BROADBAND POWER LINE THROUGHPUT OPTIMIZATION

Case Study: Embedded Software

Broadband power line throughput optimization

Broadband Power Line stands for data transmission over utility power lines. It uses windowed OFDM with TCC, operates in 2-30MHZ, with flexible spectrum notching and performs 128-AES encryption.

Used for:

- In-home TV and Internet distribution;
- Internet service providers;
- Smart grid.

Comprehend the Client
Profound understanding of clients' business environment and goals.

Problem ID
Identification of all the problems, cause and requirements.

Solution
Designed with innovative thinking and extensive experience in SW engineering.

Results
Optimize for success. More efficient and effective usage of resources.

Case Study: BPL throughput optimization

Comprehend the Client

Profound understanding of clients' business environment and goals.

Silicon vendor

Multinational semiconductor company

Our client is a semiconductor company which had both hardware and software operating solutions for Broadband Power Line modems.

Dual core SoC, main processor ARM plus dedicated 32-bit CPU running real time operating system (OS) and handling the BPL protocol. Arm runs on Linux, making use of network stack and facilitating application development.

BPL throughput optimization
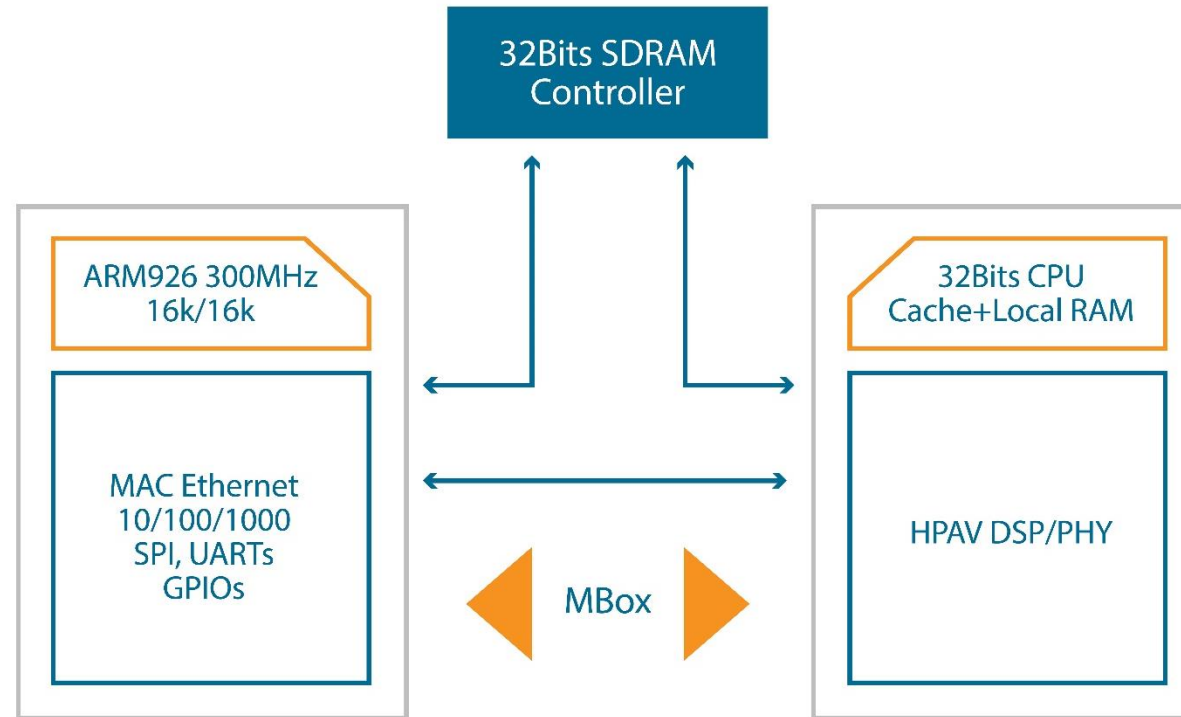
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Problem ID

Identification of all the problems,
cause and requirements.

Functionality

Scope of work and functionality

The implemented protocol was HomePlugAV, the OS was Linux and the number of modems which could effectively interoperate was up to 20.

The Channel Access implemented was CSMA, with maximum throughput of 75 Mbps in one cell.

Our client needed a solution for Internet Service Providers with **minimum 32 modems**, one **dedicated modem connected to Internet backbone** (head-end) and **traffic limitation** per modem.

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Solution

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Data transfer

More traffic and prevented starvation

Although HomePlugAV allows fixed channels between modems and hence traffic shaping, it requires complicated negotiation which is very susceptible to any asynchronism and creates additional load on CPU.

We decided to implement TDMA on a dedicated modem (master). We used modified Round Robin polling mechanism, which was giving the priority to the modems which generated more traffic to prevent starvation with mandatory polls. On Physical level it enabled higher data transfer.

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Traffic limit

Guarantee bandwidth

Next thing was to limit the traffic.

Linux has NETFILTER module, which could, together with "usual" tools like iptables and ebtables, solve traffic limitation. Again, this added additional load on CPU and further decreased throughput.

The critical modem for throughput was the one connected to the Internet, so we decided to move the traffic limitation task to "non-dedicated" modems.

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Guarantee bandwidth

We used VLAN tagging to mark the Ethernet frames for priority. The mark was read inside the Linux Ethernet drivers, extracted into sk_buff mark field that could later be used by queueing disciplines.

The disciplines we used were Class Based Queueing and Hierarchy Token Bucket. The later proved to be more reliable, with less parameters to tune.

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Results

Optimize for success. More efficient and effective usage of resources.

73.3%

Increasement of throughput

- The overall throughput was increased to 130Mbps, or 73.3%

- Maximum number of modems which could effectively interoperate was 64

- We supported 4 levels of priority as specified in HomePlugAV standard

- Client was also provided with a set of scripts for tuning the traffic (CBQ and HTB disciplines) for particular use cases.

ABOUT
Avisto Eastern Europe

Avisto Eastern Europe is a service company specialized in software engineering with extensive expertise in the area of Applicational Software, DevOps, Embedded Software and Quality Assurance & Automation. Established in 2008 as a fully owned subsidiary of Avisto, a French-based company and a member of Advans Group, Avisto Eastern Europe with its development centers in Belgrade and Novi Sad (Serbia) successfully delivers complex projects and provides support to top-notch international enterprises, highly specialized mid-size businesses, and startups.

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