

## **RECENT ADVANCES IN COMPUTER ARCHITECTURE**

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### OUTLINE

1. In anticipation of future developments the possible architectural realization of a billion transistor chip are discussed. In particular:

(A) Single CPU Superspeculative Superscalar - **SSS**

(B) Simultaneous Multithreaded - **SMT**

(C) Chip Multiprocessor - **CMP**

(D) Intelligent RAM - **IRAM**

(E) **RAW** Processors

The properties of the above solutions are compared both qualitatively and quantitatively.

2. Introduction to explicitly parallel instruction computing (**EPIC**) and to the new Intel and HP **IA-64** architecture.

## **PROPERTIES TO BE CONSIDERED IN COMPARISON**

(1) **SPEEDUP**

If speed improvement - an advantage. If not - disadvantage.

(2) **DESIGN COMPLEXITY**

If simpler design - an advantage. If more complex - disadvantage.

(3) **PARALLELISM**

If high parallelism - an advantage. If limited parallelism - disadvantage.

(4) **RESOURCE UTILIZATION**

If high utilization - an advantage. If low - disadvantage.

(5) **ON-CHIP INTERCONNECTIONS**

If short - an advantage. If not - disadvantage.

(6) **DIFFICULTY TO PROGRAM**

If easier - an advantage. If difficult - disadvantage.

(7) **MAINSTREAM DEMAND**

If greater demand - an advantage. Otherwise - disadvantage.

(8) **AVAILABILITY OF COMPILERS**

If easily available an - advantage. Otherwise - disadvantage.

ADVANTAGES ARE ASSIGNED A WEIGHT OF +1

DISADVANTAGES ARE ASSIGNED A WEIGHT OF -1

System:	A	B	C	D	E
1.	1	1	1	-1	1
2.	-1	-1	1	1	1
3.	-1	1	1	-1	1
4.	-1	1	1	1	-1
5.	-1	-1	1	-1	1
6.	1	-1	-1	1	-1
7.	1	-1	-1	1	-1
8.	1	-1	-1	-1	-1
Total:	0	-2	2	0	0

PRIORITY ORDER: C, (A,D,E), B, (xxx) - TIE

CMP, (SSS,IRAM,RAW), SMT

RELATIVE MERIT FIGURES FOR EQUAL WEIGHTING OF THE EIGHT PROPERTIES

## WEIGHTED PROPERTIES

A WEIGHT OF 0.2 IS ASSIGNED TO:

1. SPEEDUP
5. ON-CHIP INTERCONNECTIONS.

THE OTHER PROPERTIES ARE ASSIGNED A WEIGHT OF 0.1

System:	A	B	C	D	E
1.	0.2	0.2	0.2	-0.2	0.2
2.	-0.1	-0.1	0.1	0.1	0.1
3.	-0.1	0.1	0.1	-0.1	0.1
4.	-0.1	0.1	0.1	0.1	-0.1
5.	-0.2	-0.2	0.2	-0.2	0.2
6.	0.1	-0.1	-0.1	0.1	-0.1
7.	0.1	-0.1	-0.1	0.1	-0.1
8.	0.1	-0.1	-0.1	-0.1	-0.1
Total:	0	-0.2	0.4	-0.2	0.2

PRIORITY ORDER: C, E, A, (B,D)

CMP, RAW, SSS, (SMT,IRAM)

## WEIGHTED PROPERTIES

A WEIGHT OF 0.2 IS ASSIGNED TO:

3. PARALLELISM.

7. MAINSTREAM DEMAND..

THE OTHER PROPERTIES ARE ASSIGNED A WEIGHT OF 0.1

System:	A	B	C	D	E
1.	0.1	0.1	0.1	-0.1	0.1
2.	-0.1	-0.1	0.1	0.1	0.1
3.	-0.2	0.2	0.2	-0.2	0.2
4.	-0.1	0.1	0.1	0.1	-0.1
5.	-0.1	-0.1	0.1	-0.1	0.1
6.	0.1	-0.1	-0.1	0.1	-0.1
7.	0.2	-0.2	-0.2	0.2	-0.2
8.	0.1	-0.1	-0.1	-0.1	-0.1
Total:	0	-0.2	0.2	0	0

PRIORITY ORDER: C, (A,D,E), B

CMP, (SSS,IRAM,RAW), SMT

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**WEIGHTED PROPERTIES**

A WEIGHT OF 0.25 IS ASSIGNED TO:

1. SPEEDUP
5. ON-CHIP INTERCONNECTIONS.

A WEIGHT OF 0.15 IS ASSIGNED TO:

3. PARALLELISM.
7. MAINSTREAM DEMAND.

THE OTHER PROPERTIES ARE ASSIGNED A WEIGHT OF 0.05

System:	A	B	C	D	E
1.	0.25	0.25	0.25	-0.25	0.25
2.	-0.05	-0.05	0.05	0.05	0.05
3.	-0.15	0.15	0.15	-0.15	0.15
4.	-0.05	0.05	0.05	0.05	-0.05
5.	-0.25	-0.25	0.25	-0.25	0.25
6.	0.05	-0.05	-0.05	0.05	-0.05
7.	0.15	-0.15	-0.15	0.15	-0.15
8.	0.05	-0.05	-0.05	-0.05	-0.05
Total:	0	-0.1	0.5	-0.4	0.4

PRIORITY ORDER: C, E, A, B, D

CMP, RAW, SSS, SMT, IRAM