

Micro-arquitetura ZEN e sua implementação no Ryzen 7

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Abstract. *This paper describes a technical analysis about the ZEN microarchitecture provided by AMD. This analysis consists on the each block of ZEN architecture and their detailed description about how it works. Furthermore, discuss what has been implemented on Ryzen 7.*

Resumo. *Esse artigo descreve a análise técnica sobre a microarquitetura ZEN desenvolvida pela AMD. Essa análise consiste na separação de cada bloco da arquitetura ZEN e sua descrição detalhada de como ela funciona. Além disso, discutir o que foi implementado no Ryzen 7.*

A arquitetura ZEN no Ryzen 7

A arquitetura ZEN é muito diferente das antigas arquiteturas da AMD, e segundo a AMD, com ela, eles conseguiram alcançar "40% IPC(Instructions per clock) speedup em relação a arquitetura do Excavator" o que nessa seção, será discutido no Ryzen 7 1700.

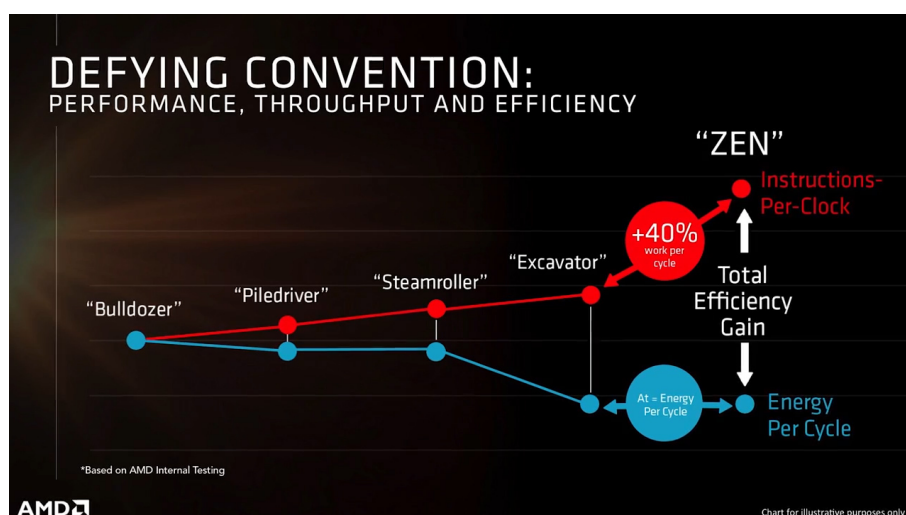


Figura 1. Comparação ZEN, fonte: AMD

É importante salientar que segundo o gráfico, houve 40% ganho de IPC e o mesmo número de energia por ciclo do Excavator, esse é um dos motivos da grande surpresa na arquitetura ZEN.

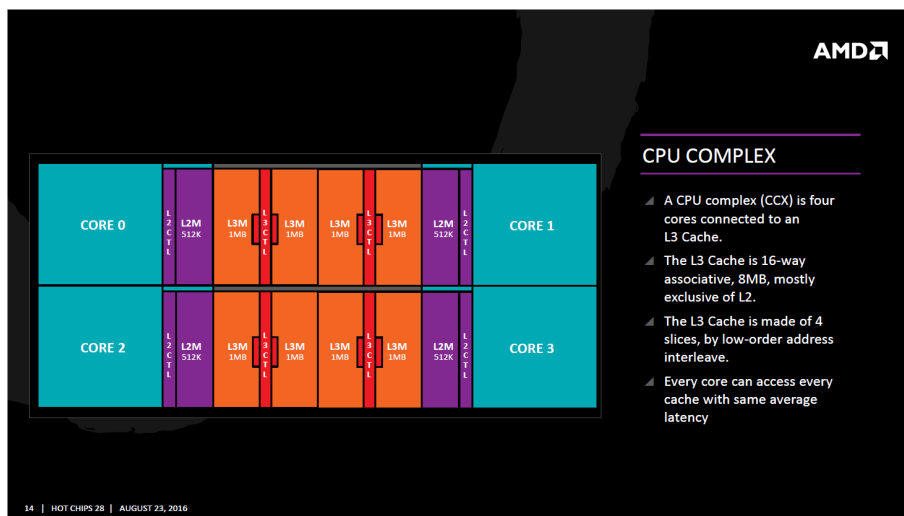


Figura 2. CPU Complex, fonte: AMD

A CPU Complex conhecida como CCX é o conjunto de núcleos da CPU. É importante ressaltar que cada CCX está conectada a uma cache L3. Sendo que, a associatividade da Cache L3 é 16-way, e que ela é feita de 4 pedaços, por low-order. E por fim, cada núcleo pode acessar cada cache como a mesma latência média.

Essa mudança foi crucial para o desempenho do Zen sobre o Excavator, na relação em que aumentou-se o número de pipelines de 4 para 6 na cache L1 e houve uma duplicação da quantidade de bits para a FMAC(fused multiply-add capability). Além disso, acrescentou-se a MMX Unit(Matrix Math Extensions), ou seja, uma unidade auxiliar para efetuar envolvendo matrizes.

O aumento da duplicação da quantidade de bits para a FMAC, possibilita o aumento da quantidade de instruções que podem ser executadas em cada FMAC. Outra modificação importante é uma instruction decoder para Inteiro e FP, que no Excavator era dividida. A unidade de decodificação é responsável, basicamente, por determinar qual instrução será executada depois que passou pelo instruction memory.

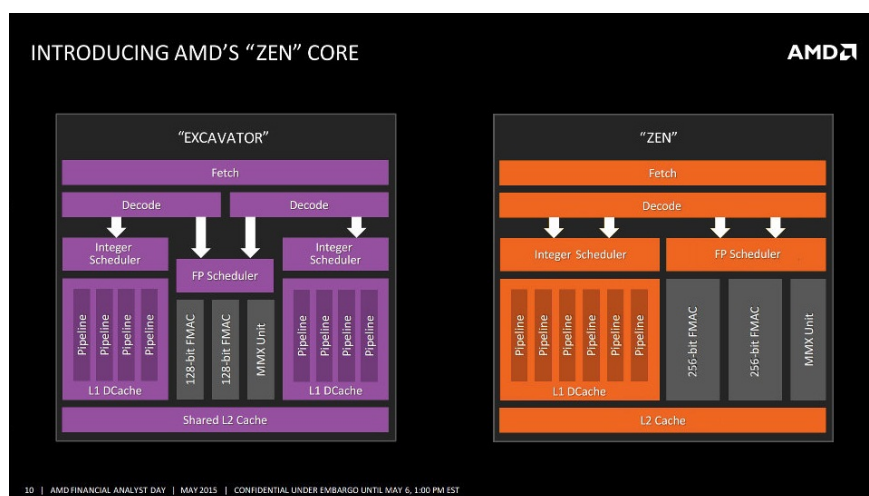


Figura 3. CPU Complex, fonte: AMD

A partir dessas informações, com o aumento da capacidade das FMACs, investimento na Cache L3 de cada CCX e o aumento do número de pipelines da cache L1, pode ocorrer que para alguns softwares o IPC do ZEN supere o IPC do Excavator.

General Information

All full papers and posters (short papers) submitted to some SBC conference, including any supporting documents, should be written in English or in Portuguese. The format paper should be A4 with single column, 3.5 cm for upper margin, 2.5 cm for bottom margin and 3.0 cm for lateral margins, without headers or footers. The main font must be Times, 12 point nominal size, with 6 points of space before each paragraph. Page numbers must be suppressed.

Full papers must respect the page limits defined by the conference. Conferences that publish just abstracts ask for **one**-page texts.

First Page

The first page must display the paper title, the name and address of the authors, the abstract in English and “resumo” in Portuguese (“resumos” are required only for papers written in Portuguese). The title must be centered over the whole page, in 16 point boldface font and with 12 points of space before itself. Author names must be centered in 12 point font, bold, all of them disposed in the same line, separated by commas and with 12 points of space after the title. Addresses must be centered in 12 point font, also with 12 points of space after the authors’ names. E-mail addresses should be written using font Courier New, 10 point nominal size, with 6 points of space before and 6 points of space after.

The abstract and “resumo” (if is the case) must be in 12 point Times font, indented 0.8cm on both sides. The word **Abstract** and **Resumo**, should be written in boldface and must precede the text.

CD-ROMs and Printed Proceedings

In some conferences, the papers are published on CD-ROM while only the abstract is published in the printed Proceedings. In this case, authors are invited to prepare two final versions of the paper. One, complete, to be published on the CD and the other, containing only the first page, with abstract and “resumo” (for papers in Portuguese).

Sections and Paragraphs

Section titles must be in boldface, 13pt, flush left. There should be an extra 12 pt of space before each title. Section numbering is optional. The first paragraph of each section should not be indented, while the first lines of subsequent paragraphs should be indented by 1.27 cm.

Subsections

The subsection titles must be in boldface, 12pt, flush left.



Figura 4. A typical figure

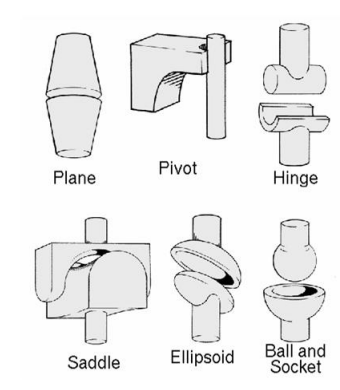


Figura 5. This figure is an example of a figure caption taking more than one line and justified considering margins mentioned in Section 6.

Figures and Captions

Figure and table captions should be centered if less than one line (Figure 4), otherwise justified and indented by 0.8cm on both margins, as shown in Figure 5. The caption font must be Helvetica, 10 point, boldface, with 6 points of space before and after each caption.

In tables, try to avoid the use of colored or shaded backgrounds, and avoid thick, doubled, or unnecessary framing lines. When reporting empirical data, do not use more decimal digits than warranted by their precision and reproducibility. Table caption must be placed before the table (see Table 1) and the font used must also be Helvetica, 10 point, boldface, with 6 points of space before and after each caption.

Tabela 1. Variables to be considered on the evaluation of interaction techniques

	Value 1	Value 2
Case 1	1.0 ± 0.1	$1.75 \times 10^{-5} \pm 5 \times 10^{-7}$
Case 2	0.003(1)	100.0

Images

All images and illustrations should be in black-and-white, or gray tones, excepting for the papers that will be electronically available (on CD-ROMs, internet, etc.). The image resolution on paper should be about 600 dpi for black-and-white images, and 150-300 dpi for grayscale images. Do not include images with excessive resolution, as they may take hours to print, without any visible difference in the result.

References

Bibliographic references must be unambiguous and uniform. We recommend giving the author names references in brackets, e.g. [?], [?], and [?].

The references must be listed using 12 point font size, with 6 points of space before each reference. The first line of each reference should not be indented, while the subsequent should be indented by 0.5 cm.