Recent advances in computer hardware architecture: The opportunities and challenges for provenance

Nikilesh Balakrishnan, Thomas Bytheway
Ripduman Sohan, Andy Hopper

University of Cambridge
Computer Laboratory

Why hardware advances?

Fine-grained capture

Precision & Accuracy

Completeness

Areas of hardware advances

1. Processors
2. Heterogeneous computing
3. Network architecture

1. Processor technology

Overlap of functionality

Hardware support

Intel PT, TraceHub

ARM Coresight ETM

Intel PT

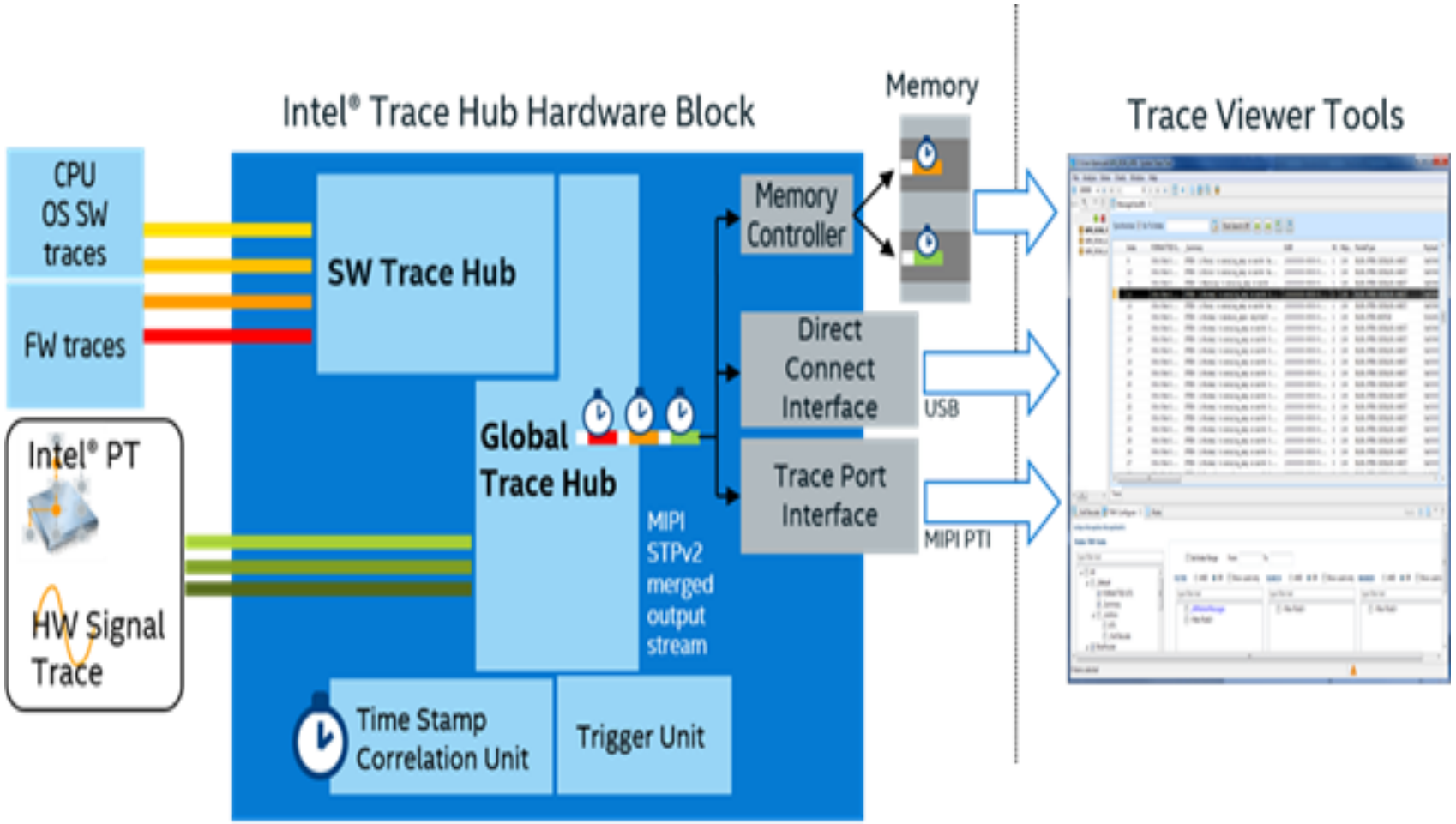
Complete control flow

- Direct branches (taken/not taken)
- Indirect branches (target IP)

Ring Buffer in memory

Recreate program execution

Intel Trace Hub



Applicability

Debugging

Data flow reconstruction

Feed-forward computation

Challenges

Processing

Storage

Too low level

2. Heterogeneous Computing

Near Data Processing

- Programmable SSDs

Accelerators/Co-processors

- GPU, Intel MIC etc.

Programmable SSDs

Firmware proprietary

New interfaces

Offload computations

Applicability:

Completeness

Challenges:

Limited processing power

Overheads

Accelerators

High parallelism

Offload computations

Results copied

Applicability:

Completeness

Challenges:

Negate performance benefits

3. Network architecture

Lack of visibility

Specialised hardware

Network Function Virtualisation

Software Defined Networking

Applicability:

Easy integration and capture

Completeness

Challenges:

Emerging technologies

Coordination across hosts

Future research directions

Leverage Intel PT and TraceHub

Retrospective data flow analysis

Summary

Hardware advances

Precision and Accuracy

Completeness

Thank You

For more info visit:

http://www.cl.cam.ac.uk/research/dtg/fresco/