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BACHELOR THESIS

Building a "Router on a chip" using
Freescale's t1040 platform

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Bucharest, 2014

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Chapter 1

Introduction

This is just a demo file. It should not be used as a sample for a thesis.

TODO:

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1.1 Project Description

1.2 Background

This thesis presents the **MySuperProject**.

1.3 The Problem

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1.4 The Solution

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Introduction: -length= ??(probabil pana in 4 pagini)

* Background: - state of the art - utilitatea routerelor de genul - context / routere / ce exista pe piata - cam 1 pagina?

* The problem - ce probleme au solutiile existente - 0.5 - 1 pagini?

* The solution - ce fac eu - ce am in plus, de ce e mai bun - foarte sumar - cam 1 pagina

Main body: -length= ? (20-30 pagini)

* The Freescale Platform - hw specs - detalii generale arhitectura - ce face bine, de ce e bun pentru un astfel de proiect - 4 pagini?

* Characteristics - ce functionalitati are - prezentat in subcapitole separate fiecare parte (TODO)
- poate intra mult, deci poate chiar 10

* Architecture: - scheme - altceva???

* Scenarii de folosire: - small office router - lightweight hosting - TODO: mai gaseste chestii de bagat

* Performante: - maybe?

Chapter 2

The t1040 platform

This chapter offers details on the hardware used in this "Router on a chip". The first section offers hardware specifications necessary when comparing this platform to other commercial routers, the second section offers general details on the specific architecture used when building the platform, and the last section evaluates the strengths and weaknesses of the hardware in order to assess better the final performance of this application

2.1 HW specs

The t1040 platform hosts a quad core processor and targets the low-end sector through its price accessibility and low power consumption. The e5500 cores are based on the Power architecture, have a maximum frequency of 1.4Ghz and host a 256KB L2 cache each.

An important feature for this application is the presence of the 3 levels of instructions: user, supervisor and hypervisor. This allows the processor to cooperate with a hypervisor, enabling hardware virtualisation and extending the application scenarios that can be run.

The RAM memory is DDR3 and the platform supports a maximum throughput of 1600MT/s. DMA is dual four channel

TODO:

reread the above paragraph

On the connectivity side, included are 2 Serial ATA(SATA 2.0) controllers, enhanced secure digital host controllers (SD/MMC/eMMC), 2 USB2.0 ports with integrated PHYs, 4 PCI-express ports, controllers for NAND and NOR flash memory and 4 UART ports.

TODO:

Poate e mai bine ca lista??

The networking connectivity includes 5 Gbps Ethernet MAC ports (with support for SGMII and QSGMII interfaces) and a hardware Gigabit Ethernet switch with 8 ports.

TODO:

Spune de specificatiile placii wireless

2.2 General arch details

Being a Communications Processor T1040 offers facilities for speeding up packet analysis, classification and distribution, by offloading them in hardware. Also present are Buffer Managers and Queue Managers for handling frames in hardware, before they get sent for processing.

TODO:

cred ca e mai bine pe lateral, pusa pe o pagina intreaga

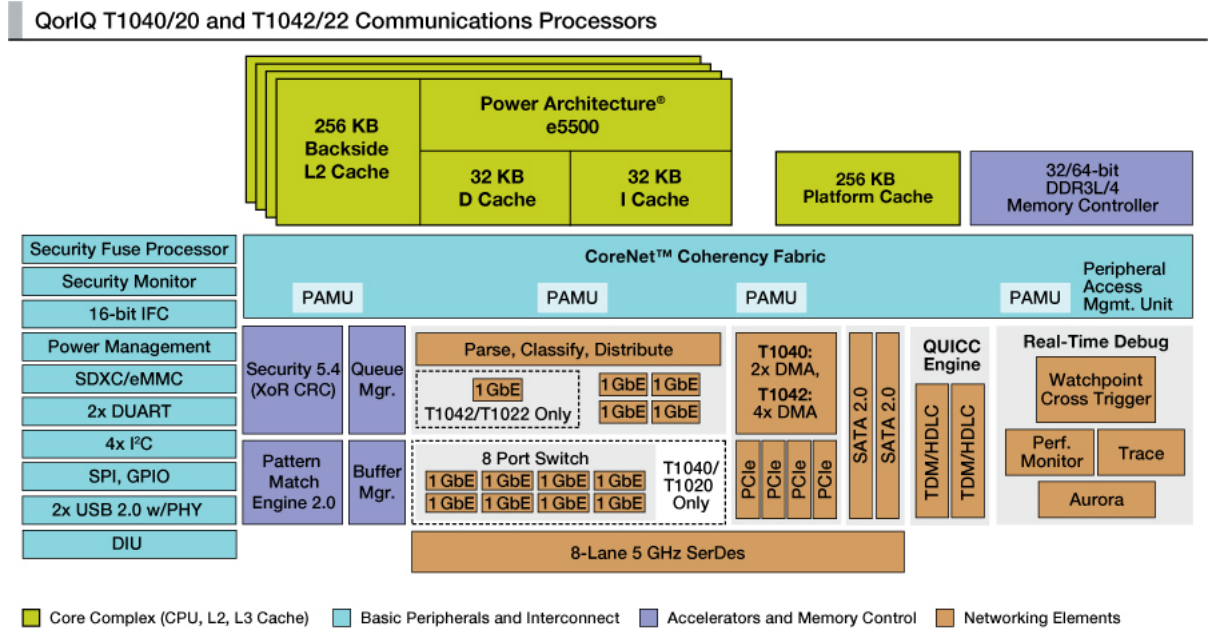


Figure 2.1: T1040 diagram

As soon as a packet enters through the physical interface it gets handled by a Frame Manager. The Frame Manager is responsible for having pre-allocated frames for the incoming packet. This is where the Parse, Classify, Distribute step takes place. The pattern matching is done by a configurable HW engine. Based on the analysis, the packet is then classified and handed to the Queue Manager. The Queue Manager can set affinities for different types of traffic, allowing to send all packets of a type to preset processor

We can also have citations like [1].

2.3 Why is it good for what we need

The presence of a Frame Manager, PCD(Parse, Classify, Distribute) engine and encryption/decription engine means that an important part of the operations done by a router, for example static forwarding, blocking ports and filtering traffic can be done by the hardware.

All this hardware offloading capabilities of this platform helps save important CPU cycles allowing it to maintain higher transfer rates with with less CPU load, leaving more capabilities for the applications running on the machine.

These advantages recommend the platform for this type of application.

Chapter 3

Features

TODO:
Capitolul este complet, dar continutul trebuie extins

This chapter presents the different functionalities of the router. Some of them are basic, while some of them are more advanced. The basic features are needed in order for it to function as a router, while the advanced ones showcase some interesting applications that can be housed and run on this router.

3.1 Basic functionality

These functionalities are needed by the application in order to function as a router. They are provided by almost all the commercial routers, therefore they can not be absent.

3.1.1 LAN network with switching

One of the basic characteristics of a router is being able to function as a switch. Software solutions, while being cheaper and more versatile in configuring, have a lot to suffer when it comes to intense packet crunching. This is why HW switches are preferred.

The integrated hardware switch provides 8 LAN ports and the chip is able to handle the packets up the Line Rate of 1Gbps.

3.1.2 Wireless network

Included in the router is a wireless network that complies with the IEEE 802.11n standard.

TODO:
mai spune ceva?

3.1.3 Wireless security and authentication

Limiting access to the wireless network is done in software by hostapd, through the WPA2 protocol.

3.1.4 Wireless + LAN bridge

LAN and Wireless are bridged forming a single address space. This choice was made for the sake of simplicity, although it has a downside. Switching between LAN and the Wireless network is limited in speed compared to switching just between the LAN ports

3.1.5 HW/SW routing

Routing is the core of the application. It can be done both in HW and SW.

Routing using the hardware means configuring the Frame Manager to intercept certain types of traffic / addresses, to bypass verification by the kernel and send them directly to a specified port. While it is a bit rigid and harder to configure, it can provide a very important speed boost over SW routing.

3.1.6 NAT

TODO:

Oare trebuie explicat ce este NAT??

Network address translation is done in software, through iptables.

3.1.7 SW services

Among the basic software services there is a DHCP server, responsible for servicing the LAN + Wireless.

Port forwarding thorough iptables.

TODO:

oare NAT merge pus tot aici?

3.1.8 Easy administration using Webmin

TODO:

da linkuri si explica mai bine ce e Webmin

Webmin is an open source project that provides a web-based interface for system administration for Unix. Using any modern browser one can setup user accounts, Apache, DNS and change everything you want about the administrated machine.

Using Webmin administrators don't need to connect phisically to the machine and manually edit configuration files. It also provides support for scripts, a shell and has a modular construction, making it easy to extend, limit the functionalities of the client.

All administration is done through Webmin.

3.2 Advanced functionality

These features are not critical in order for the machine to run as a router, but provide powerful additions to the range of applications the machine has.

3.2.1 HW/SW firewall

The router has firewalling capabilities in software, through iptables. It also has the ability to configure the HW in order to limit specific IPs, block ports and filter incoming traffic.

3.2.2 Demilitarized partition

For improved security, the router features two different virtual machine partitions: the Master partition, which controls 3 of the 4 CPU cores and all the HW, and a Demilitarized partition (DMZ), which controls just one CPU core.

This DMZ partition can be compromised without losing data, or contaminating the entire machine. It can be easily rebooted and restored without rebooting the whole router. The root filesystem is loaded from flash, but it can be loaded restored from an virtual machine image as well.

It has a range of applications, for example hosting webservers and it's completely isolated.

3.2.3 SW services

Installed on the DMZ partition is a lighttpd server that serves static content. It's just an example of the application that can run securely, without impacting the router's overall performance

Chapter 4

Architecture

This is just a demo file. It should not be used as a sample for a thesis.

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4.1 ?????

Chapter 5

Usecases

This is just a demo file. It should not be used as a sample for a thesis.

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5.1 Use 1

5.2 Use 2

5.3 Use 3

5.4 Use 4

5.5 Use 5

Chapter 6

Conclusions

Bibliography

- [1] International Organization for Standardization. Iso/iec 26300:2006 open document format.
http://std.dkuug.dk/keld/iso26300-odf/is26300/iso_iec_26300:2006_e.pdf, December 2006.