SysteMorph: AnSoC Framework for Adaptive Dynamic Optimization Systems

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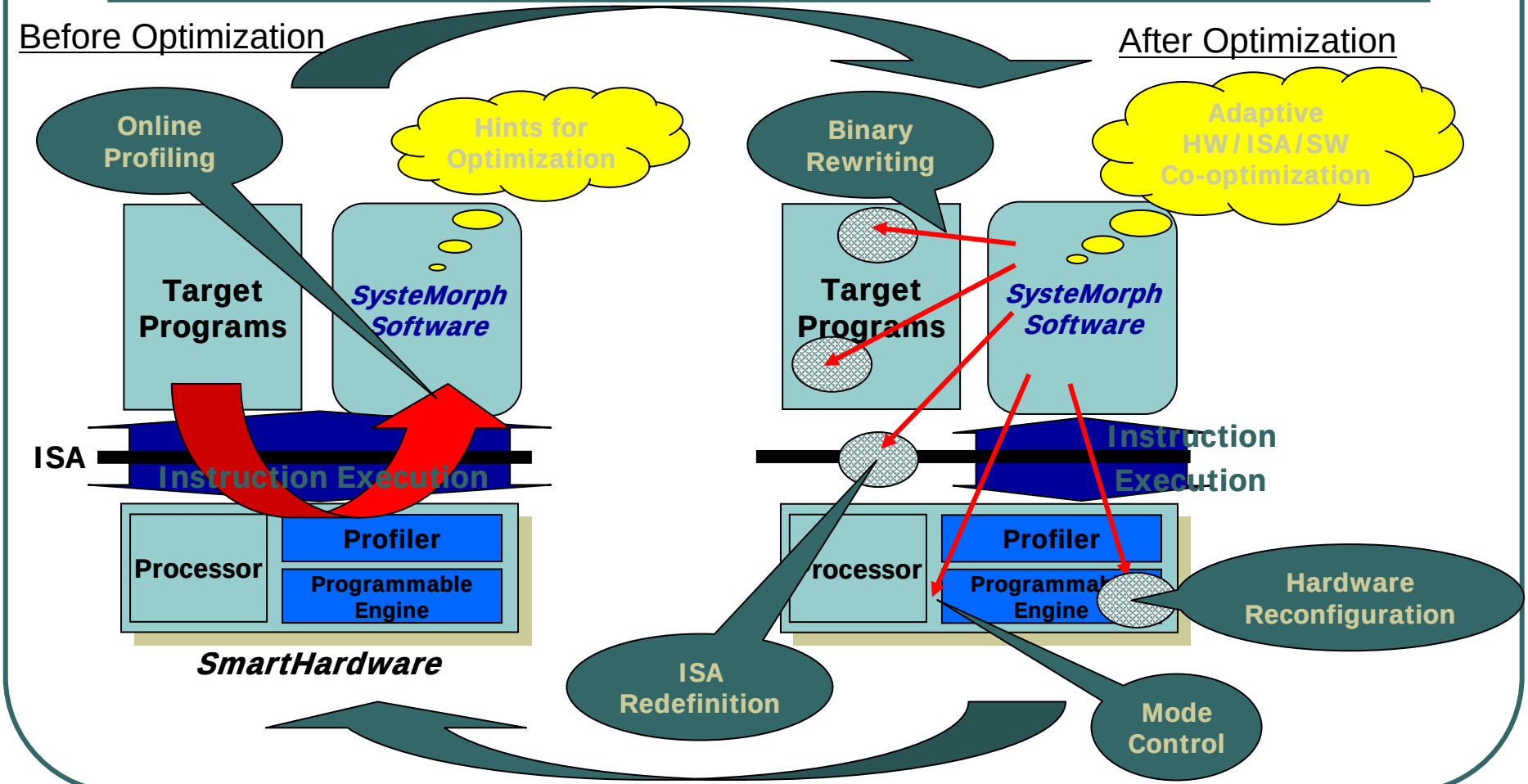
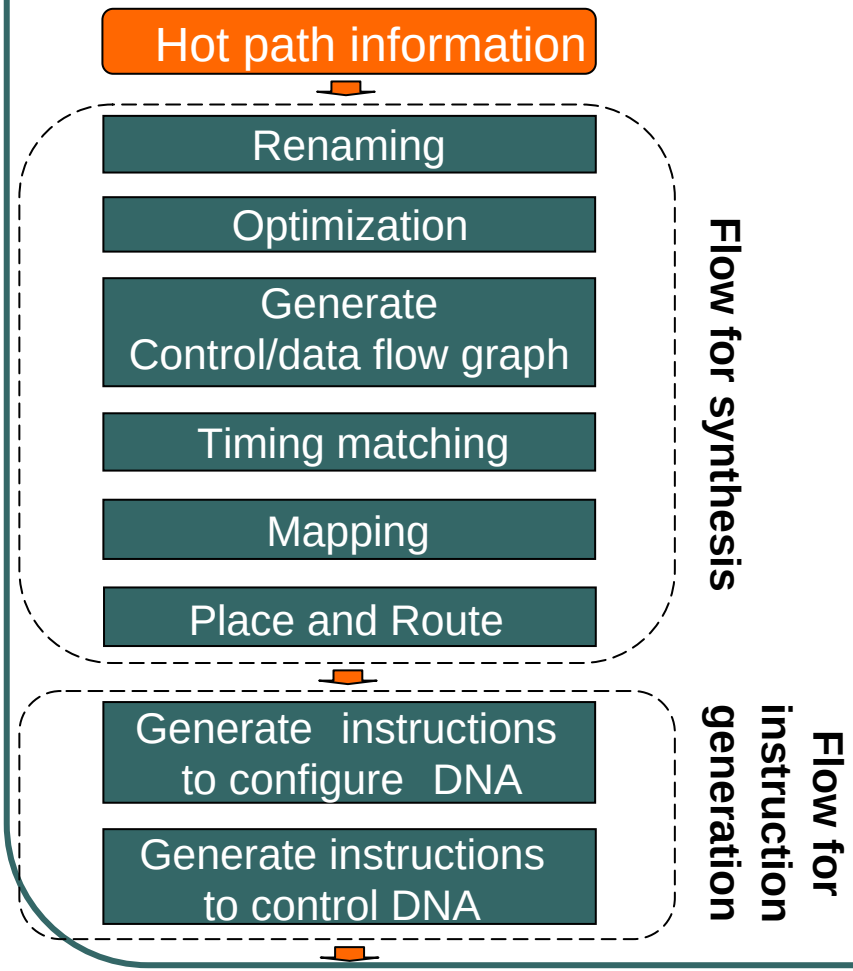
Abstract

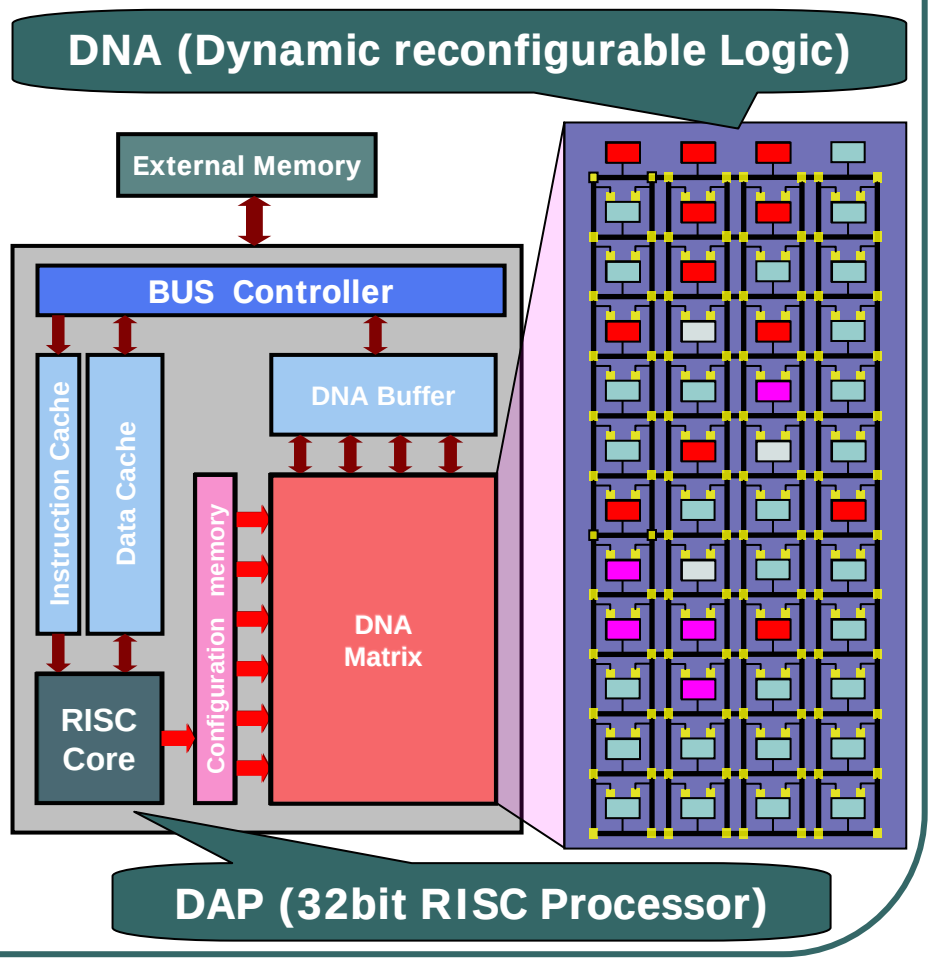
- This research investigates a possible architecture to adaptive dynamic optimization systems. In this architecture, the running application is monitored and high frequently executed parts of the code are detected. Then, these parts of code are optimized, according to the architecture of embedded hardware accelerator. To be able to use the hardware accelerator, the new binary code is rewritten. IPFlex DAP/DNA-HP was the target of our prototyping to validate the concept. The proposed architecture for SoC implementation utilizes dynamic software pipelining technique for optimization and a simplified 8-way VLIW as the accelerator. Some preliminary performance evaluations show speedup.

Concept of SysteMorph

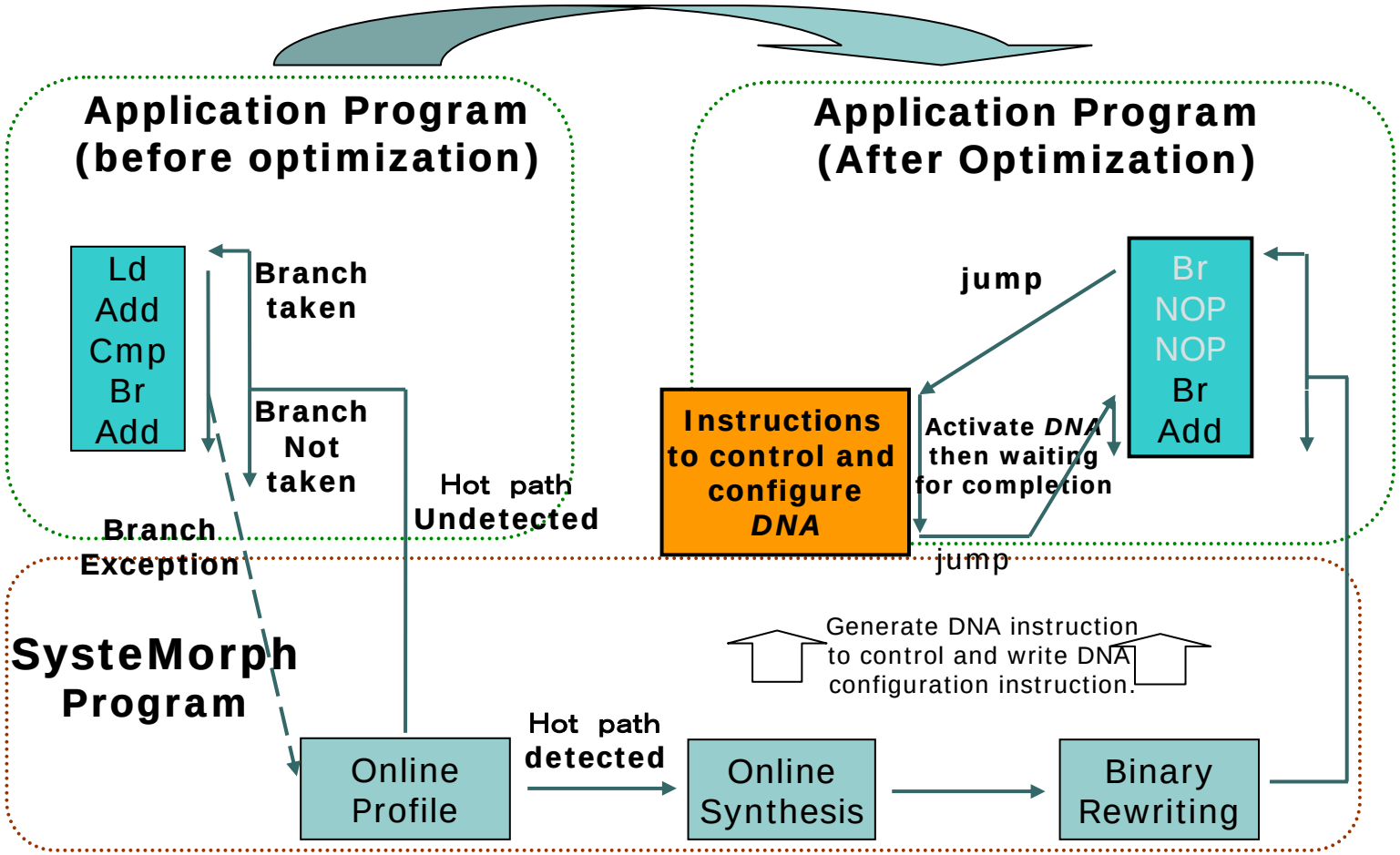


SysteMorph Synthesis Flow on DAP/DNA-HP





Execution Flow on DAP/DNA-HP



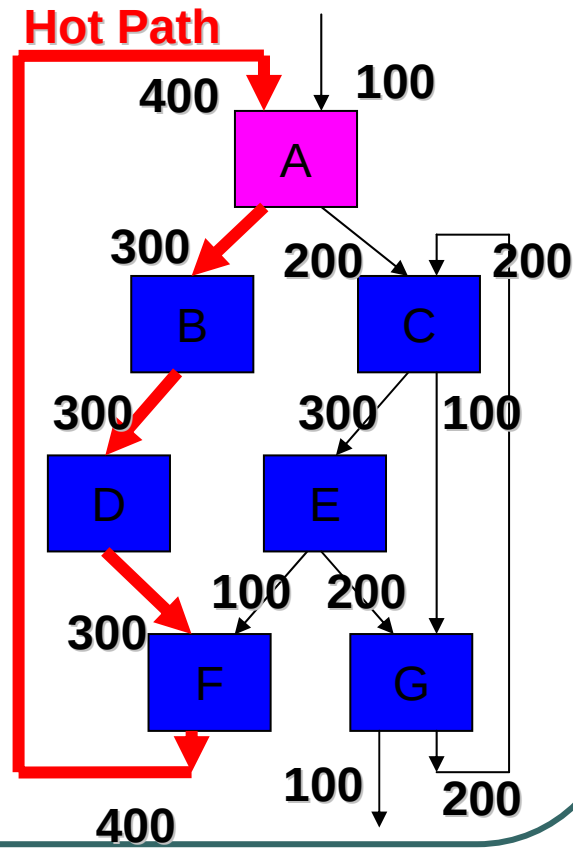
Branch History Method

- **Branch History Table**

Atop : Head Address of Basic Block **A**
Abottom : End Address of Basic Block **A**

Branch Address	Branch Target Address	Number of Branch
Abottom	Btop	300
Abottom	Ctop	200
…	…	…

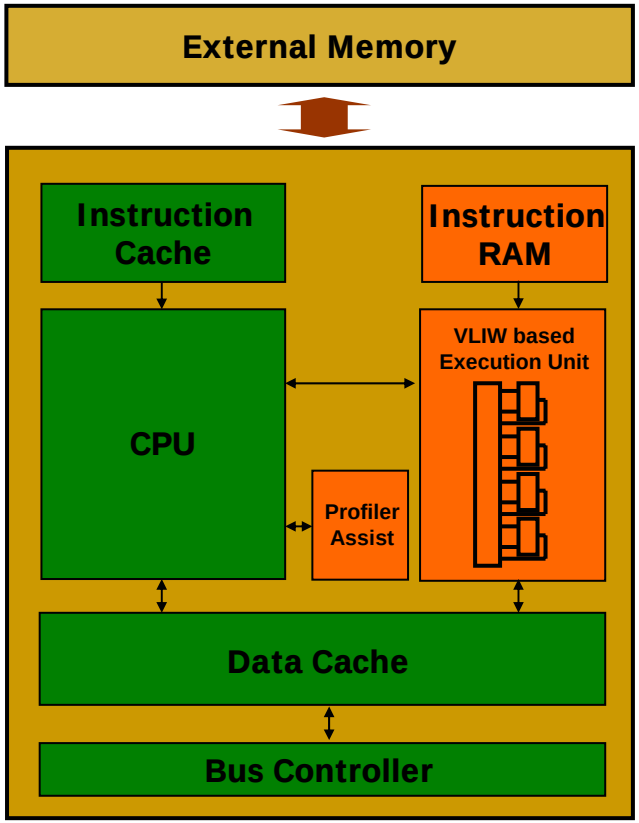
Number of Backward Branch > Threshold



- **Find Hot Path**

A path which has more frequently taken is chosen as a Hot Path.

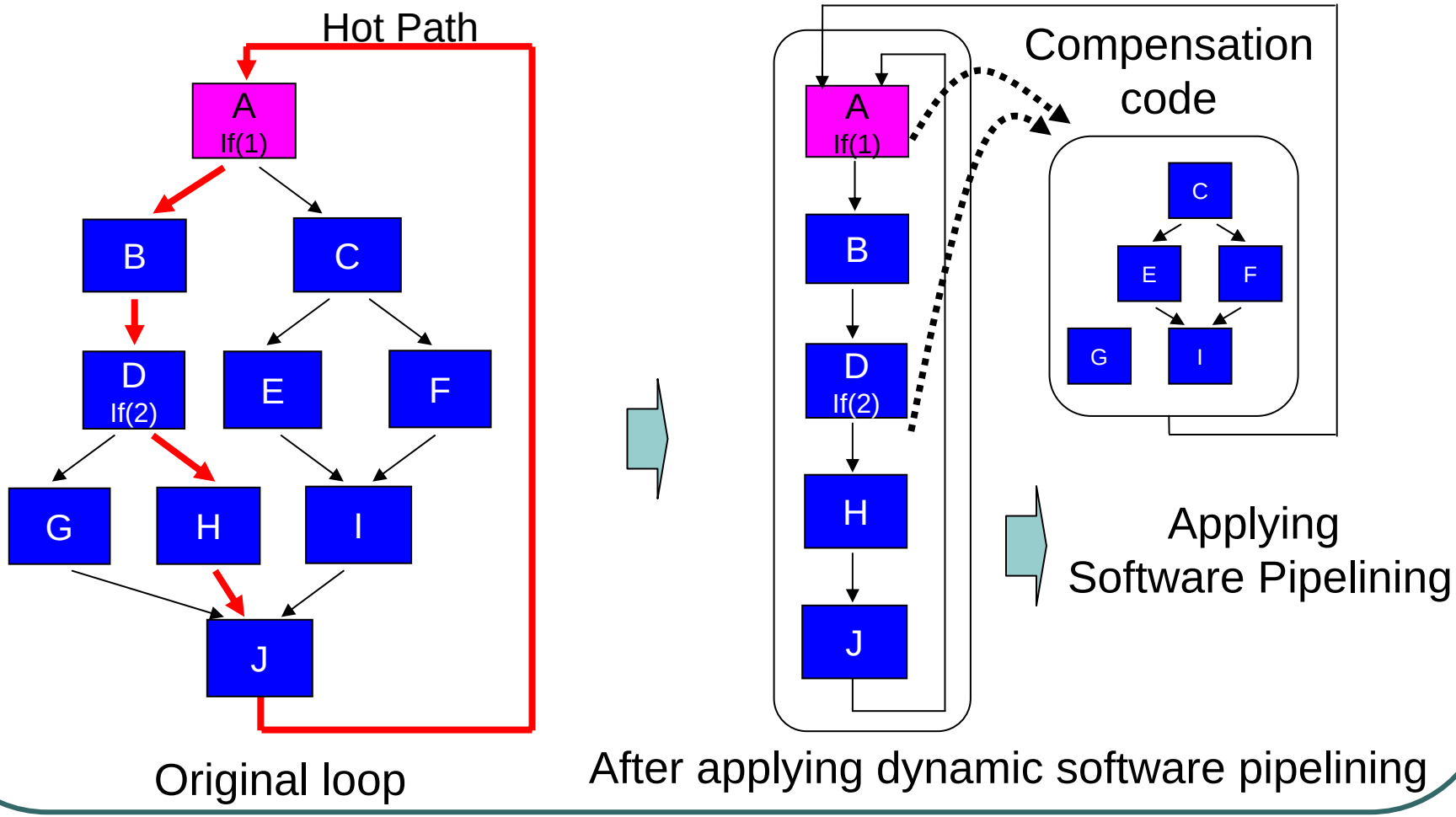
SysteMorph with VLIW accelerator



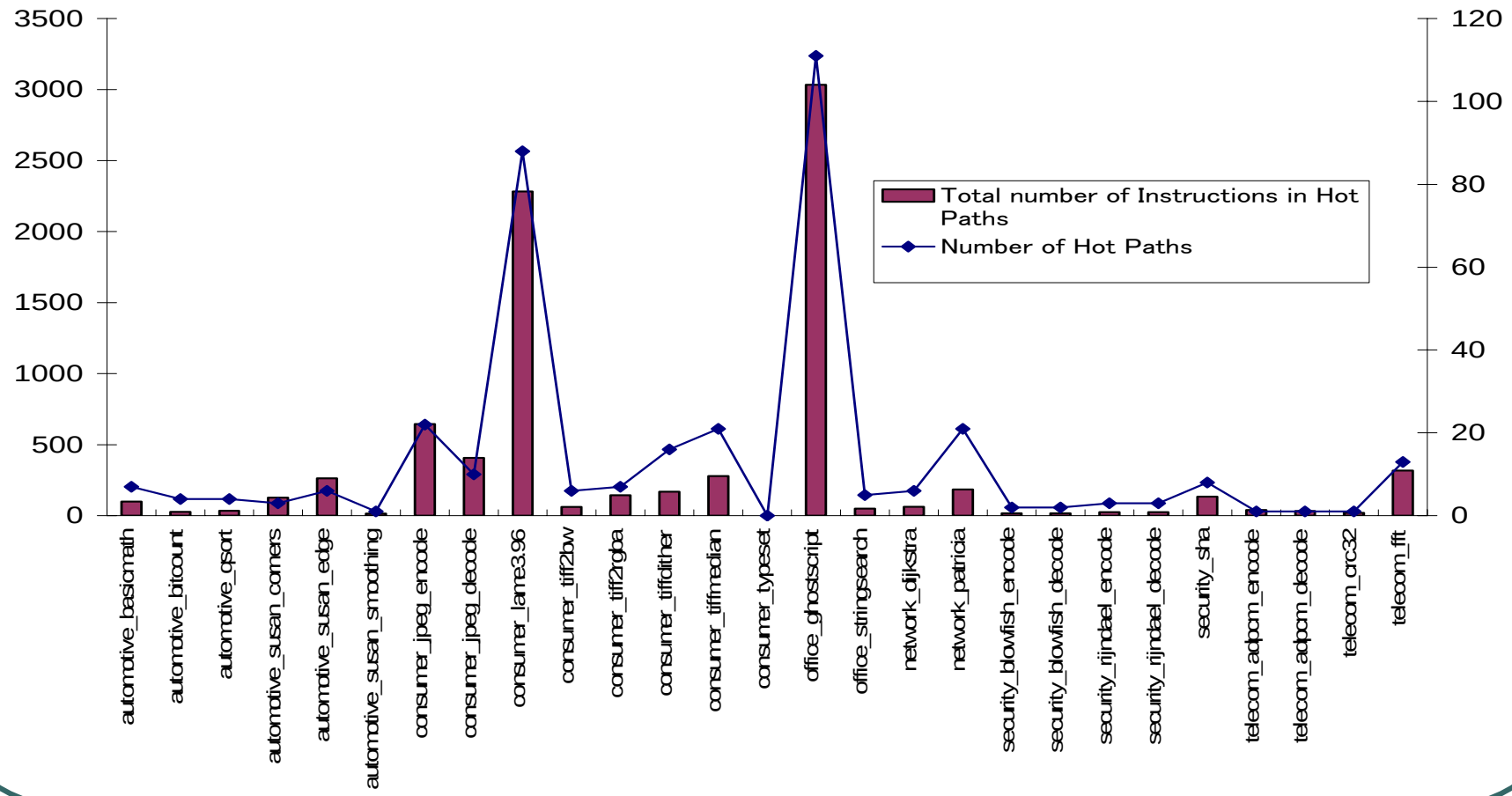
- **CPU**
  - Simple RISC processor
- **VLIW based accelerator**
  - Instruction RAM
  - Compute intensive execution unit
- **H/W profiler assist**

  Store Branch history information
  - Branch Target Address
  - Branch Instruction Address
  - Number of Taken/Not Taken

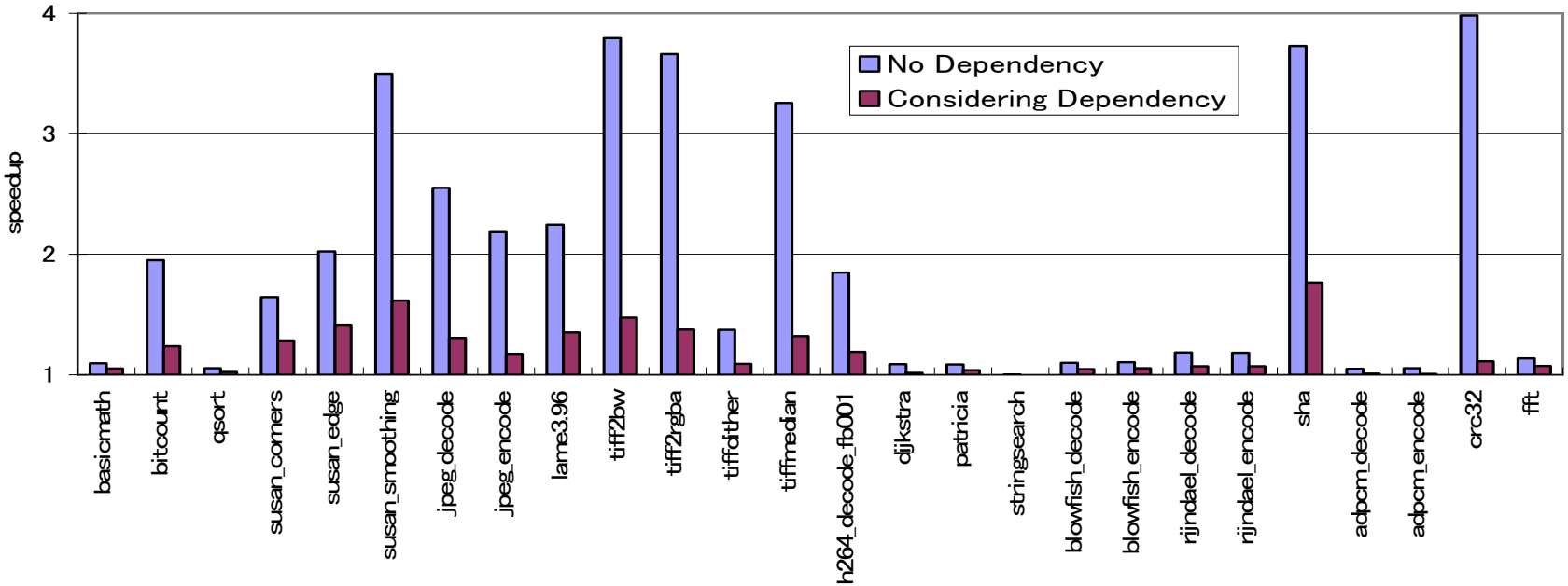
Dynamic Trace Based Software Pipelining



Hot Paths


3500
3000
2500
2000
1500
1000
500
0
120
100
80
60
40
20
0
Total number of Instructions in Hot Paths
Number of Hot Paths
automotive_basicmath
automotive_bitcount
automotive_qsort
automotive_susan_corners
automotive_susan_edge
automotive_susan_smoothing
consumer_jpeg_encode
consumer_jpeg_decode
consumer_lame3.96
consumer_tiff2bw
consumer_tiff2rgba
consumer_tiffdither
consumer_tiffmedian
consumer_typeset
office_ghostscript
office_stringsearch
network_dijkstra
network_patricia
security_blowfish_encode
security_blowfish_decode
security_rijndael_encode
security_rijndael_decode
security_sha
telecom_adpcm_encode
telecom_adpcm_decode
telecom_crc32
telecom_fft

Preliminary Performance Evaluation



	N (way)	Int	FP	Ld/St	Br
Exp. 1	4	3		1	
Exp. 2	8	3	1	3	1
Exp. 2	12	5	1	5	1