Lightweight benchmarking of platforms for network traffic processing

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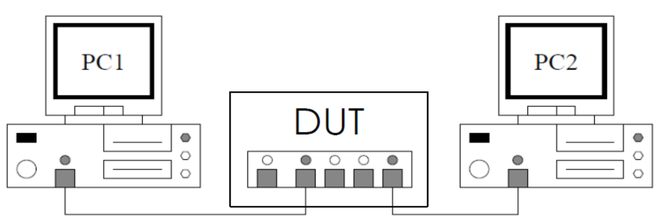
Introduction

Embedded processors seem to be a viable solution for network traffic processing. We can observe that the current network development boards utilize ARM, MIPS rather than specialized network processors. The processors for embedded applications are low cost and low power, but their performance is not clear. In this work we aim at revealing their performance in terms of their throughput and processing power. To this end, we select three network processing functions and we benchmark several available platforms with embedded processors by implementing and running these test in a controlled environment.

Design of tests

Test of network throughput

- using **iperf** tool
- all combinations of **IPv4/IPv6** and **TCP/UDP**
- for **64, 128, 256, 512, 1024, 1500** bytes packet sizes
- **forwarding** and **routing** tested separately
  - if not possible (e.g. single port platform) then only as a *client/server*



Performance measured on network algorithms

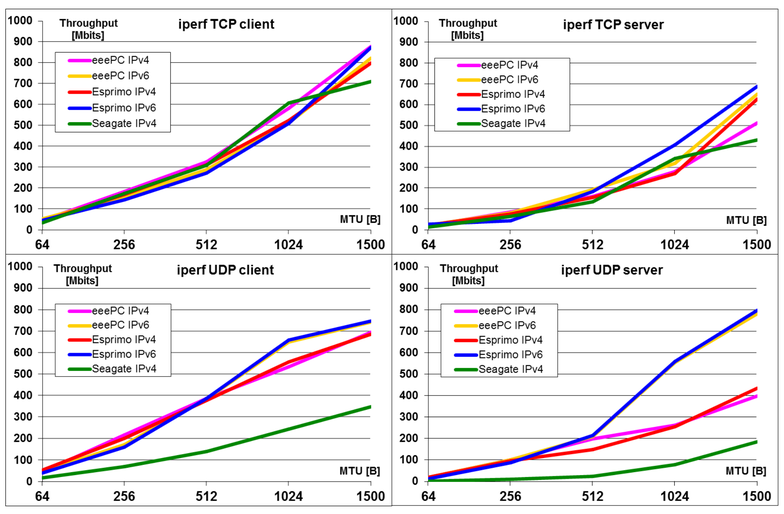
- **Filtering**
  - Bloom Filter *(BF)*
  - Counting Bloom Filter (CBF)
- **Pattern Match**
  - Delay DFA *(DFA)*
  - Hybrid FA *(HFA)*
- **Longest Prefix Match**
  - Tree-bitmap *(TBM)*
  - Shape Shifting Tries *(SST)*

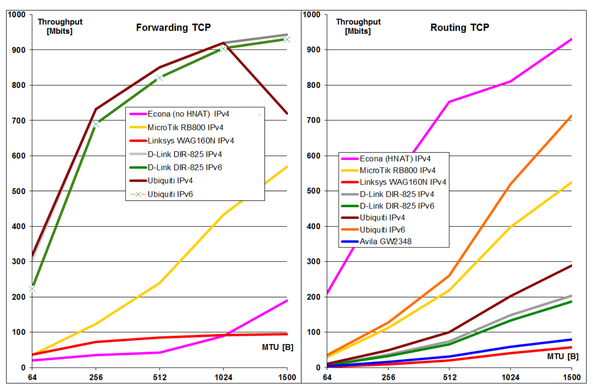
All performance tests were implemented in form of toolset [1], which can be easily ported and compiled for any platform and OS. It consists of algorithm source codes, setup and measurement scripts, input data samples and generators.

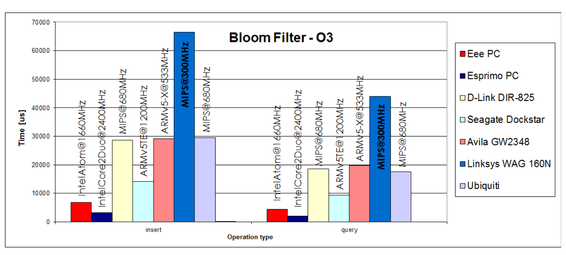
Selected platforms

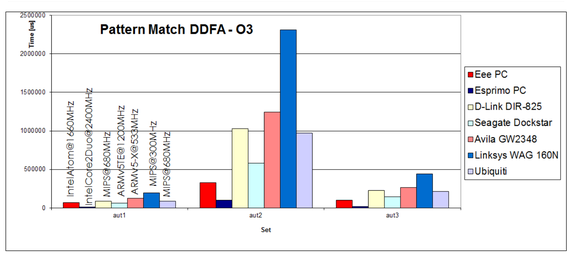
Name	Processor	Architecture	Frequency	Cache	OS	RAM	Others
Linksys WAG 160N	Broadcom BCM6538	MIPS	300 MHz	I:32kB, D:16kB	OpenWRT	32 MB	100Mb
D-Link DIR-825	Atheros AR7161	MIPS	680 MHz	24kB	OpenWRT	64 MB	5x1Gb
Ubiquiti	Atheros AR7161	MIPS	680 MHz	24kB	OpenWRT	128 MB	RouterStation-PRO
Econa	Cavium Star CS1102	ARMv4T	250 MHz	I:16kB, D:16kB	Linux, 2.6.16	512 MB	5x1Gb, HNAT
Avila GW2348	Intel IPX425	ARMv5 XScale	533 MHz	I:32kB, D:32kB	OpenWRT	64 MB	100Mb, DES, AES
Seagate Dockstar	Marvell Kirkwood	ARMv5TE	1200 MHz	I:16kB, D:16kB	OpenWRT	128 MB	Network Storage
Spartan-3E XC3S1600E	Xilinx MicroBlaze	8.00.b	50 MHz	I:8kB, D:8kB	Linux, 2.6.37	32 MB	32b MUL
Spartan-3E XC3S1600E	Xilinx MicroBlaze	8.00.b	50 MHz	I:16kB, D:16kB	Linux, 2.6.37	32 MB	64b MUL, predikcia skokov
MicroTIK RB800	Freescale MPC8544	Power QUICC 3	800 MHz	I:32kB, D:32kB L2:256kB	RouterOS 4.0	256 MB	HW XOR
eeePC	Intel Atom D510	Intel Atom D510	1660 MHz	L2: 1MB	Linux, 2.6.35	2048 MB	PC
Esprimo	Intel Core2Duo	Intel Core2Duo	2400 MHz	L2: 3MB	Linux, 2.6.38	3072 MB	PC

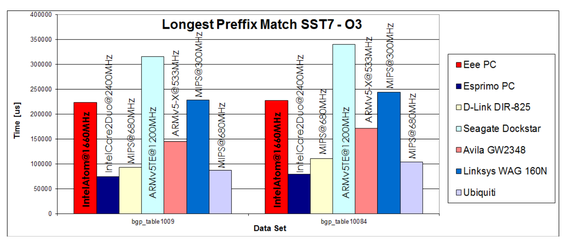
Results











Conclusions

Observations made during throughput test:

- Specialized HW support (Econas' HNAT) can significantly improve performance
- UDP is likely to reach lower throughput with correctly delivered packet
- IPv6 routing might be on some platforms faster than IPv4
- Processor frequency influences the throughput less than expected

Observations made during performance test:

- In case of filtering and pattern matching, the higher processor frequency the better results
- For LPM eeePC@1660MHz is more than two times slower than MIPS@680MHz
- MIPS architecture is generally faster than ARM for LPM
- Again for LPM, faster, but older (ARMv5TE@1200MHz) processor is slower compared to newer running on lower frequency (ARVv5-XScale@533MHz)
- Only a small change in Xilinx MicroBlaze architecture invokes more than 2 times better performance.

References

[1] Procbench-toolsed used for platforms testing can be downloaded from:

http://www.fit.vutbr.cz/research/view_product.php.en?id=174

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