Porting a Domain Specific Language for Parallel Graph Analysis to the Many-Core Intel Single-Chip Cloud Computer

Alex Becherer and Dennis Brylow
Department of Mathematics, Statistics and Computer Science

Motivation

- Analyze the ability of parallel architectures/ applications to solve graph problems
- Test the advantages of running Green-Marl on the lightweight XINU OS vs. SCC Linux
- Further understand the need for mainstream many-core computers
- Explore and analyze traditional data when represented by non-traditional data structures (graphs)
- Discover which industries (social network sites, artificial intelligence) could benefit from parallel graph analysis
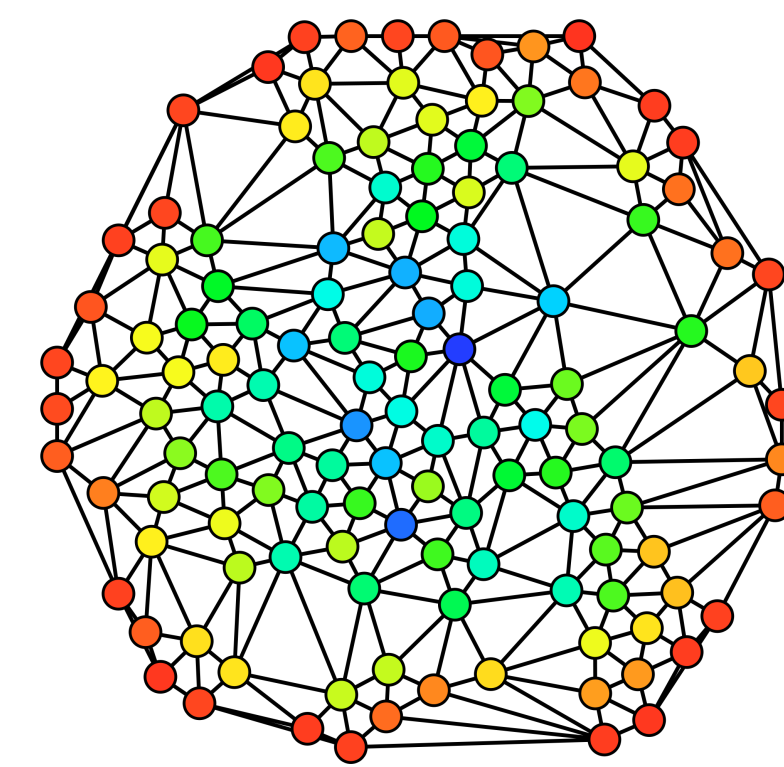
Figure 1: An example graph of "betweenness centrality"

Green-Marl

- Domain Specific Programming Language for "easy and efficient graph analysis", Stanford University
- Single-core machines perform graph analysis poorly; use parallelism to accelerate the process
- Simple syntax; complex algorithms can be implemented by intermediate programmers
- User writes program in Green-Marl
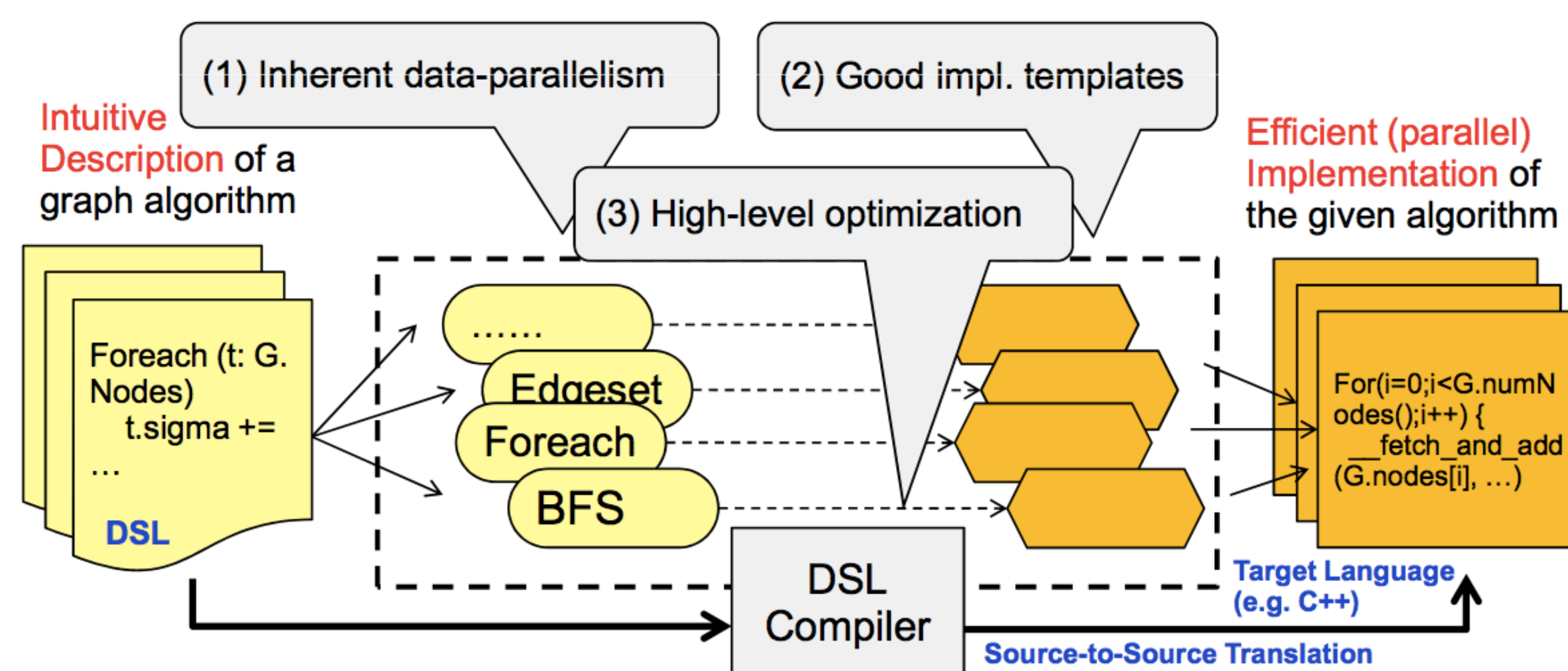- Compiler translates it to a parallel, optimized implementation in the target language

Figure 2: The Green-Marl Compile Process
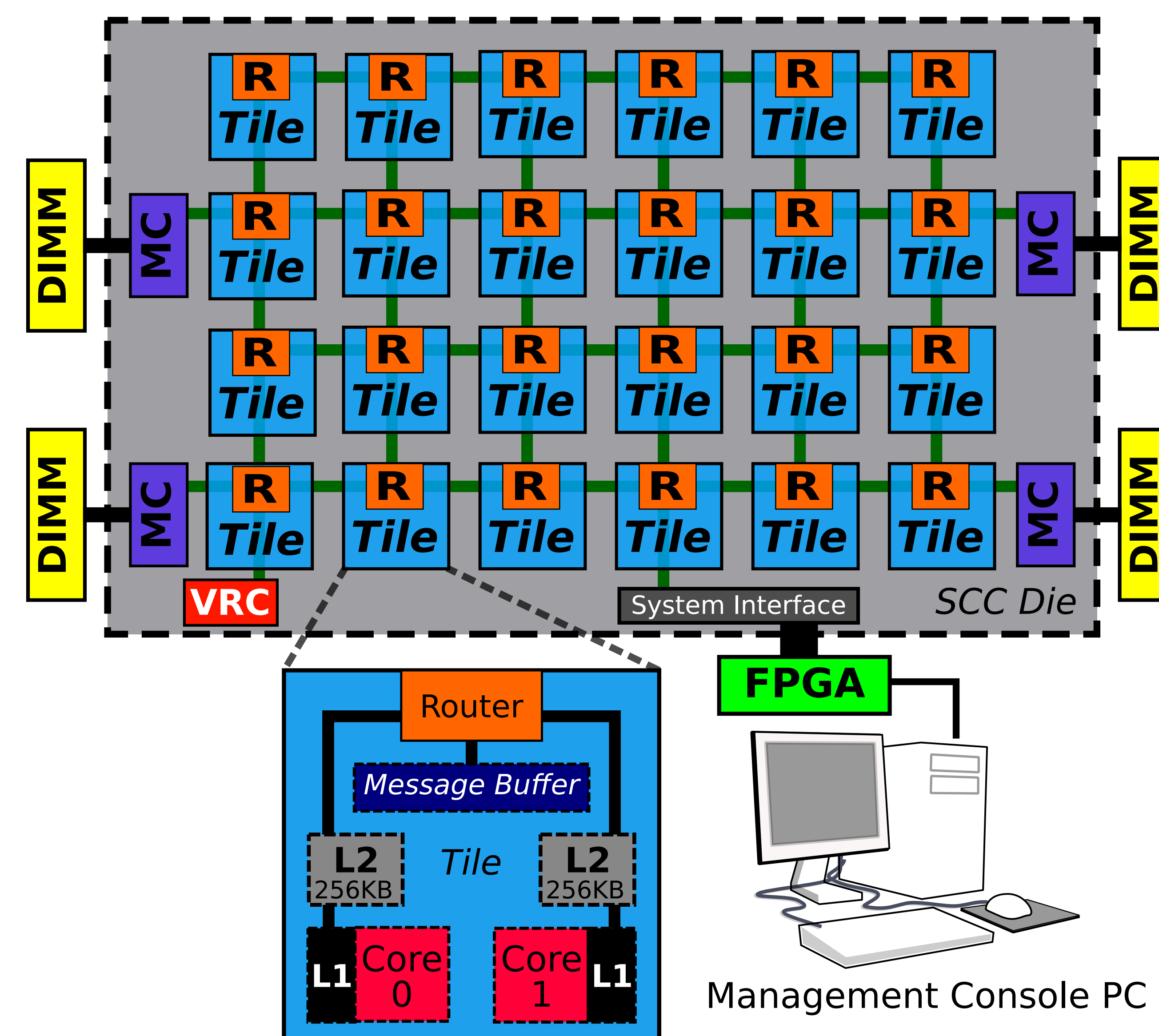
The Intel Single-Chip Cloud Computer

Figure 3: A Block Diagram of the Intel SCC

- 24 tiles, 2 IA P54C Pentium cores per tile
- 256 Gb/s bisection bandwidth
- Router, mesh based on-chip network
- 16KB shared message passing buffer per tile
- Dynamic frequency and voltage domains
- Concept vehicle for many-core applications research

Proposed System

- Port Green-Marl to the SCC
- Demonstrates code optimized for parallel execution on a many-core architecture
- SCC XINU is smaller and potentially faster than standard SCC Linux
- SCC XINU is easily configurable at low levels
- Provides an educational platform to teach parallel programming at the OS level
- Offer a platform to explore different message passing implementations on a many-core architecture

Parallel Data Analysis
↓
Green-Marl
↓
SCC XINU
↓
Intel SCC

References

- Intel Corporation, SCC External Architecture Specification (EAS), Nov. 2010, Revision 1.1.
- Sungpack Hong, Hassan Chafi, Eric Sedlar, and Kunle Olukotun, "Green-Marl: A DSL for Easy and Efficient Graph Analysis," *ASPLOS '12*, March 2012
- Michael Ziwisky, "A message-passing, thread-migrating operating system for a many-core architecture lacking cache coherency", Master's Thesis, Marquette University, 2012

Systems Lab • Department of Mathematics, Statistics, and Computer Science • Marquette University • Milwaukee, WI, USA