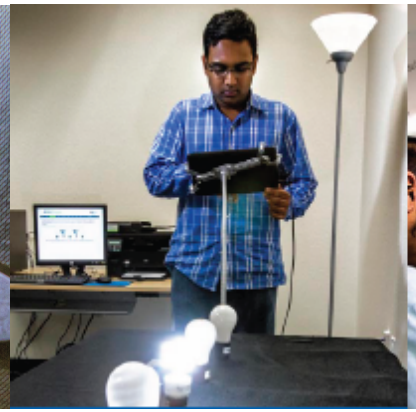
CalPlug's 5W5s Roadmap for Efficient STBs






Dr. Arthur Zhang, Technology Manager
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California Institute for Telecommunications and Information Technology

Oct 30, 2012

www.calplug.org

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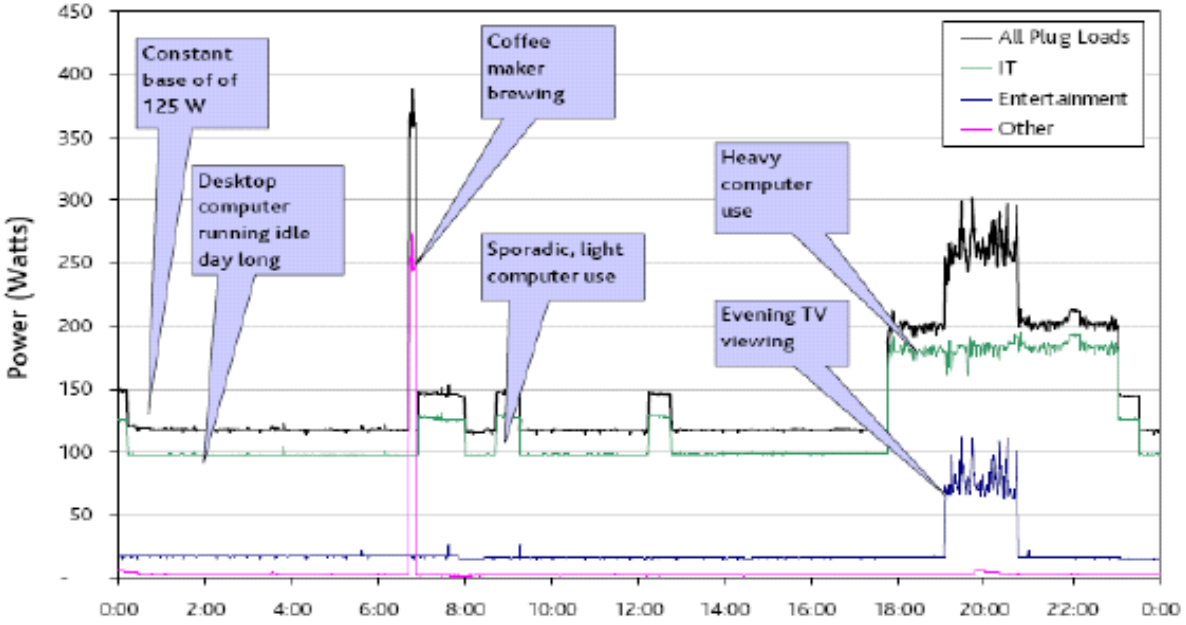
Outline

- Methodology for efficient Plug Load devices
- Current STB systems: potentials and limits for efficiency
- CalPlug's 5W5s roadmap for efficient STBs
- Phase I&II design architecture
- Conclusions

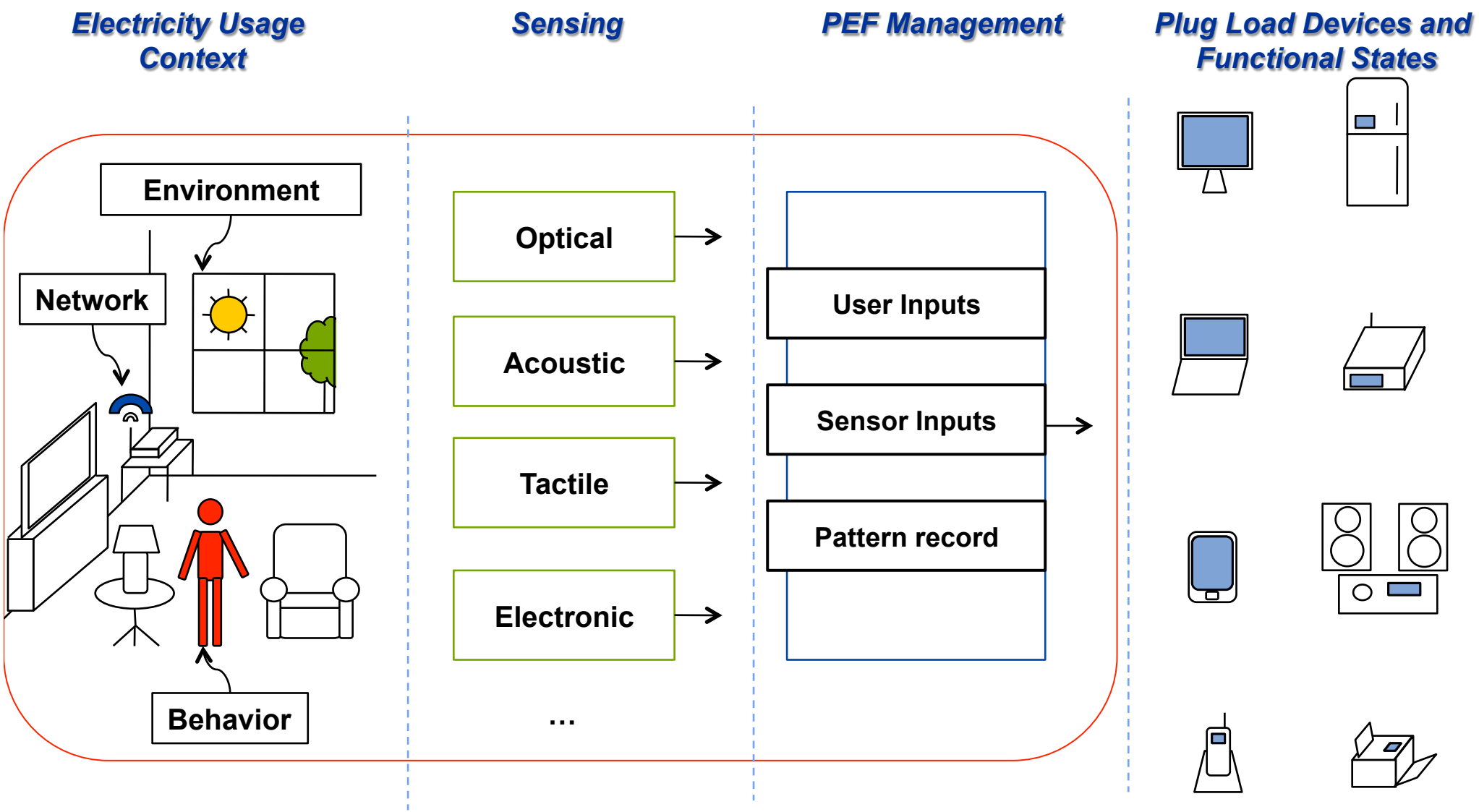
Energy efficient plug load devices

- **Define efficiency**
- **Duty-cycle, sleep modes, and deemed savings**
- **Personal energy footprint (PEF) management**



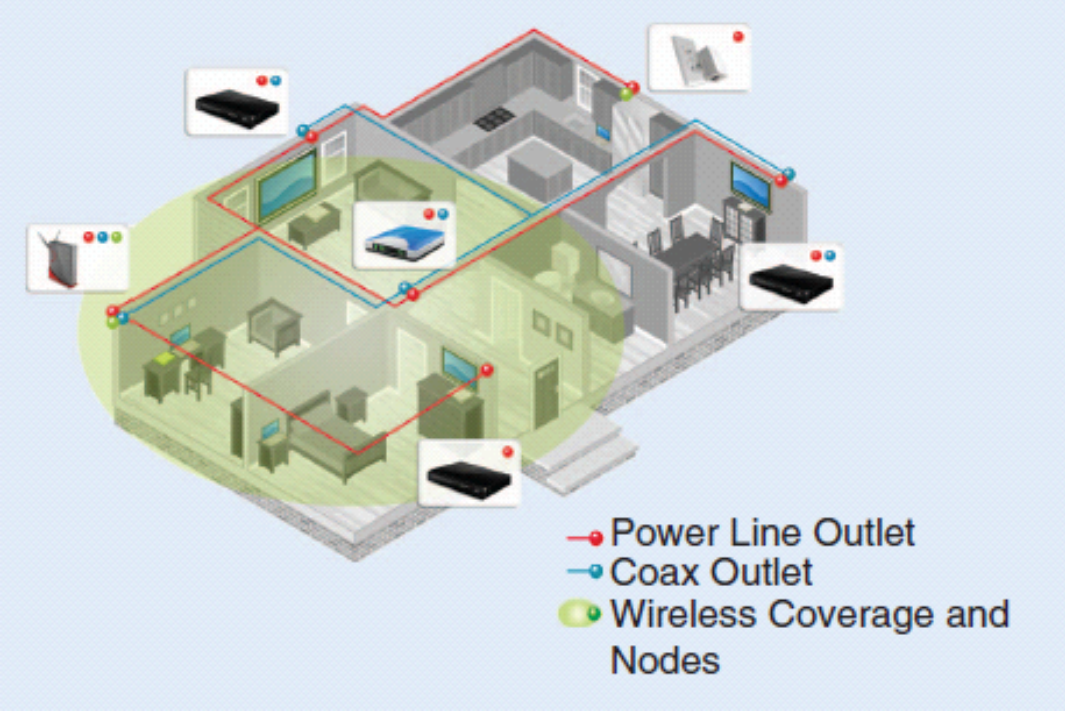
Source: Porter et al. 2006

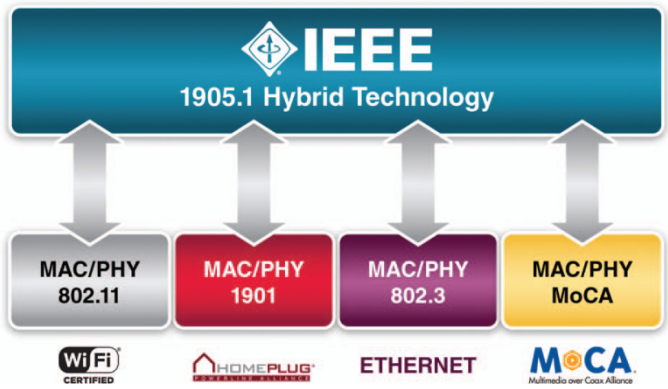
Personal Energy Footprint Management



STBs and Whole Home Networks

- **STBs are connected devices**
- **Server STB and multiple clients**

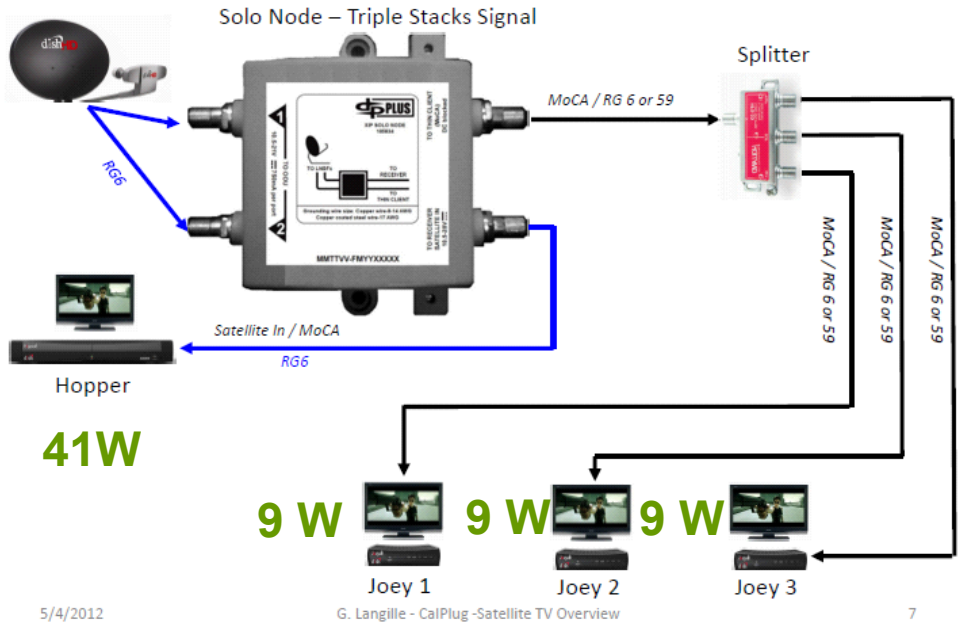




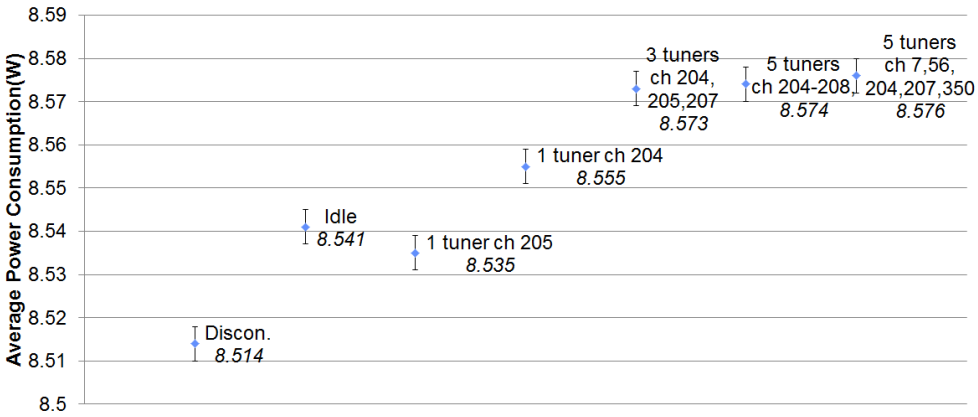
Stephen Palm, ICCE Magazine, 2012

Multi-room Architecture and Power Savings

- **Average 2.5 TV sets each household**
- **Thin-clients, compatible TV/tablets**
- **Share the fixed cost of energy on consumer-premise equipment**



Average Power Consumption vs. Number of Tuners Consumer Premises Equipment



CalPlug Engineering Lab August 2012

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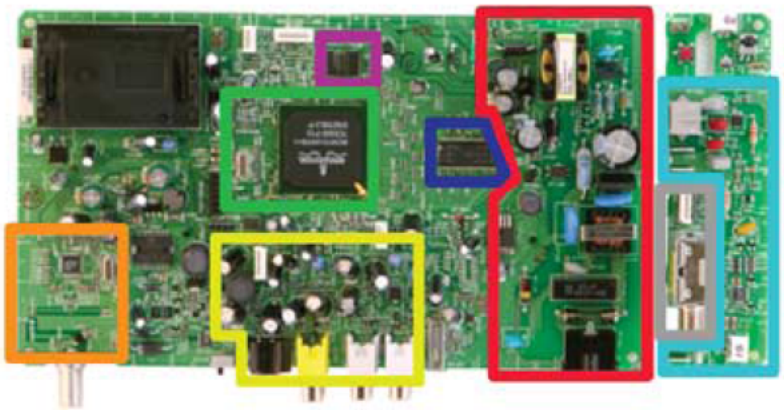
STB Device-Level Power Saving Potentials

- Power scaling system-on-a-chip CPUs
- Improved switching power supplies
- More efficient recording memory (Hard-drive-less, Hybrid, spin-down on-demand)
- Software, middleware updates
- Light-sleep/Deep-sleep bus system design to selectively de/activate components

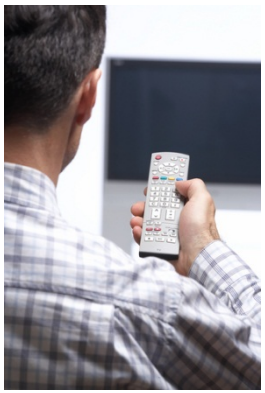


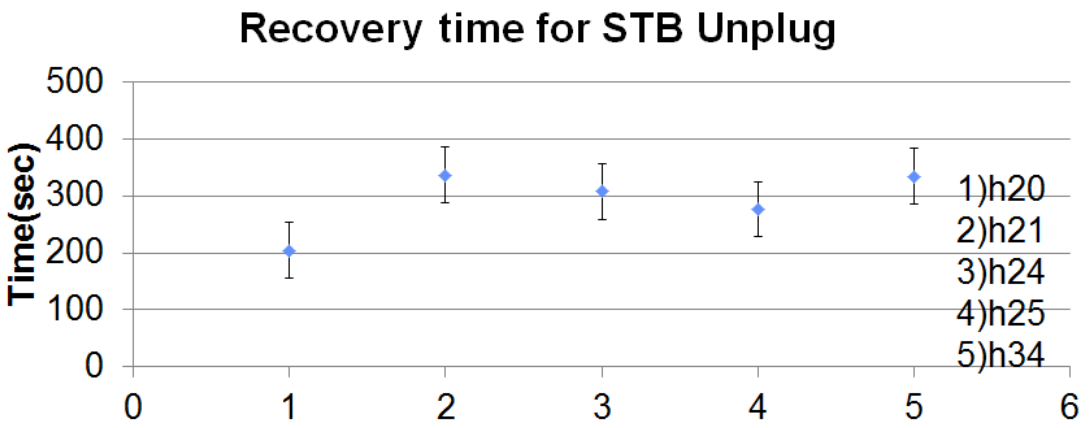
MPEG Decoder + Transport + Modem + Control CPU + NTSC Encoder
AC-DC Power Supply
Volatile RAM
EMPROM (Flash) Non-Volatile Memory
Modem Analog Front End
Satellite Tuner
Analog Video and Audio Output
RF Modulator

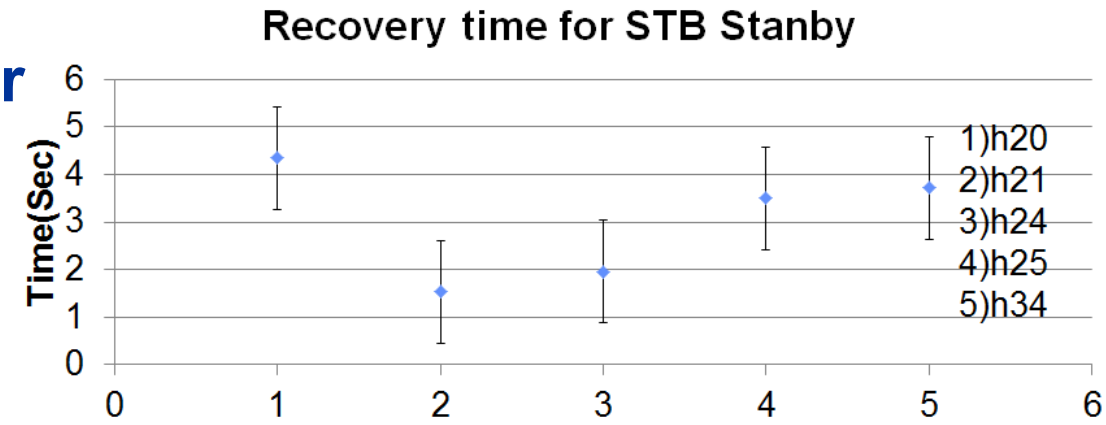
STEPHEN DULAC, PROCEEDINGS OF THE IEEE, VOL. 94, NO. 1, JANUARY 2006

Consumer Tradeoffs in Efficiency Designs

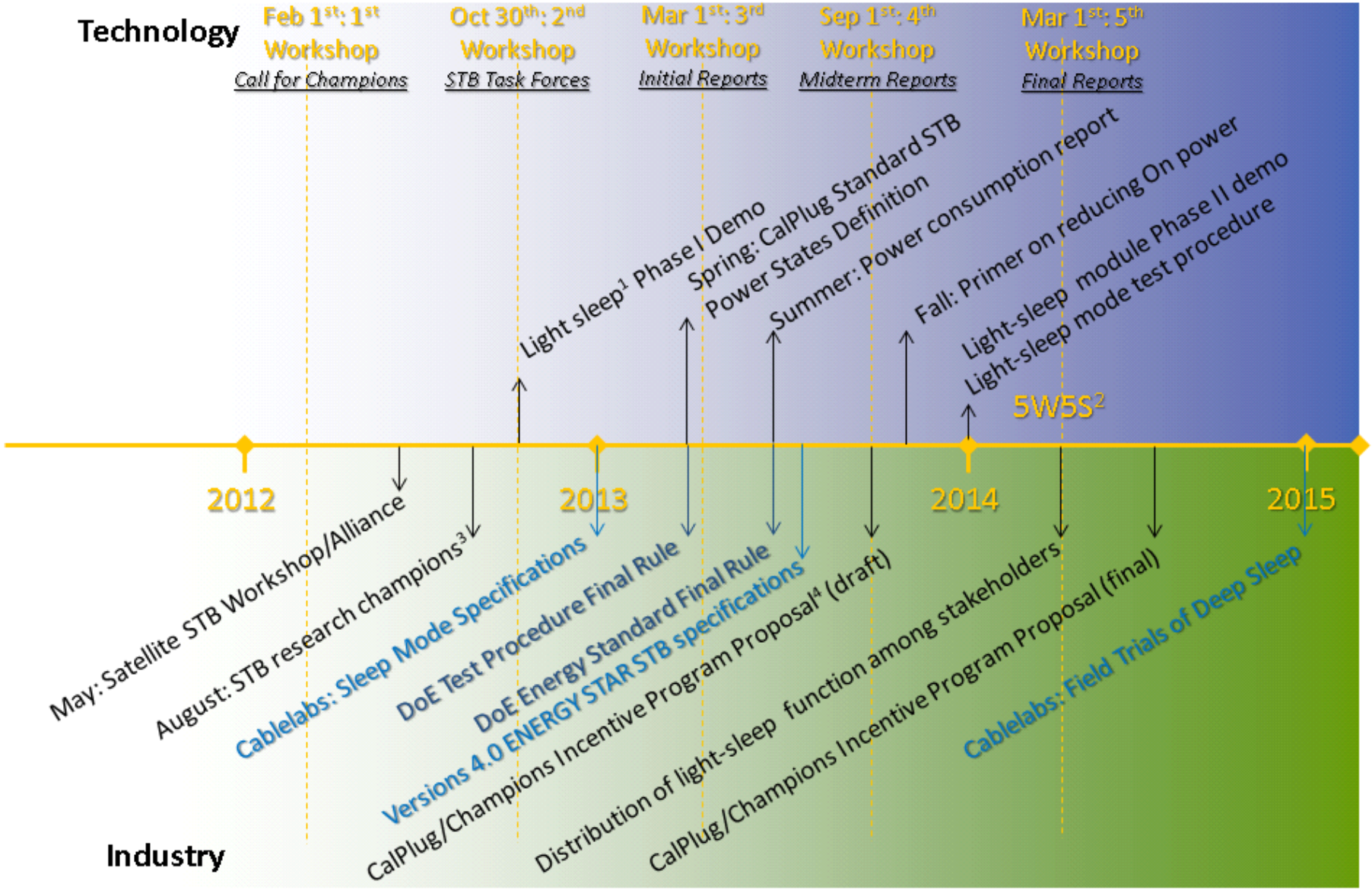
- **Efficient, on-demand designs always have tradeoffs in system response time**
- **"Frustration threshold" study**
- **How to reduce consumer perceived "Delay"?**



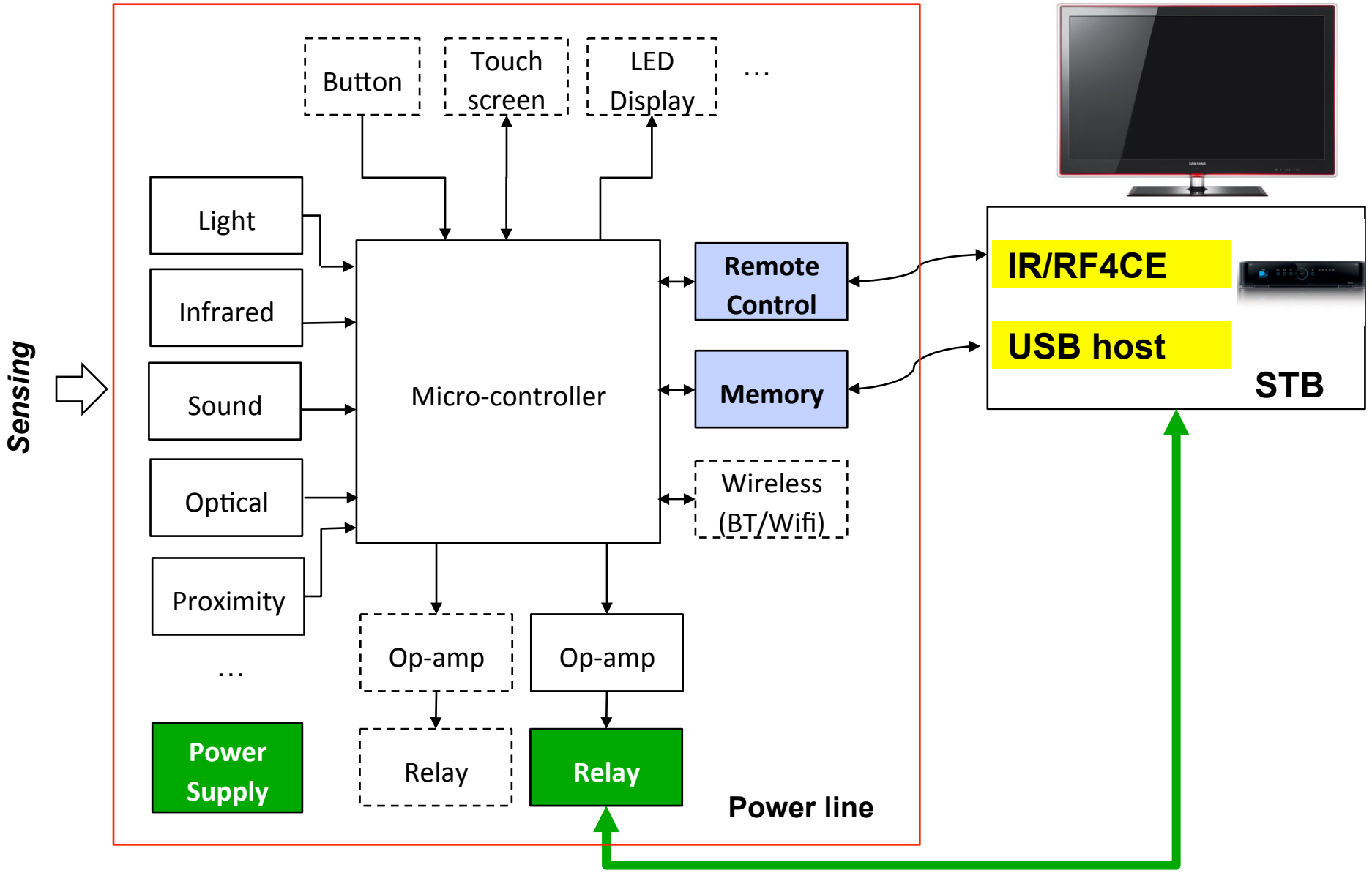




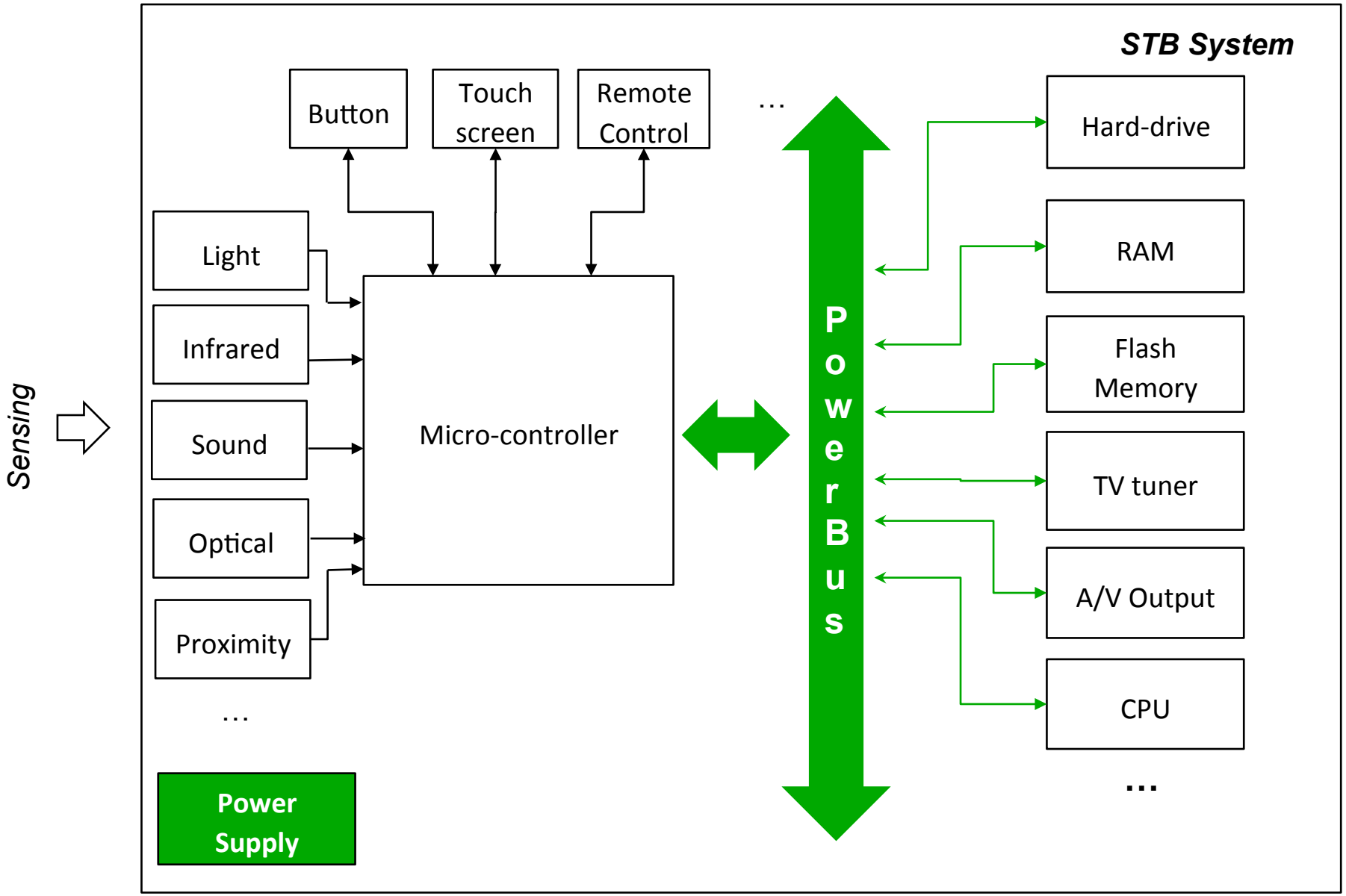
CalPlug's 5W5s Roadmap for Efficient STBs



Phase I Design: Standalone Solution



Phase II Design: Integrated STB Solution



Conclusion

- **CalPlug's 5W5s goal intends to address both power consumption and consumer tradeoff**
  - **Phase I: A low cost standalone solution for existing fleet**
  - **Consumer behavior as an "External clock"**
  - **Phase II: Consumer behavior integrated as an "Internal Clock"**

Thank you!