Architectures, Languages, and Compilers for the Streaming Domain

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Web Resources

- http://cag.lcs.mit.edu/streamit
- http://cag.lcs.mit.edu/raw
- http://cag.lcs.mit.edu/wss03
- http://www.morphware.org
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<td>Stream Architectures (Saman)</td>
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<td>2:20-3:00</td>
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The Streaming Domain

- Widely applicable and increasingly prevalent
  - Embedded systems
    - Cell phones, handheld computers, DSP’s
  - Desktop applications
    - Streaming media
    - Software radio
      - Real-time encryption
      - Graphics packages
  - High-performance servers
    - Software routers (Example: Click)
    - Cell phone base stations
      - Radar tracking
    - HDTV editing consoles
      - Streaming databases

- Based on audio, video, or data stream
  - Predominant data types in the current data explosion
What is stream processing?

"A model that uses sequences of data and computation kernels to expose and exploit concurrency and locality for efficiency."
Properties of Stream Programs

- A large (possibly infinite) amount of data
  - Limited lifetime of each data item
  - Little processing of each data item
- Computation: apply multiple filters to data
  - Each filter takes an input stream, does some processing, and produces an output stream
  - Filters are independent and self-contained
- A regular, static computation pattern
  - Filter graph is relatively constant
  - A lot of opportunities for compiler optimizations
Radar Stream Signal Processing Algorithms

GMTI (STAP) Algorithm

SAR Algorithm

Synthetic Aperture Radar (SAR): ~ 100-1000 GOPS ~ 1-100 s latency
Ground Moving Target Indicator (GMTI): ~ 100-1000 GOPS ~ 0.1-1s latency
Space-Time Adaptive Processing (STAP): ~ 1-100 GOPS ~ 0.01- 0.1s latency
XML Processing: Streaming Approach

Motivation:
• XPath lookup is next major bottleneck in XML processing after parsing
• Streaming access is most efficient mode for memory hierarchies and large documents

XAOS (XPath Analysis and Optimization for Streaming)