Firmware of SCAMPI adapter

2nd SCAMPI Workshop

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Firmware of SCAMPI adapter

- **TSU** — Time Stamp Unit
- **HFE** — Header Field Extractor
- **LUP** — Lookup Processor
- **STU** — Statistic Unit
- **SAU** — Sampling Unit
- **PCK** — Payload Checker
- **DISP** — Packet Dispatcher
- **/dev/null**
- **HOST**
Timestamp unit

- timestamp format - 64 bit fixed point
  - 32 number of seconds (since 1.1.1970)
  - 32 fraction of second (precision about 230 ps)

- 100 MHz clock (oscillator 10 MHz, multiplied by 10)
  - TCXO - temperature compensated
  - resolution 10 ns (64 bytes at rate 10Gb/s ~ 50 ns)

- controlled by PPS input (e.g. GPS receiver)
  - accuracy (with PPS) ~ 1 us
  - accuracy (with NTP) ~ 50 us
  - accuracy of calibrated oscillator without PPS ~ aging of quartz

- PLL derived from ‘nanokernel’ of NTP project
VHDL blocks

- **HFE** (header field extractor)
  - extracts data from TCP/UDP and IP headers
  - unified header structure assembling

- **LUP** (look-up processor)
  - CAM matching (width 272 bits)
  - evaluation of conditions - programmable engine for processing of unified header fields (32 bits comparison)
  - result of classification - 32-bit word

- **SAU** (sampling unit)
  - deterministic sampling - each $n$-th packet is passing through
  - probabilistic sampling - packet is passing with probability $1/n$
VHDL blocks (cont.)

- **PCK** (payload checker)
  - checks payload for defined patterns (16 bytes)
  - patterns aggregated into groups

- **STU** (statistic unit)
  - packets lengths statistic: number of packets, total length, sum of squares of lengths, min/max value
  - statistics of intervals between packets: number of packets, total time, sum of squares of intervals, min/max

- computed statistics
  - length: average data rate, average length of packets, variation of packets lengths
  - time: total time of data flow, average inter-packet interval, variation of inter-packet interval
Control word

- control word describes processing of packet
  - 32 bits
  - output from packet classification

- SAMASK (16 bits)
  - assigns packet to SAU
  - packet might be processed by several SAU

- STATID (8 bits)
  - identifies STU
  - only 1 (of 256) STU processes the packet

- PCMASK (8 bits)
  - defines subset of 8 groups of patterns
Adapter output

- **id** - 2 bytes
  - interface number
  - result of SAU and PCK processing

- **timestamp** - 4 bytes

- **control word** - 4 bytes

- **rlen** - 2 bytes
  - length of this record

- **wlen** - 2 bytes
  - wire length of the packet

- **data** - up to 1560 (up to 16 kBytes)
  - captured packet
Limitations

- **LUP**
  - up to 2000 rows in CAM (matching part)
  - up to 8 condition (processing part)
  - 32 bits of output word (classification)

- **Control word**
  - size of word limits number of addressed units
  - at least 48 bits needed for better utilization

- **STU**
  - ‘time’ part limits utilization of rules parsing
  - more STU processing units is required - limited by addressing

- **PCK**
  - throughput is 3 Gb/s
Conclusion

SCAMPI adapter advantages:

• Advanced functionality on adapter

• Open system, users can download their own firmware

• Low cost of 10 Gb/s adapter