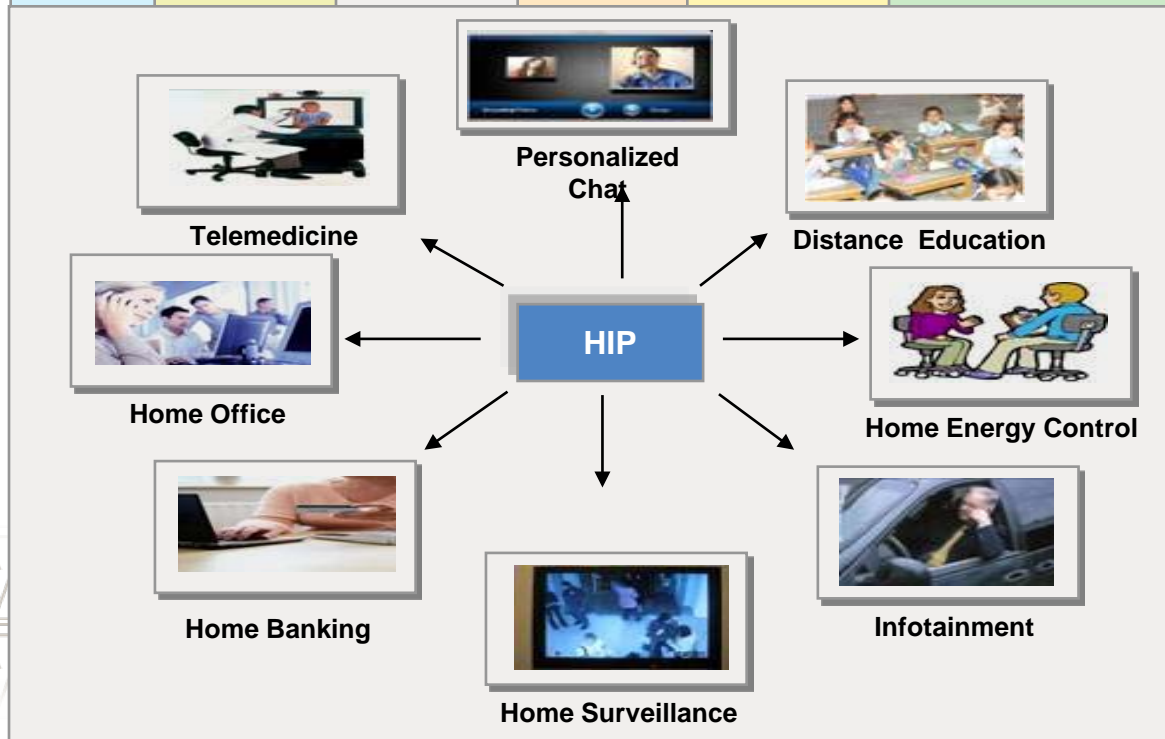
- Facilitate Home Devices to access Internet
- Access to Home Devices from Internet

# Home Infotainment Platform (HIP) - a Low-cost Internet

## Access Device on TV

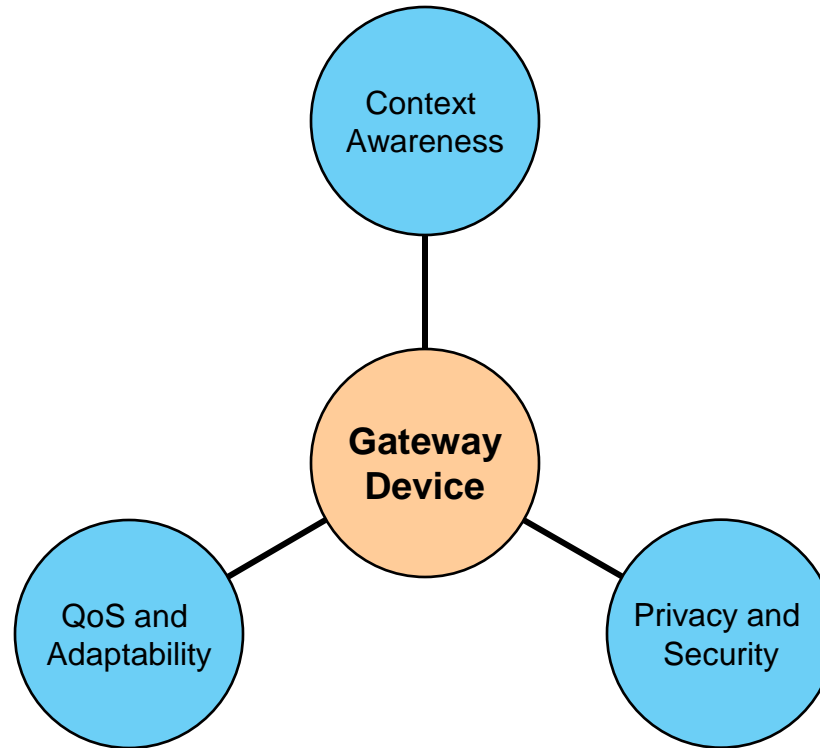
Demand for a converged Low cost computing platform

World Regions	Population	TV Households	Internet Users	Internet Connections	Potential Market
Asia	3,776,181,949	700,000,000	578,538,257	235,703,000	464,297,000
Africa	955,206,348	100,000,000	51,065,630	25,075,000	74,925,000
Europe	800,401,065	227,000,000	384,633,765	168,387,000	58,613,000
North America	337,167,248	114,500,000	248,241,969	80,000,000	34,500,000



# Technology Requirements from IOT Perspective

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# Context Awareness



# Context-aware TV - TV and Internet Mash-ups



Live TV program

News ticker from internet



Weather Information from Internet

# Intelligent Blending – Channel Logo Based EPG Mashup

- Channel logo of the currently viewed program gets detected
- Logo gets identified and the corresponding channel EPG gets downloaded
- One can have access to detailed EPG especially in non DTH environments where EPGs are not available
- Alternatively, one can click on the logo using your TV remote and navigate to the channel website using the internet gateway for additional information



Logo identified

Select text from the EPG and information gets mashed up from the internet

EPG downloaded from the internet



# Intelligent Blending - OCR Based Mashup

- Pre defined key words gets automatically identified on live TV
- Key words can be texts accompanying breaking news like “Terrorist Attack”, “Tsunami”, etc.
- One can click on the identified text using your remote
- One can access detailed information corresponding to the clicked text through the internet gateway





# Some results for Logo and OCR Detection

## Logo Detection

Channel	Type of show	Avg Time to converge (in sec)	Recall	Precision
HBO	Movie	8.3	1	1
Star Plus	Entertainment	4.8	1	1
Star Sports	Sports	3.5	1	1
Ten Sports	Sports	3.4	1	1
Star Gold	Indian Movie	8.26	1	.98
Nat Geo	Report	7.67	1	1

## OCR Detection

96.57% Accuracy

### Standardization Need -

- Semantic Format of the Context need to be Standardized so that it can be shared across devices

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# QoS and Adaptability



# Bandwidth aggregation over multiple WAN Interfaces

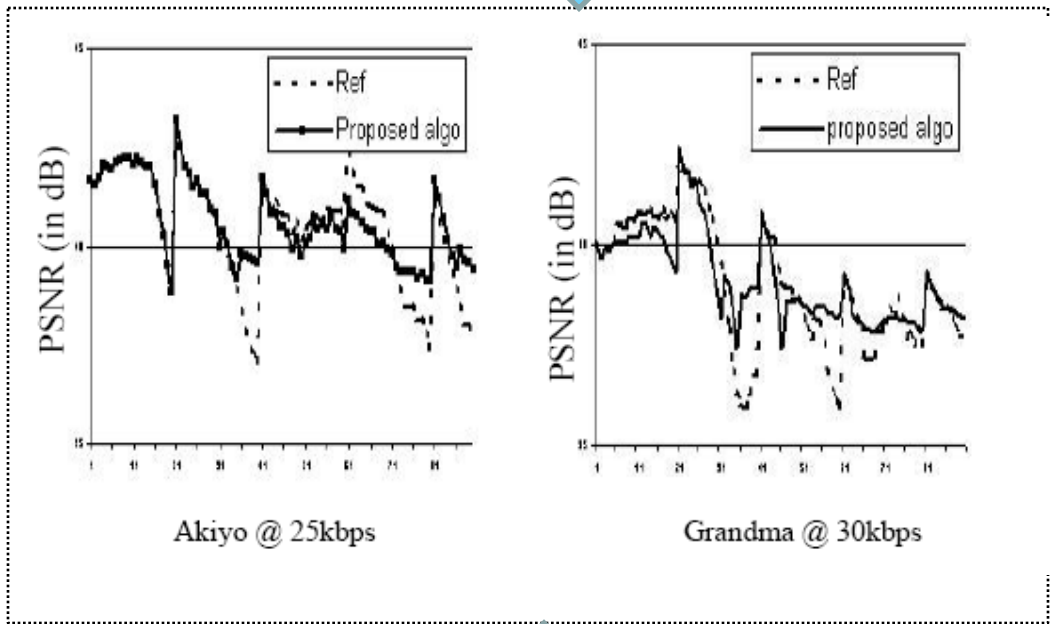
- ✓ Simultaneous data transfer( transmit and receive) through multiple active interfaces .
- ✓ Bandwidth Aggregated Faster File transfer and receive
- ✓ Dedicated Applications for Aggregated Transfer
- ✓ Future work for Application-agnostic systems

Results Captured			
Download File Size	Interfaces used	Observed speed in kbps	Enhanced data rates in kbps with aggregation
30.94 MB	Interface 1 & 2 (Photon Plus HSIA modem)	Interface1 = 61.436 Interface2 =59.9	<b>Aggregated rates = 101.34 kbps</b> <b>43.40 / 72.45%</b> <b>increased data rate</b> ( best case out of 4 attempts )
141.04MB	Same as above	Interface1 = 57.031 Interface2 =57.031	<b>Aggregated rates = 110.43 kbps</b> <b>53.40 / 93.63% increased data rate</b>

# Rate-Adaptive Bandwidth-Efficient Video Conferencing System

	Mean in kbps	Standard deviation in kbps
Adsl-adsl	596.1447864	203.454445
Modem-modem	19.23255948	26.96014122
Modem-adsl	18.13249667	3.208220763

Estimated Bandwidth used as input to the rate control algorithm – Rate Control done inside Video Compression



Detect Network Condition in Real-time using

**Standardization Need -**

- Cross-layer Communication need to be standardized in order to do real-time adaptive control

to Adaptive

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# Privacy and Security



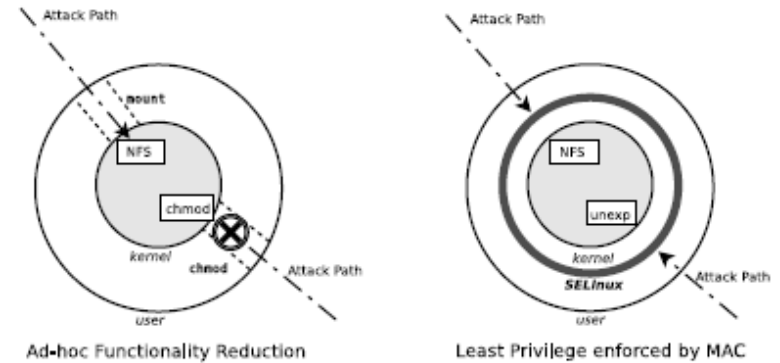
# Security for Home Gateway Box

## Vulnerability

- Open debug Ports to gain access inside box (e.g. Telnet/ssh)
- Vulnerability in Box Provisioning and Authentication
- Vulnerability in Operator Network Lock

## Possible Remedies

- Strong MAC and User Management Policy for Debug Ports
- Chip Die-ID used as Unique ID for Provisioning and Authentication – only encrypted version of the same is sent over public media
- Use of HTTPS protocol for secure communication required for Provisioning, Authentication and Operator Network Lock
- Contemplating use of Security-hardened OS



## Standardization Need -

- Security needs to be standardized for Gateway boxes – both from Protocol and Access-inside-box point of View

# References

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1. Arpan Pal, “Next Generation Internet on TV - Intelligent Mash-ups between TV Content and Internet”, *First WWW 2011 Warm-up Workshop, January , 2010, Kolkata, India*
2. Tanushyam Chattopadhyay, Ayan Chaki, Dhiman Chattopadhyay, Nandini Chatterjee and Arpan Pal, “A Novel Value Added Interactive Services for Active Pages of DTH Set Top Boxes” in *PREMI Experience Workshop 2009*
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