Ultra High Speed WSI Viewing System
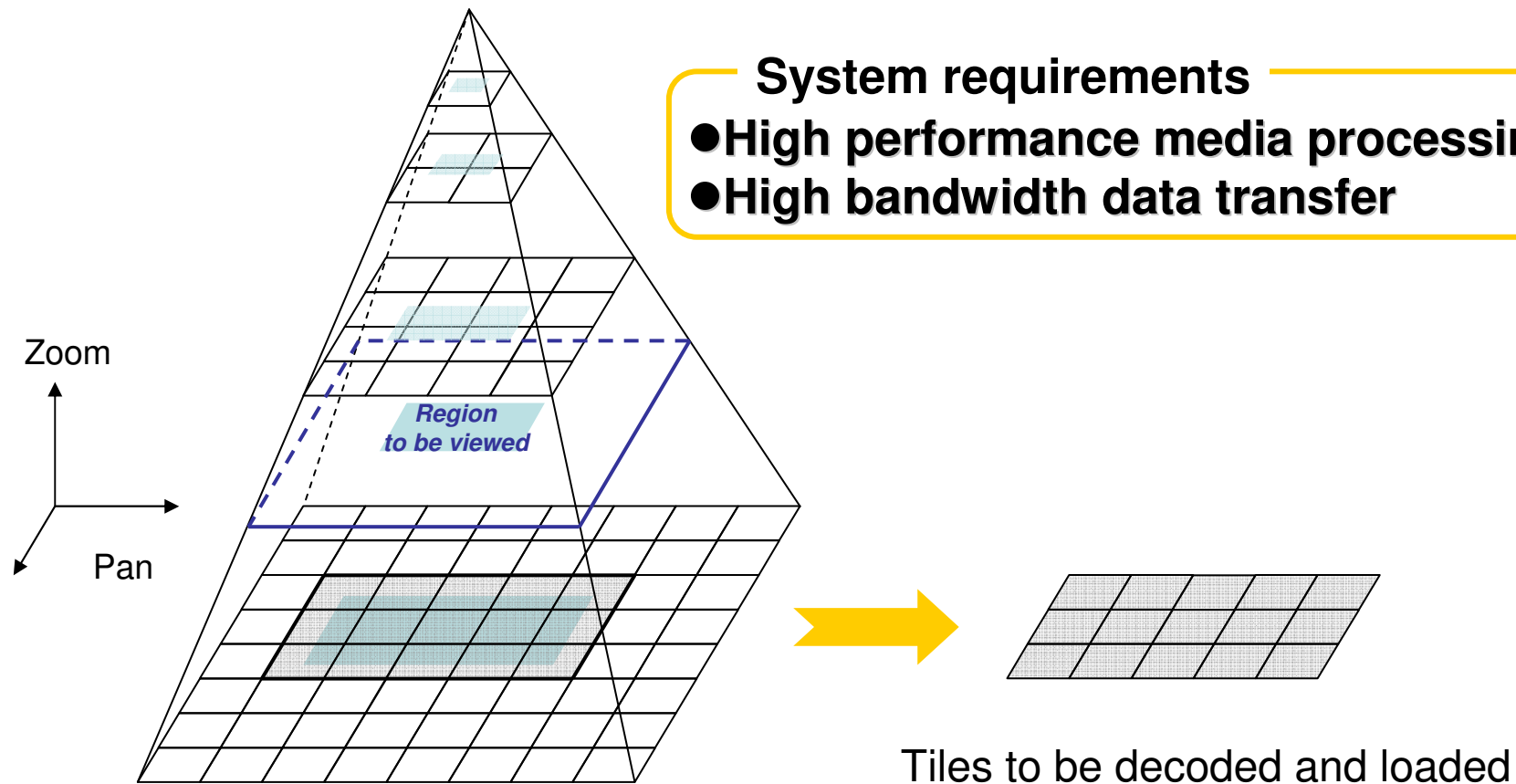
Shigeatsu Yoshioka[1], Yukako Yagi[2], Naoki Tagami[1], Hiroshi Kyusojin[1], Masashi Kimoto[1], Yoichi Mizutani[1], Kiyoshi Osato[1], Hiroaki Yada[1]

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Pathologists need the ability to rapidly pan and zoom huge images

System requirements
- **High performance media processing**
- **High bandwidth data transfer**

Zoom

Pan

Region to be viewed

Tiles to be decoded and loaded

WSI as a "Pyramid" of image data
e.g. 80,000 x 60,000 pixels, 1GB (compressed)

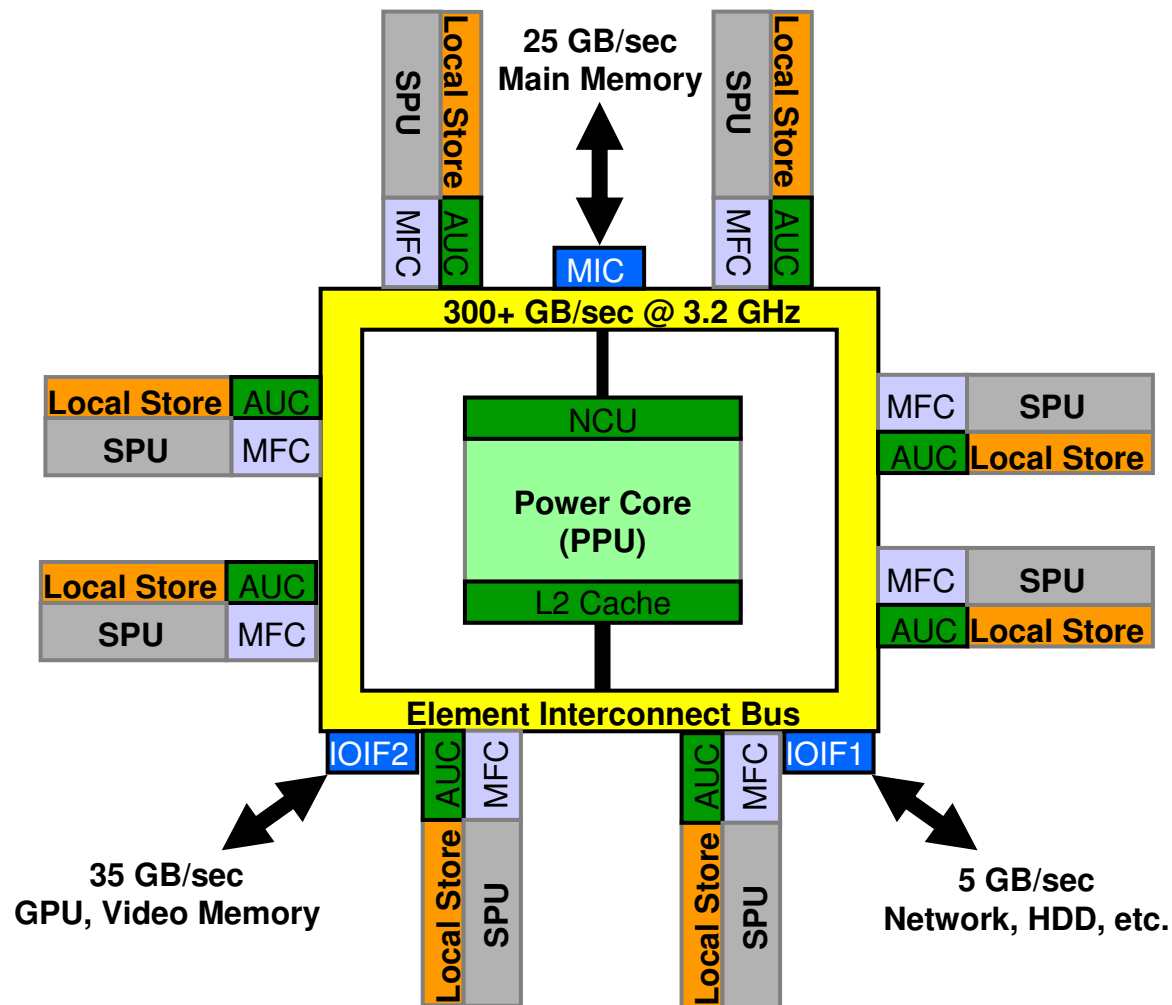# PlayStation3® is a useful WSI viewing system

- PS3® is more than just a video game console
- Its CPU (Cell Broadband Engine™) is specially designed to support wide range of real-time applications

Cell architecture

- Heterogeneous multi-core microprocessor (9 cores)
- Explicit DMA transfer to/from local store of each SPU

Cell BE excels at media processing

- Best trade-off between parallelism and controllability
- Highly customizable memory-to-memory data transfer

	CPU Intel (Core i7)	Cell BE Sony / IBM / Toshiba	GPU nVidia GTX480
Cores	4	9	480
Conditional branching	◎	△	×
Clock rate	3.2 GHz	3.2 GHz	1.4 GHz
Data transfer method	Hardware Cache	DMA	Texturing/Rendering

Real time, lossless encoding and decoding of 4K images

Simultaneous decoding of 48 MPEG-2 streams

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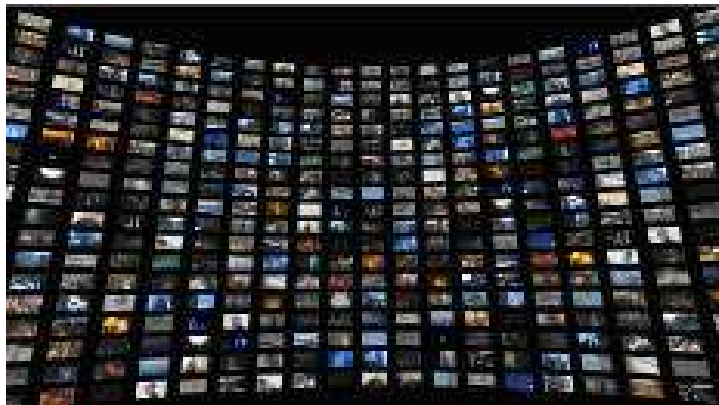**Real time, lossless encoding and decoding of 4K images**

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WSI viewing system based on PS3® prototyped by Sony to evaluate viewing speed and usability

Wide variety of slides

Scanner

Server

Slide data

Via network

100 Mbps

Local storage

Slide data

Existing PC-based viewer (Core i7)

Viewer software (Non game application)

Slide data

PS3®-based viewer
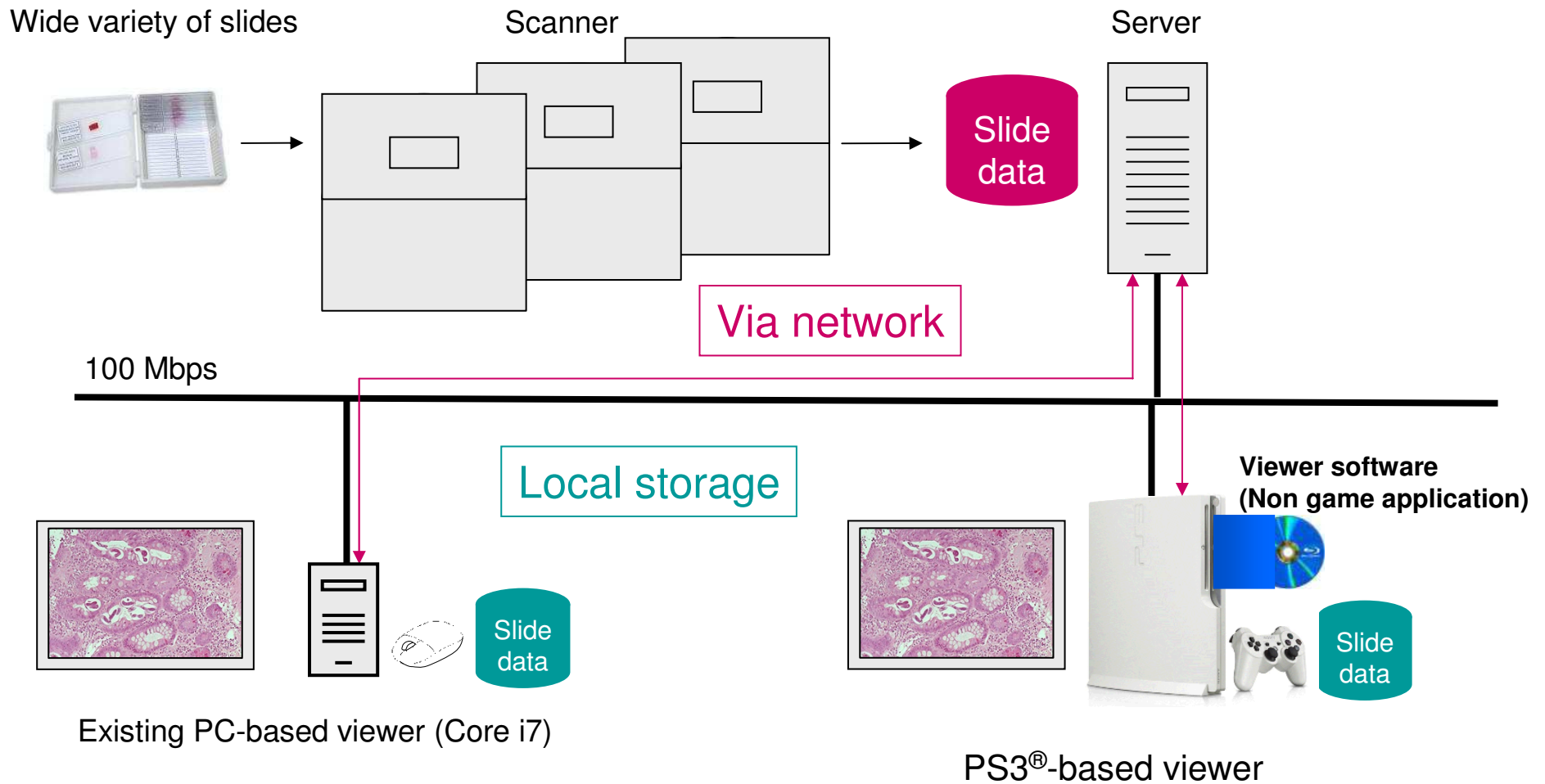
Most operations are reflected in real-time
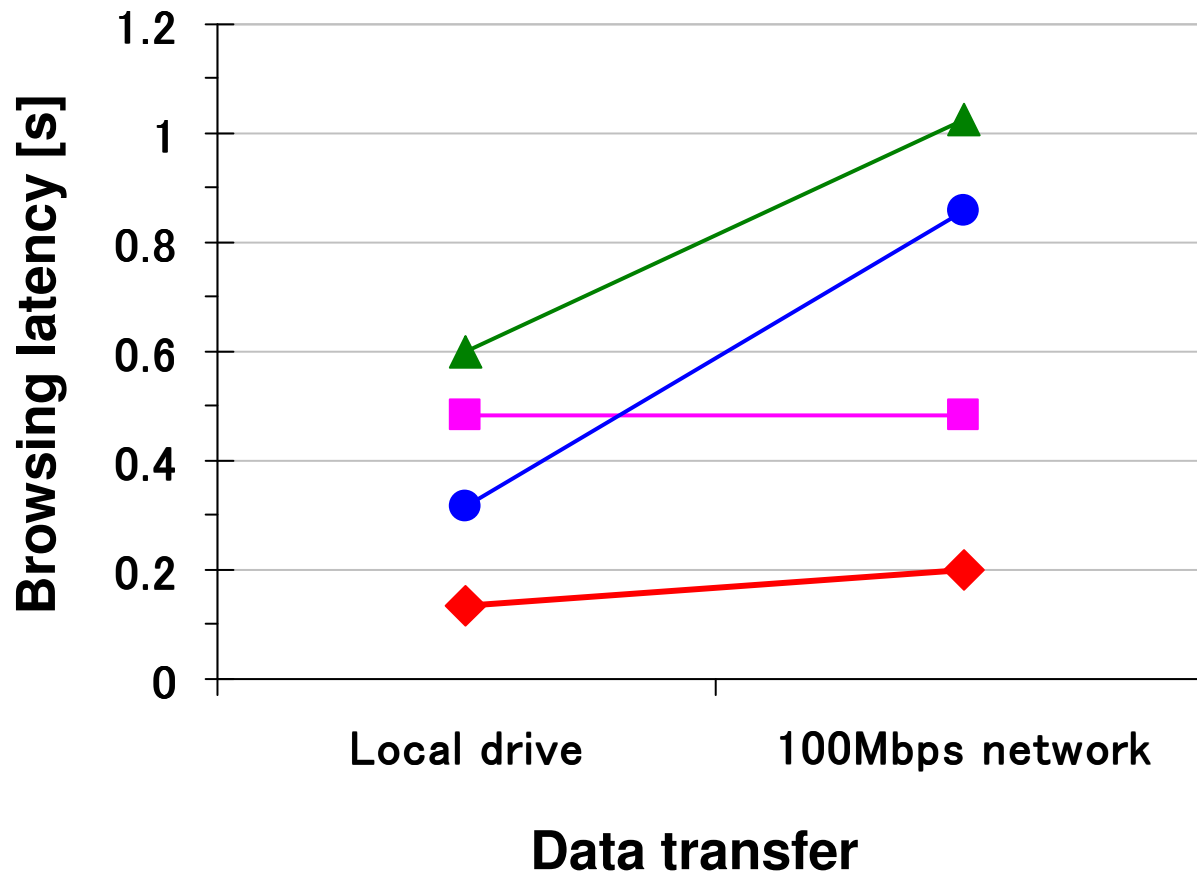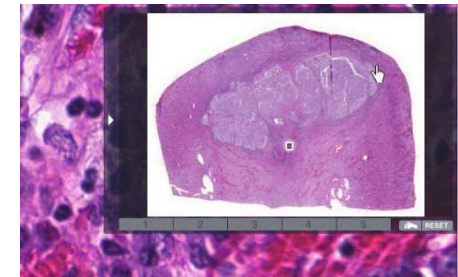- Effect of high-speed processor and cache hit rate improvement by "movement prediction prefetch"

↑ Click to play

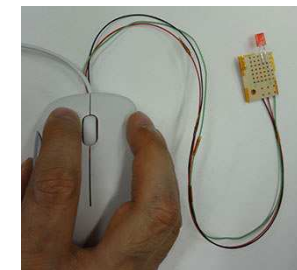# In the case of cache miss, browsing latency is several times smaller than existing viewers

In the case of cache miss

Legend:
- PS3-based Viewer
- Viewer A
- Viewer B
- Viewer C

Y-axis: Browsing latency [s] (0, 0.2, 0.4, 0.6, 0.8, 1, 1.2)

X-axis: Data transfer (Local drive, 100Mbps network)

Thumbnail view

LED attached mouse

Advantages of using game controller
- Less fatigue after prolonged use
- Easier to keep track of the region of interest

Pan	Zoom	Simultaneous Pan & Zoom
Repetitive motion drag	**Repetitive spinning** Zoom out　Zoom in	**Hard to operate**
Simply tilt analog stick	**Simply push LR button** Zoom out　Zoom in	**Seamless**

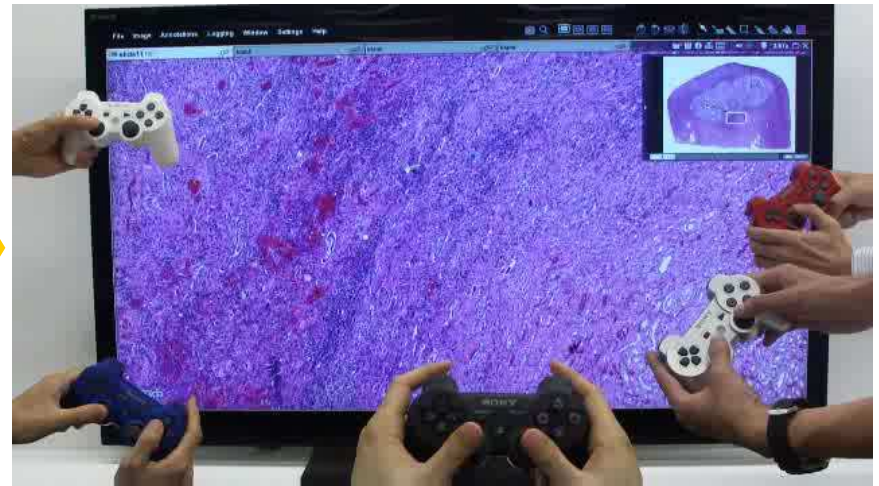# Quality of discussions can be improved by simultaneous multiuser operation

Game

Pathology

↑ Click to play

A PS3®-based viewer can improve the efficiency of many imaging tasks

- In terms of browsing latency, good performance was achieved using a PS3®
- A game controller was found to be a suitable user interface for a WSI viewing system
- Simultaneous multiuser operation is possible at meetings and conferences

Acknowledgements

- Department of Pathology, Massachusetts General Hospital, Boston, MA, USA