Beyond von Neumann
Mapping streaming applications to many core architectures

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Introduction

Embedded Systems
- today: 3G, 10 Gops
- tomorrow:
  - 4G, 1000 Gops
  - phased array antennas car radar systems, 10 Tops
- more computational power
- same energy budget
Silicon Technology

- Moore’s law
- no increase in frequency
- parallelism

Accelerators
to many standards and variants
Processors

- instruction level
- thread level
- limited by: # independent instructions
- memory bus bandwidth
- thread synchronization
- cache synchronization
- energy hungry

Weakly Programmable Processor Arrays

- local state
- local communication
- costly global communication
OFDM time synchronization

- standards:
  - IEEE 802.11n
  - 3GPP LTE
  - DVB
- 2 concurrent streams
- adapts QoS

Software

Its success is based on reuse:
- component based
- object oriented
Von Neumann

- a common model
- simple to understand
- enables high reuse of software
- liberates software from target hardware

Extending for Parallelism

- threads
- locks and synchronization
- at least 2x development cost
- increase in # bugs
Target Specialized Implementations

for efficiency:
- vendor specific API/language
- each architecture require its own implementation

Data Flow Model

- natural match for signal processing applications
- preserve the inherited parallelism
- matches WPPA hardware
- opendf.org
- mpeg reference implementation

Tool Flow
Partitioning

- data centric
  - limited memory size
  - local communication
- static sub-graphs
- constraint programming

Liberate Software from Target

software
  - abstract concepts
tools/run-time
  - when
  - where
  - how
intermediate model
  - operations
  - storage
  - synchronization
Summary

processing power will be provided

liberate software from target HW

• we need a new programming paradigm
• data flow