

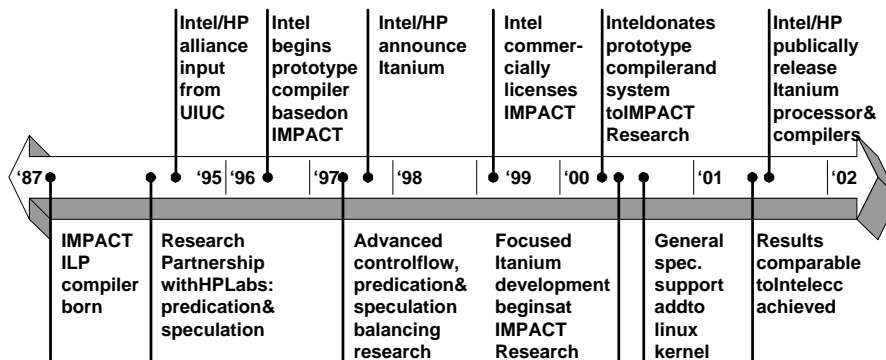
ItaniumPerformanceInsights fromtheIMPACTCompiler

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ItaniumDevelopmentHistory

Intel and Hewlett Packard



University of Illinois at Urbana-Champaign

HotChips13 August21,2001

ItaniumArchitectureOverview

- Itaniumdesigngoal:enhancescalabilityofparallelismby movingcomplexdecisionstothecompiler
 - Bundling:enablesstaticschedulingbycommunicatinginstruction parallelism
 - Predication:allowscompilertooptimizeacrossmultiplepathsby providinganalternativetocontrolflow
 - Speculationsupport:allowscompilertoselectspecificinstructions forearlyexecution

Original

ControlSpeculation

Predication

ItaniumPerformanceInsightsfromtheIMPACTCompiler **IMPACT**

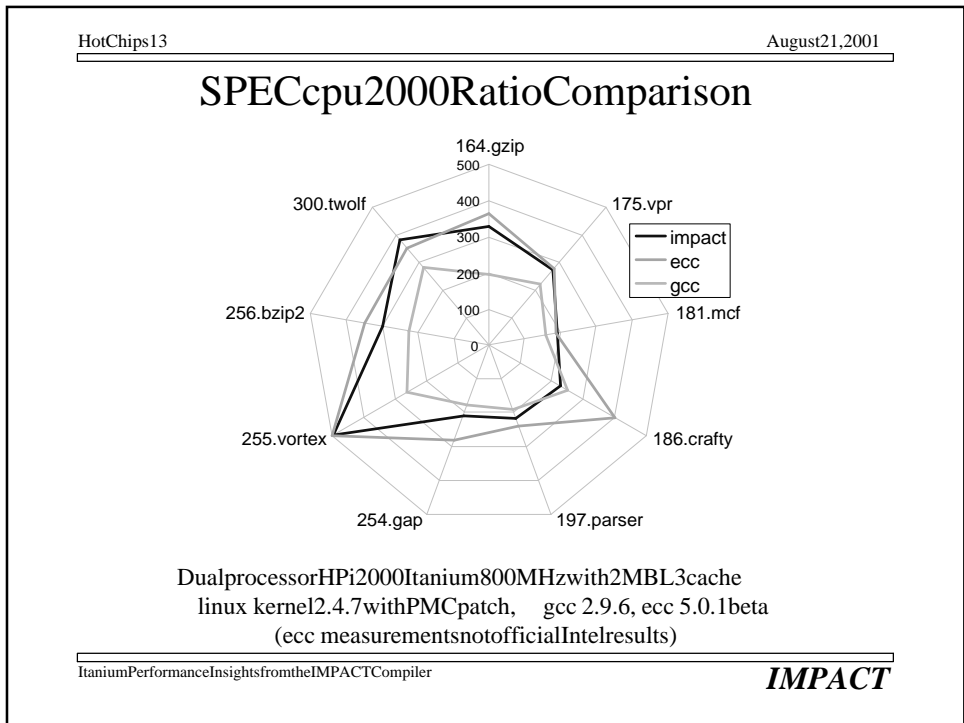
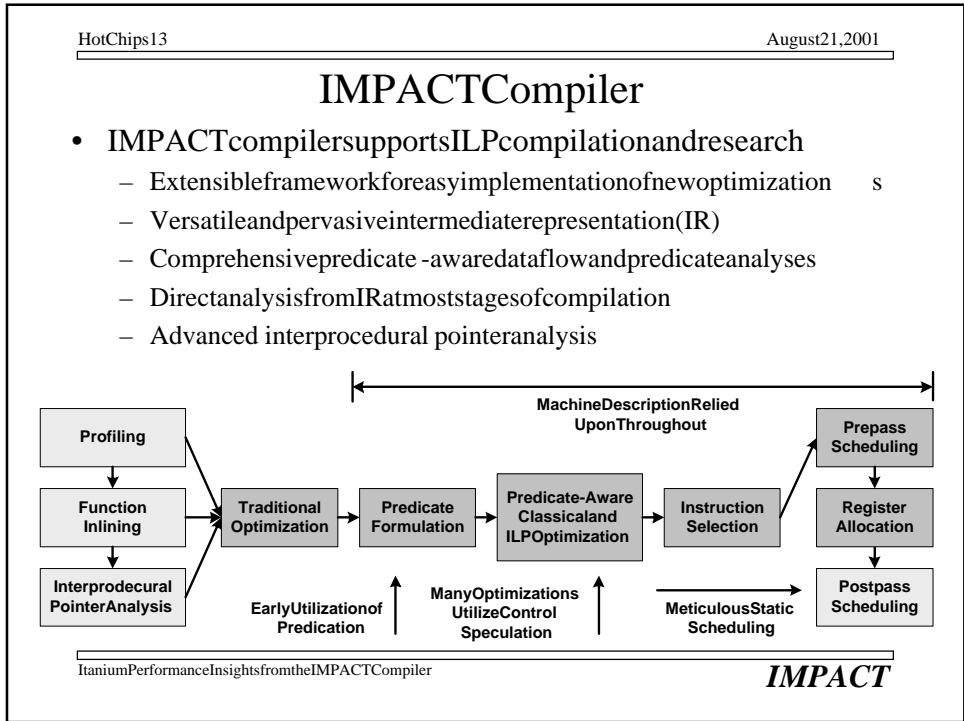
HotChips13 August21,2001

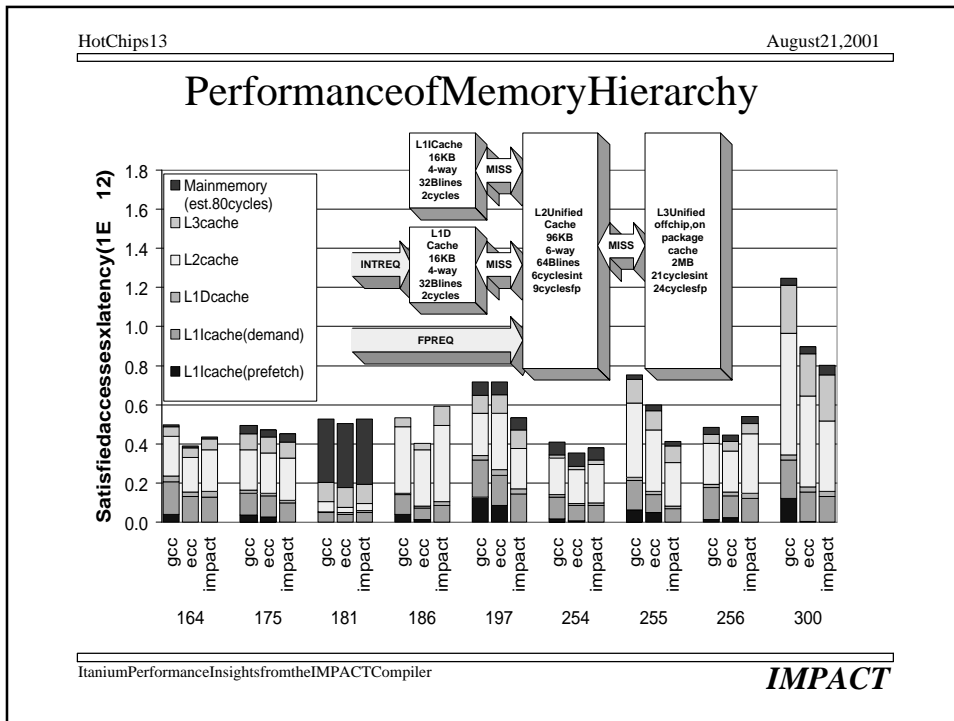
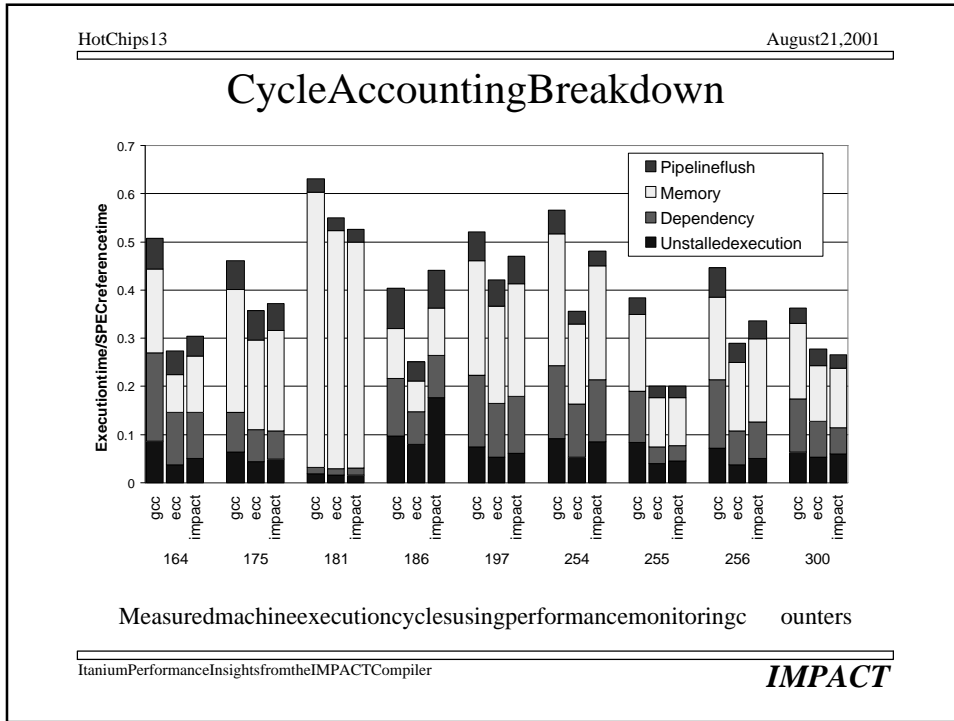
ItaniumCompilationLandscape

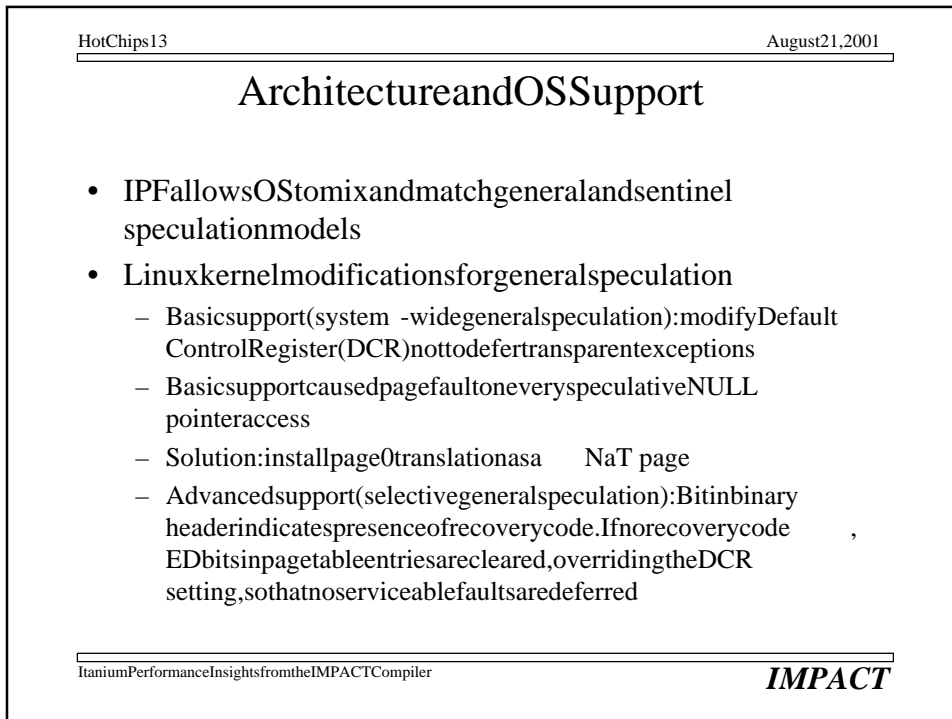
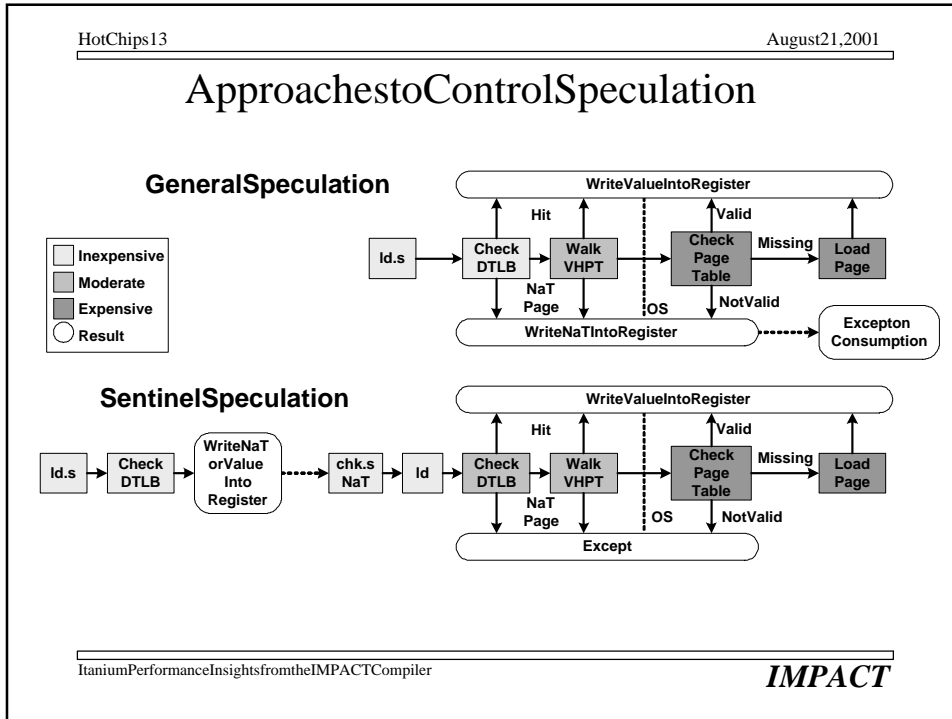
- Increasedrelianceonthecompilerforperformance
 - Explicitcontrolofthearchitecture:realitiesofmodern microarchitecture havebecomevisibleatsoftwarelevel
 - Particularproblems:effectsofruntimeuncertainty
 - Controlresolution,variablememorylatency,etc.
 - SolutionsfromEPIC/VLIWresearch
 - Memorydisambiguation,profiling
 - Staticscheduling,controlspeculation,predication

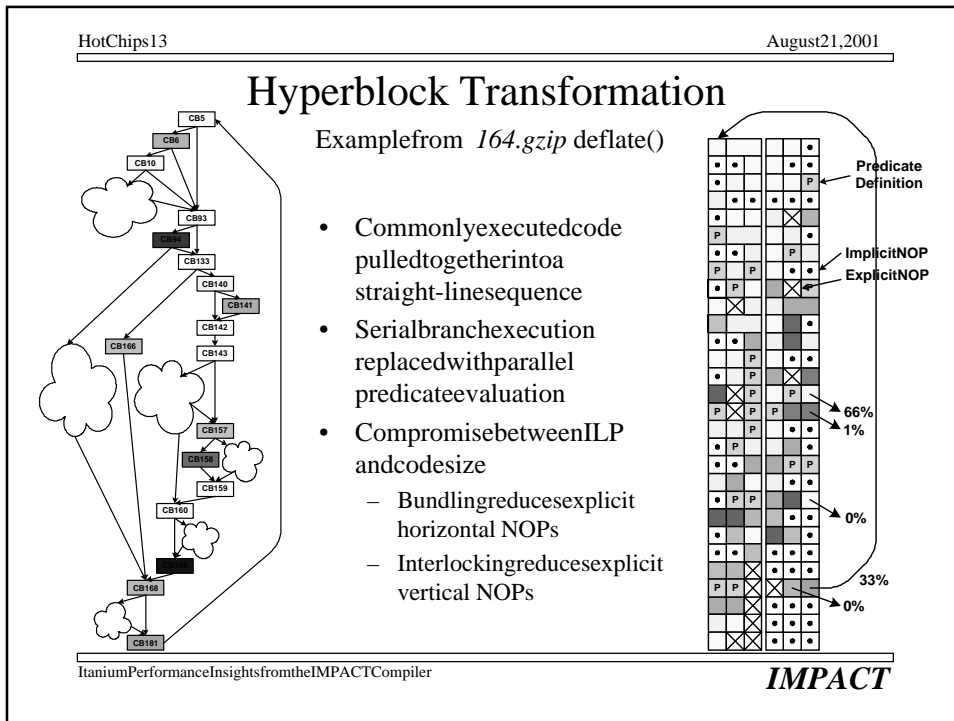
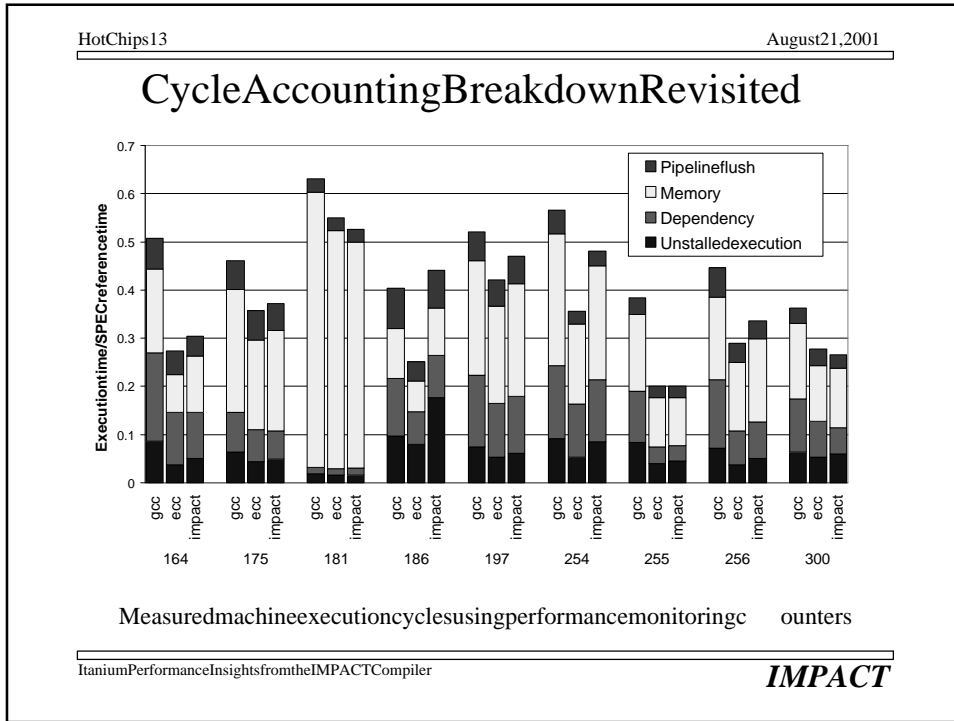
	Applicability	Public/ Proprietary	Peephole opti level	ILP opti level	Extensibility
gcc	VeryHigh	Public	Low	VeryLow	Low
ecc	High	Proprietary	High	High	High
IMPACT	Medium	FuturePublic	Medium	VeryHigh	VeryHigh

ItaniumPerformanceInsightsfromtheIMPACTCompiler **IMPACT**



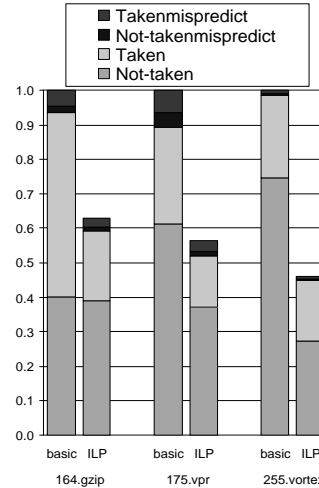




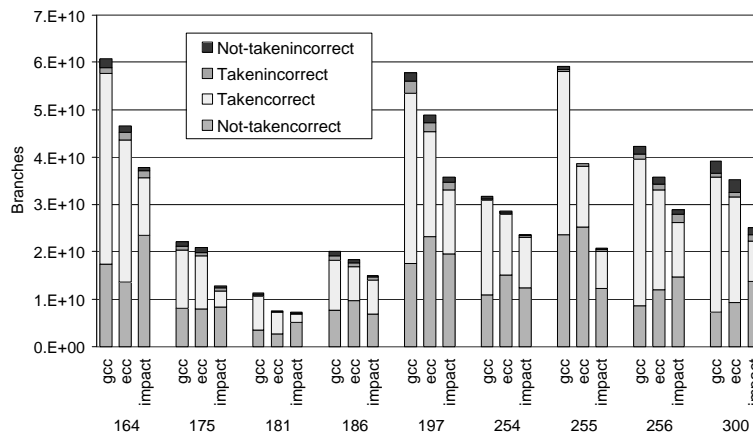


BranchEffectsofILPTransformations

- ILPcompilationeliminatesbranches
 - Predicationandbranchcombining
 - Loopunrolling
- Reductionintotaldynamicbranches
- Proportionallyfewertakenbranches
- Reductionin mispredicted branches



ComparisonofBranchBehavior



ChallengesandFutureDirections

- Profiledependenceandaccuracy
 - Gettingprofileintobuildsystems
 - Transparentruntimecollectionandre-optimization,makingmoreuseof theItaniumperformancemonitoringcounters
- EffectivenessofILPcompilationalgorithms
 - Newalgorithmstoincreasebothaggressivenessandstabilityof speculation andpredication
 - ProgramlevelILPtransformations
- Memorysubsystemimprovements
 - Moreefficientpointeranalysisalgorithms
 - Memorydataflowanalysisandoptimization
- MoreresultsarebeingderivedforpresentationatMicroprocesso rForum

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 - Carole Dulong,JohnCrawford,Dan Lavery,Steve Skedzielewski,JimPierce
- HPItaniumTeam
 - RichardHolman, VatsaSanthanam,CarolThompson,RichardHank
- HPLabsPDTeam
 - BobRau,Mike Schlansker, VinodKathail,Scott Mahlke
- HPLabsLinuxTeam
 - BrianLynn,David Mosberger,HansBoehm, StephaneEranian
- HPPhilanthropy - 9i2000Itaniummachines,expedited
 - KarenFontana,Tony Napolitan,Ralph Hyver,Chris Hsiung,Rob Bouzon
- Intel - 2alpha/betaItaniums
 - Carole Dulong,JohnCrawford