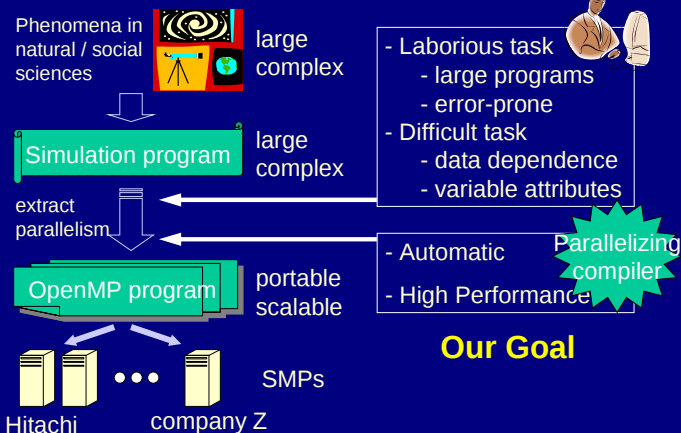


Interprocedural Analysis and Parallelization

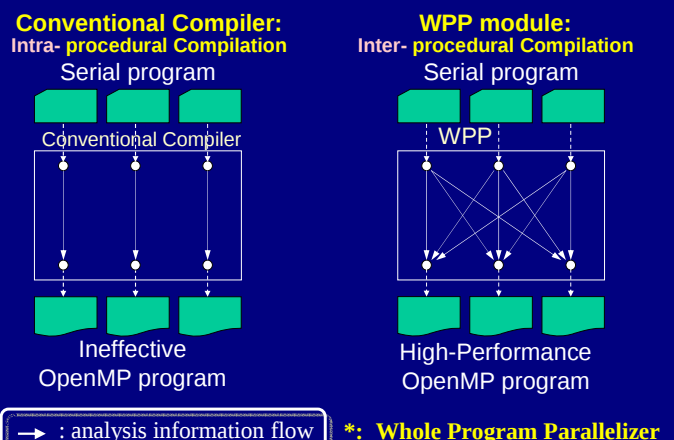
Makoto SATOH^{1,2}, Yuichiro AOKI^{1,2}, Motoyasu TAKABATAKE^{1,2}, Kiyomi WADA^{1,2},
Takayoshi IITSUKA², and Sumio KIKUCHI²

¹ APC Technology Group ² Hitachi, Ltd.

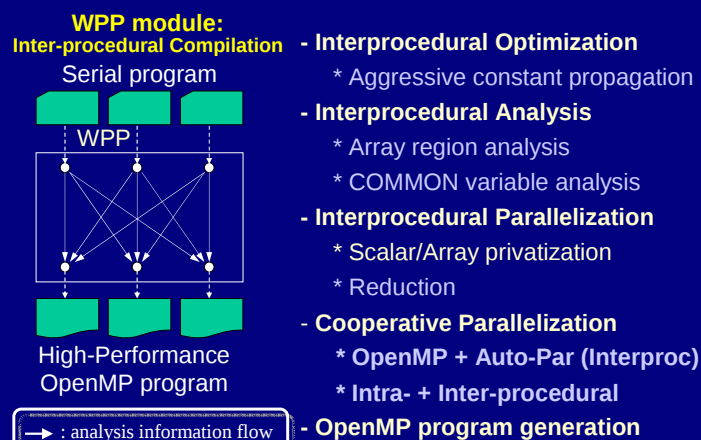
Introduction



Features of WPP*

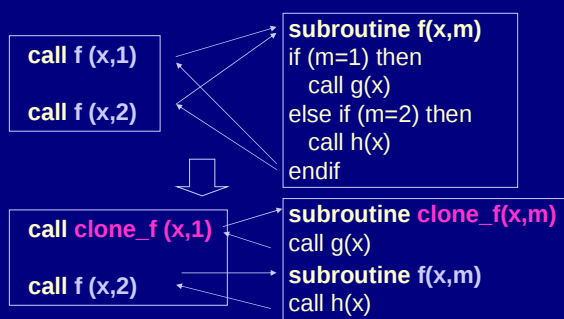


Features of WPP



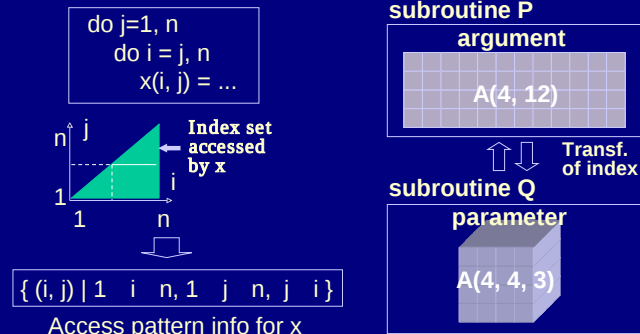
Aggressive Constant Propagation

The WPP makes clone procedures, propagates constants beyond procedure boundaries, and evaluates expressions at compile time.



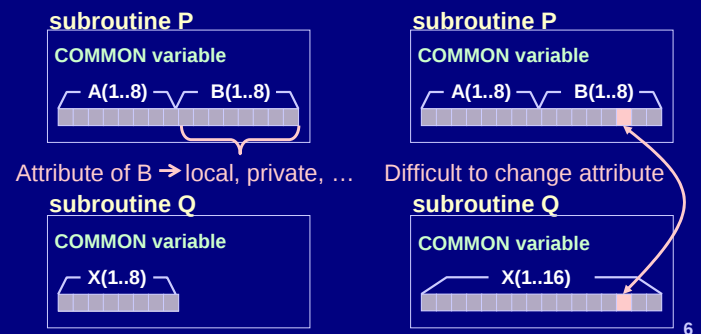
Array Region Analysis

The WPP uses a system of linear inequalities that enables the analysis of complex access patterns and complex argument-to-parameter transformation.



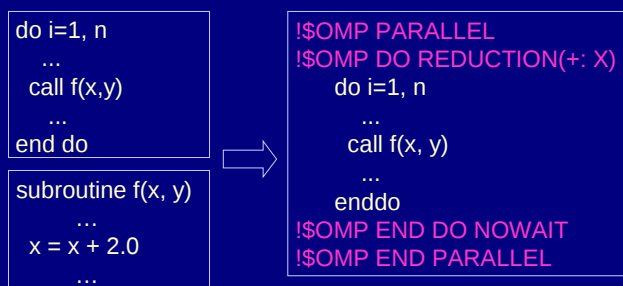
COMMON Variable Analysis

The WPP analyzes reference and alias information of COMMON variables; it can change the variable attributes at every subroutine (furthermore, at every loop).



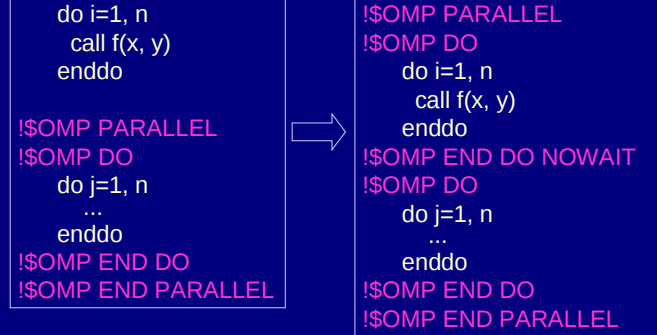
Interprocedural Parallelization

The WPP can parallelize loops including procedure calls changing variable attributes to private or reduction if necessary.



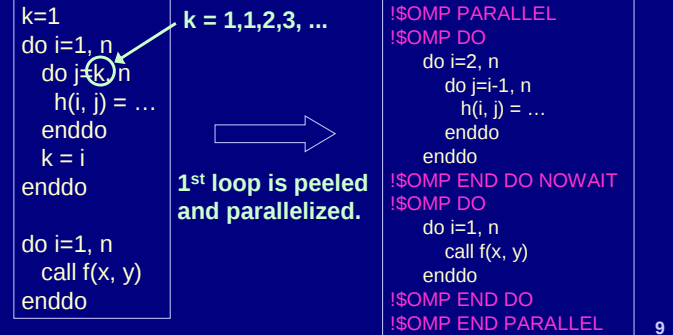
Cooperative Parallelization (1)

The WPP can parallelize both of the loops to which OpenMP is specified and the loops not specified in a program and enclose the contiguous parallel loops in a parallel region.



Cooperative Parallelization (2)

The WPP can apply inter-procedural parallelization to the loops with procedure calls and apply strong intra-procedural parallelization to the loops without them.



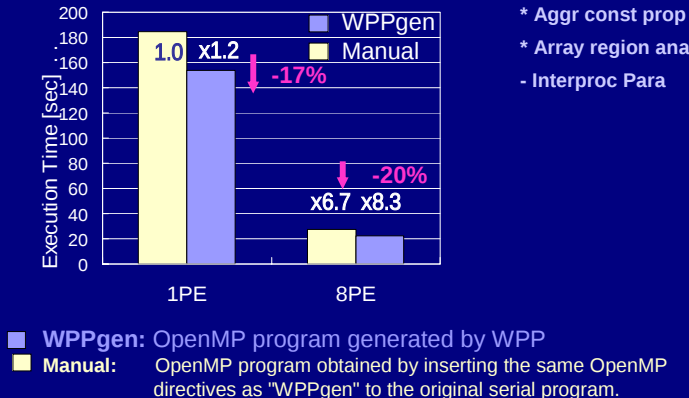
Evaluation Environment

Hitachi SR8000
CPU: Proprietary, 375MHz
Structure: SMPs (16PEs = 8PEs/node x 2 nodes)
L1: 128KB
Compiler: OFORT90 V01-04-/B

SGI® Origin® 2000
CPU: R10000®, 195MHz
Structure: DSM (32 PE= 2PEs/node x 16 nodes)
L1: 32KB / 32KB
L2: 4MB/PE
Compiler: MIPSpro™ Fortran90 Version 7.30

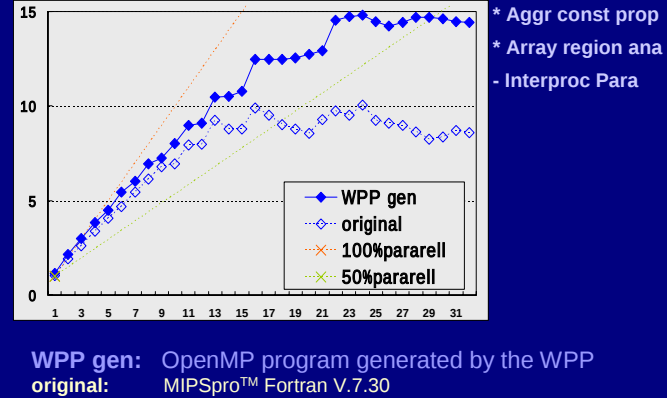
Evaluation (1)

SPEC® CFP95 / turb3d on SR8000



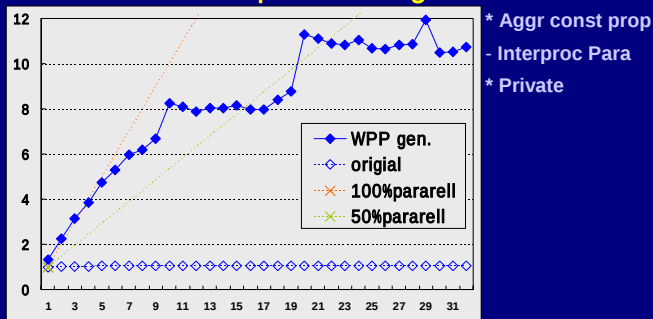
Evaluation (2)

SPEC® CFP95 / turb3d on Origin® 2000



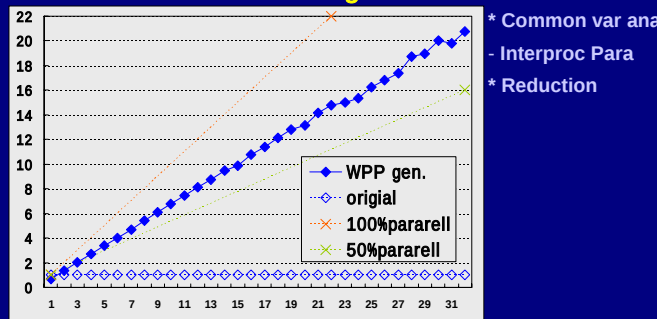
Evaluation (3)

SPEC® CFP2000 / wupwise on Origin® 2000



Evaluation (4)

NPB2.3 serial / EP on Origin® 2000



Conclusion

We have developed the WPP, Interprocedural parallelizing module in APC compiler, which

- optimizes programs interprocedurally.
- parallelizes the loops including procedure calls.
- generates high-performance OpenMP programs.

Evaluation shows its effectiveness in scientific benchmarks.

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