MikroTik

Router Architecture Evolution

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Router Architecture ????

Router ??

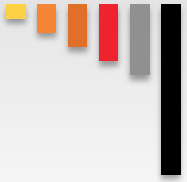
- Apakah Router sebuah komputer ?
- Router menggunakan komponen apa saja ?
- Apakah Router memerlukan spesifikasi yang tinggi ?
- Router yang seperti apa yang paling ideal?

First Router !!!
ARPANET (DARPA)

Honeywell DDP-516

16bit Minicomputer
2.5 – 5MHz Processor

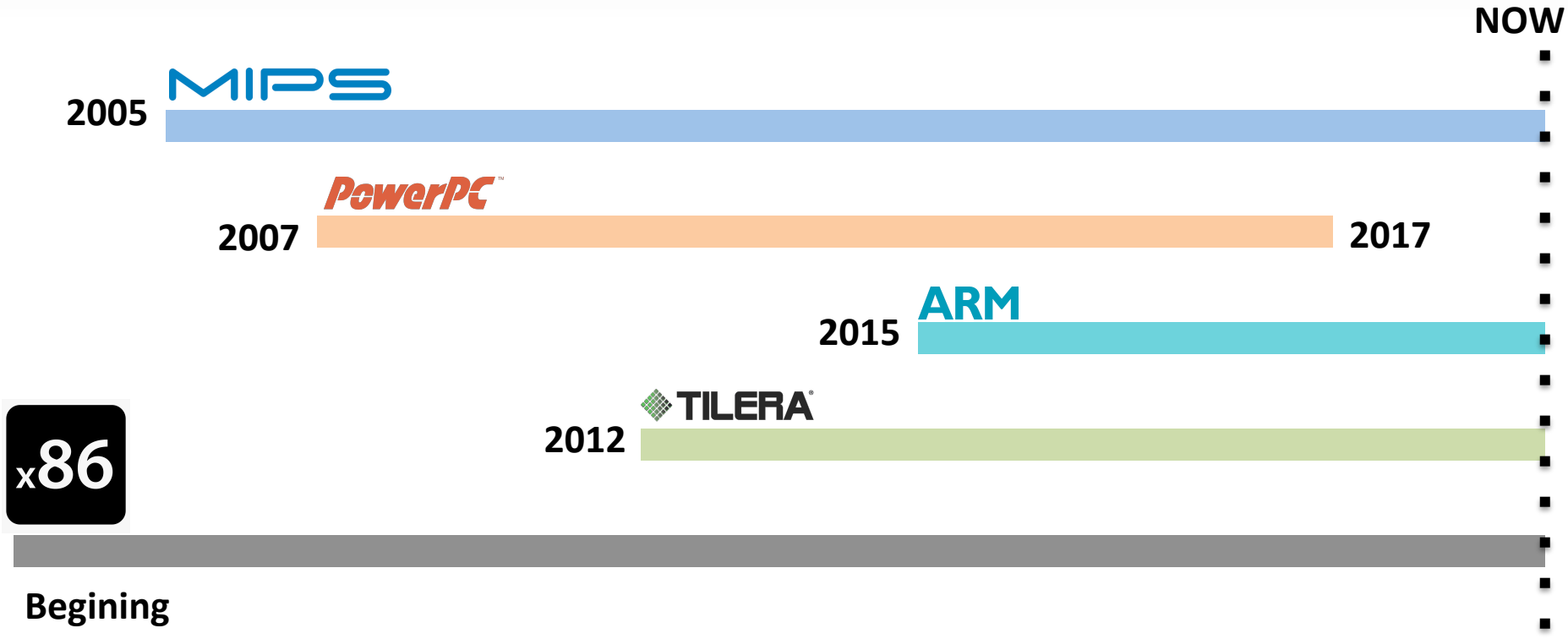
54KG – 475Watt
(1969 – 1989)



Router Architecture

- Router adalah sebuah “networking device”
  - Passing traffic by routing decision
- Saat ini Router menjelma menjadi “multi purpose device”
  - Monitoring, server, bandwidth limiter, firewall, iot dll
- Semakin banyak fungsi yang dibutuhkan, semakin menuntut kinerja router terutama dari processor yang tertempel di router.
- Mikrotik menggunakan berberapa CPU Architecture yang berbeda untuk bisa mengakomodasi kebutuhan berbagai macam fungsi yang ada di RouterOS.

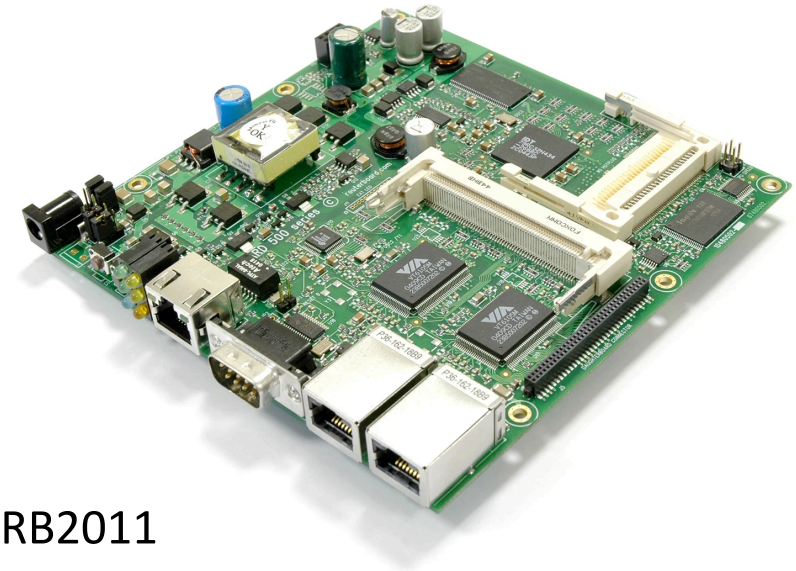
RouterBoard TIMELINE



MIPS Architecture

Introduced	**1981**
Design Architecture	**RISC**
Instruction Set	**32bit/64bit**
Multicore support	**Yes**
Core	**1 Core – 4 Core**
Clock Speed	**233MHz - 680MHz**
Cache Memory	**16KB - 64KB L1 Cache**
	64-256KB L2 Cache
Power Consumtion	**4W – 10W**

RB532



- First Product : RB532
- Current Active Product :hAP, hEX, LHG, RB2011
- Mikrotik Package :
  - MIPSLE(deprecated)/MIPSBE/SMIPS/MMIPS

MIPS Key Features

- "MIPS (**Microprocessor without Interlocked Pipelined Stages**), *simple and robust design ensures reliable non-stop operation*"
- Pros :
  - Low Cost ☺
  - Power-efficient
  - Compact Size
  - Simple Design
- Cons :
  - Low Interrupt capacity
  - Low Clock Speed

PPC Architecture

Introduced	**1990**
Design Architecture	**RISC**
Instruction Set	**32bit/64bit**
Multicore support	**Yes**
Core	**1 Core – 30 Core**
Clock Speed	**333MHZ - 4000MHz**
Cache Memory	**16KB - 48KB L1 Cache** **64KB – 4MB L2 Cache** **18MB – L3 Cache**
Power Consumtion	**4W – 25W**

- First Product : RB333
- Current Active Product : -
- Last Product : RB1100AHx2
- Mikrotik Package :
  - PPC

PowerPC Features

- "developed by **IBM-APPLE-MOTOROLA** in early stages for PC. **Freescale** continue the project primary use in system-on-a-chip (SoC) designs with speed ranging up to 1066 MHz, thus making them ideal for embedded applications"
- Pros:
  - Simple design
  - Bigger interrupt capacity
  - Power efficient
  - Higher FPU (Floating Point Unit)
- Cons:
  - Complex code density

TILERA Architecture

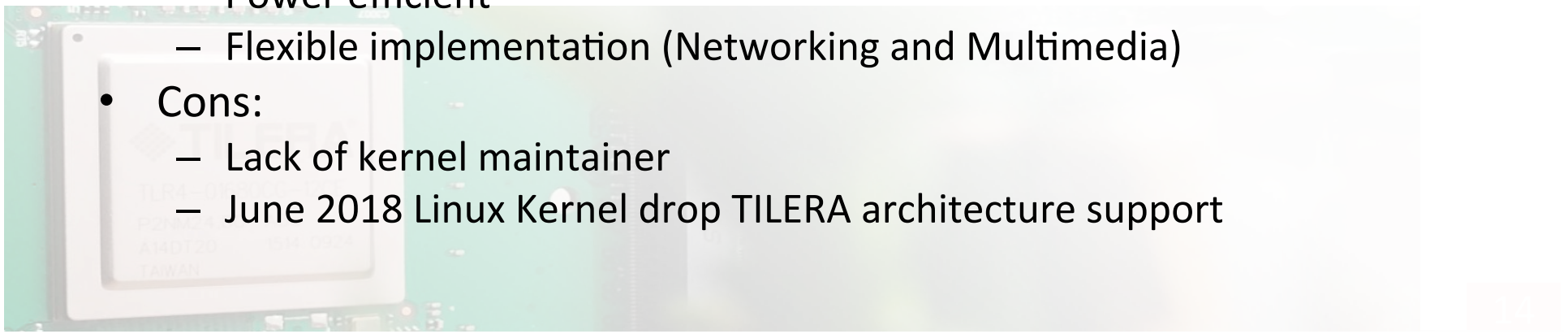
Introduced	**2004**
Design Architecture	**RISC**
Instruction Set	**64bit**
Multicore support	**Yes**
Core	**9Core – 100Core**
Clock Speed	**600MHz - 1200MHz**
Cache Memory	**32KB L1 Cache Per Core**
	256KB L2 Cache Per Core
	18MB L3 Cache
Power Consumtion	**10W - 65W**

CCR1072

- First Product : CCR1016
- Current Active Product : CloudCoreRouter series
- Mikrotik Package :
  - Tile

TILERA Features

- “developed by **MIT** since 1990. First processor released in 2007 with 64Core-TILE64. **Mikrotik** is the first Manufacturer to ship devices using this processor. Right now TILERA acquired by NVIDIA”
- Pros:
  - Individual core combined in mesh (iMesh design)
  - Scalable Lot of core
  - Power efficient
  - Flexible implementation (Networking and Multimedia)
- Cons:
  - Lack of kernel maintainer
  - June 2018 Linux Kernel drop TILERA architecture support



TILERA Implementation

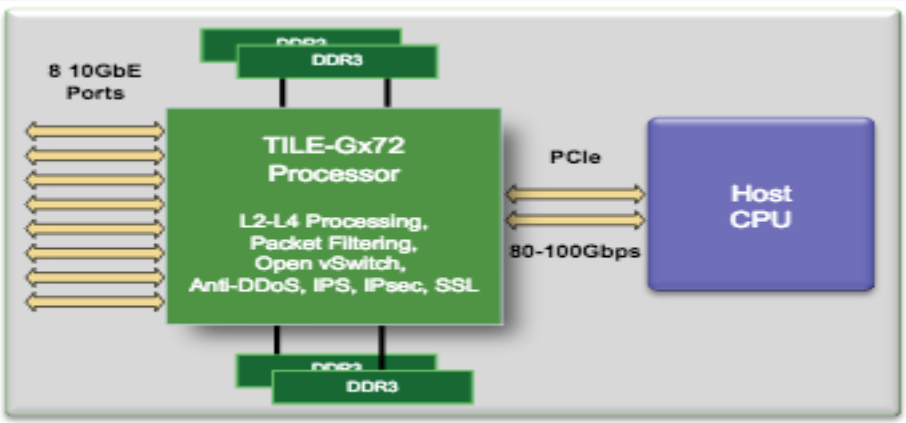


Figure 2. *High I/O "Front End" Application Processor*

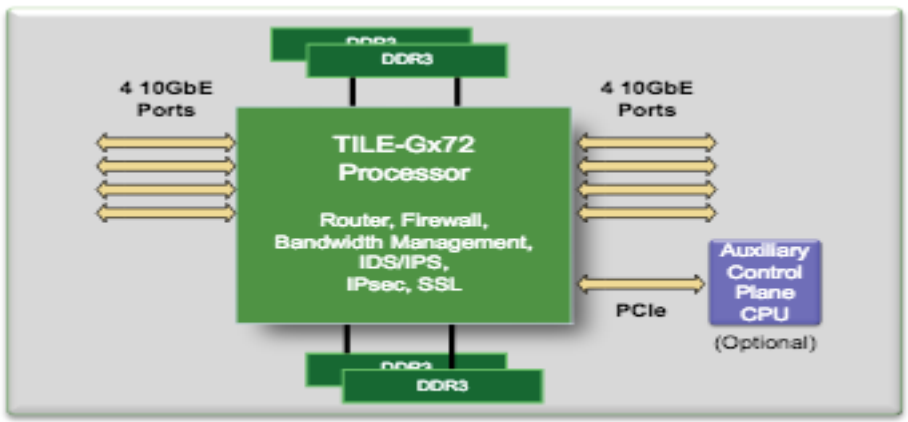
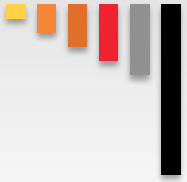


Figure 3. *40Gbps In-Line Dataplane Processor*

ARM Architecture

Introduced	**1985**
Design Architecture	**RISC**
Instruction Set	**32bit/64bit**
Multicore support	**Yes**
Core	**1 Core - 128 Core**
Clock Speed	**700MHz - 3GHz**
Cache Memory	**16KB - 64KB L1 Cache** **64-1MB L2 Cache**
Power Consumtion	**4W – 250W**

- First Product : RB3011
- Current Active Product : RB3011, RB1100AHx4, CCR2004, Audience, RB450Gx4 etc..
- Mikrotik Package :
  - ARM, ARM64



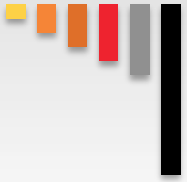
ARM Features

- "(Advanced RISC Machines) **ARM** processor become the mainstream of consumer electronic devices right now. It is because ARM has balanced performance and power efficiency "
- Pros:
  - Ideal for embedded and mobile devices
  - Flexible to develop / design your own processor
  - Power efficient
- Cons:
  - Developing software need more effort
  - Performance of the Processor depend on the software
  - Software compatibility

X86 Architecture

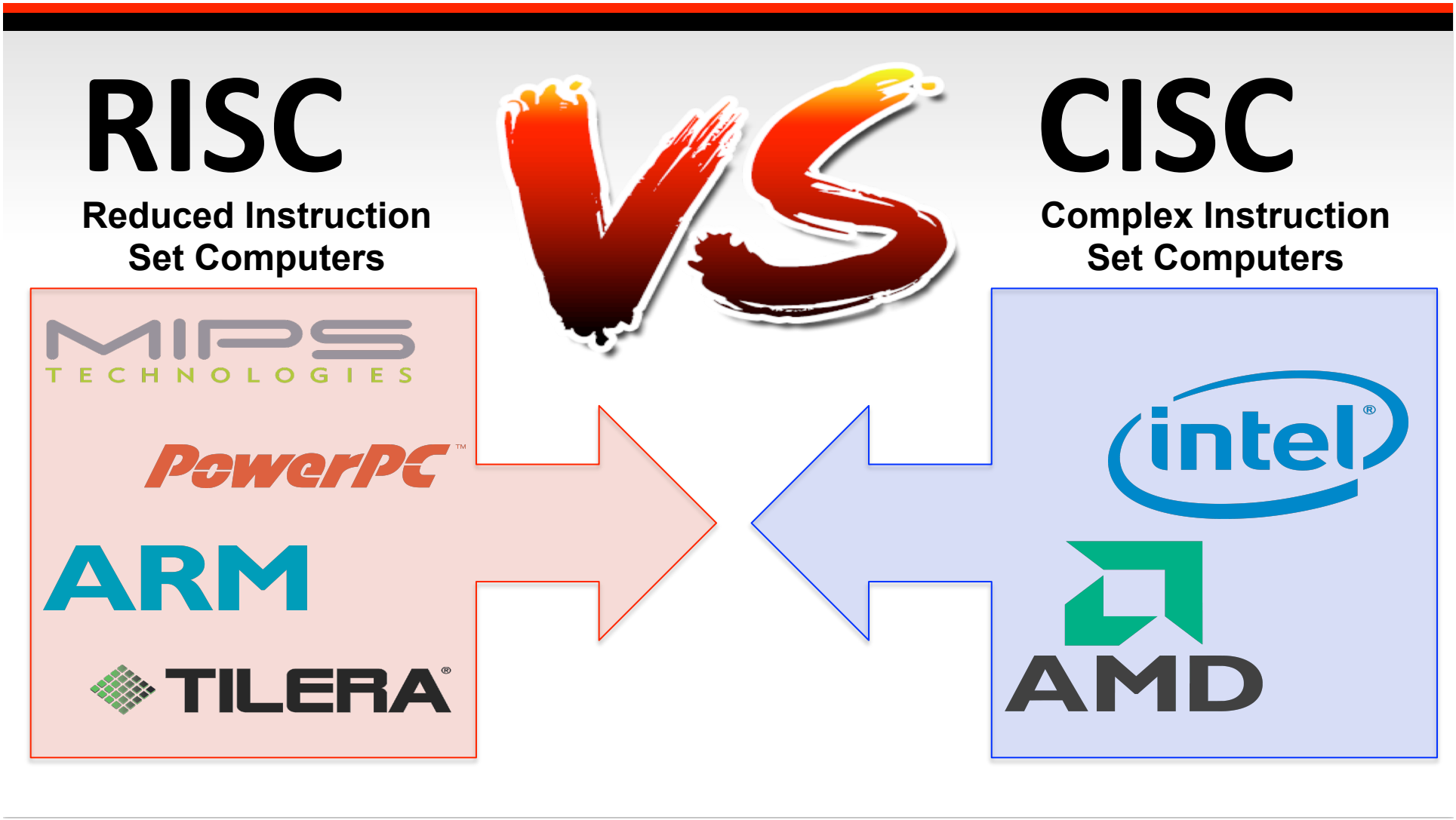
Introduced	**1978**
Design Architecture	**CISC**
Instruction Set	**32/64**
Multicore support	**Yes**
Core	**2 Core - 64 Core**
Clock Speed	**1000MHz - 4GHz**
Cache Memory	**64KB L1 Cache / Core**
	6MB L2 Cache
	64MB L3 Cache
Power Consumtion	**10W – 255W**

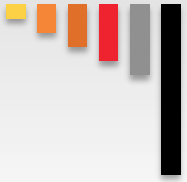
- First Product : RB230
- Current Active Product : -
- Mikrotik Package :
  - x86



X86 Features

- “x86 is one of the oldest microprocessor architecture, Intel and AMD really serious to developing this architectures”
- Pros:
  - Fast development and lot of kernel maintainer
  - Multi purpose
  - Easy upgrade and maintenance
- Cons:
  - Power hungry
  - License of the architecture for developing your own processor. (x86 – Intel, x86-64 – AMD)
  - expensive


RISC
Reduced Instruction Set Computers
VS
CISC
Complex Instruction Set Computers
MIPS TECHNOLOGIES
PowerPC
ARM
TILERA
intel
AMD



RISC vs CISC

- **RISC**
  - Emphasis on hardware
  - Includes multi-clock complex instructions
  - Small code sizes, high cycles per second
  - Transistors used for storing complex instructions
- **CISC**
  - Emphasis on software
  - Single-clock, reduced instruction only
  - Low cycles per second, large code sizes
  - Spends more transistors on memory registers

Mikrotik Product (RouterBoard)

- Mikrotik menggunakan hampir semua architecture yang ada sekarang untuk mengadopsi fungsi-fungsi yang ada di RouterOS yang makin lama semakin banyak.
  - MIPS – 113 type
  - PPC – 0 type
  - ARM – 48 type
  - TILERA – 10 type
  - X86 – masih dimaintain sebagai software package

- Terdapat pergantian architecture pada satu seri.
  - RB1100AH series, RB450 series

Kenapa ?

Terdapat berbagai alasan kenapa Mikrotik mengunakan beberapa architecture pada produk hardware nya:

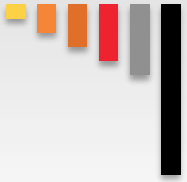
- Sesuai dengan kebutuhan implementasi perangkat
- Perkembangan teknologi dan fitur yang ada di RouterOS
- Harga menjadi pertimbangan paling penting
- Teknologi processor terkadang sudah ketinggalan jaman

Clock Speed VS Multi Core

Clock Speed VS Multi Core

- Which one do you need ?

- RouterOS v7 - List of tasks that can be split in Multicore:
  - Handling of "print" command
  - Entire OSPF protocol handling
  - Entire RIP protocol handling
  - Static configuration handling
  - Routing Policy configuration
  - BGP connections and configuration handling
  - BGP receive (one task per peer or grouped by specific parameters)
  - BGP send (one task per peer or grouped by specific parameters)
  - FIB update.

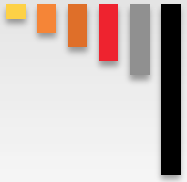


Clock Speed VS Multi Core

- “Packet filtering itself is hard to make take advantage of parallel execution because of stateful filtering and because the traffic has to be processed in order”
- “heavy operations based on per-connection processing need single-core performance, ex. Queue”
- Tidak semua fitur pada router bisa memanfaatkan multicore !

Kesimpulan

- Router Mikrotik berkembang seiring mengikuti perkembangan teknologi komputasi.
- Performance Router secara keseluruhan dipengaruhi dari hardware yang digunakan, tetapi tetap harus didukung oleh software yang mampu menunjang seluruh potensial dari hardware terebut.
- Setiap Architecture processor memiliki keunggulan dan kelemahan masing-masing



Kesimpulan

- Processor paling ideal untuk semua kebutuhan masih belum ditemukan sampai saat ini.
- Gunakan Architecture yang optimal sesuai dengan kebutuhan.

Pertanyaan ????

Terima kasih kepada :

Terima Kasih

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