Implementation and Evaluation of Shared Memory System for Establishing λ Computing Environment

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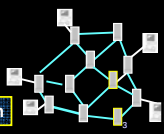
Contents

- Research background
  - Grid computing environment
  - λ computing environment
- Research objective
- Implementation of shared memory system
- Evaluation
- Conclusion and future work

Grid computing environment

- Grid computing environment
  - Computing nodes share CPU and storage by utilizing network
- QoS demands of Grid computing environment
  - Wide range, large-scale distributed computing
  - High-speed transmission of volume data
- Computing nodes communicate by TCP/IP
  - The overhead of packet processing
  - Decreasing of transmission rate

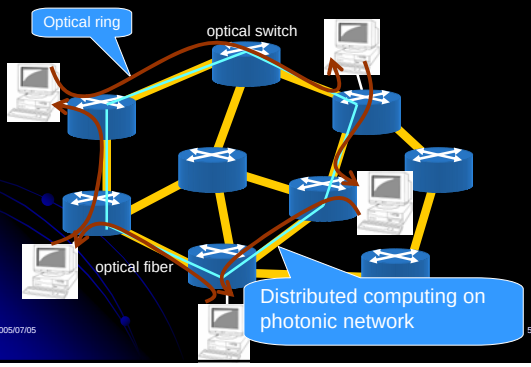


It is difficult to achieve high-quality communication

λ computing environment

- In the Lambda computing environment
  - Connect each computing node and router with optical fiber
  - Utilize wavelength path for communication
  - Treat wavelength as degree of granule treating information
- Provide high-speed, high-reliability communication pipe to end users
  - High-speed data sharing at hardware level
- We can apply the lambda computing environment to distributed computing and data sharing

λ computing environment



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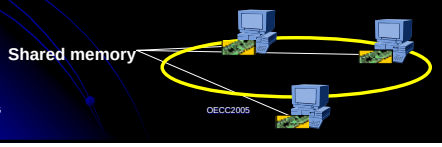
Research objective

- Implementation of the shared memory system
- Evaluation of the shared memory system
  - High-speed channel architecture
    - Computing nodes have the data sharing area
    - The optical ring is used for exclusive communication pipe for date sharing
  - Utilize AWG-STAR system developed by NTT Photonics laboratory



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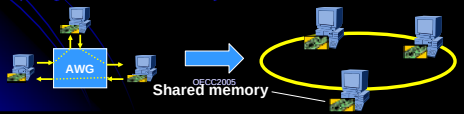
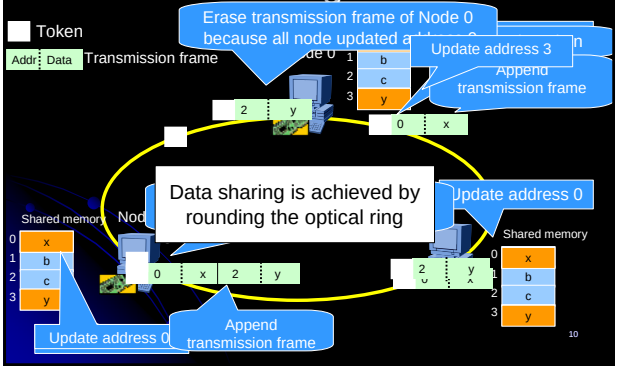
AWG-STAR system

- AWG-STAR system is an information sharing platform realized by
  - WDM technology
  - Wavelength routing using AWG routers
    - The AWG router processes signals without O-E-O transforming
- Computing nodes
  - are connected to AWG router
  - configure physical start topology but have logical ring topology
- Each node is equipped with a shared memory board
  - Shared memory contains the identical data at the same address over all computing nodes
  - Information of data changed on the shared memory is transmitted to other computing nodes by using optical ring and update other computing node's shared memory

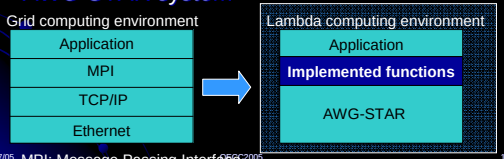


AWG-STAR data sharing method



Implementation of shared memory system

- Design and Implement some functions
  - Synchronization
  - Memory allocation for shared variable
  - Source code modification for applying to AWG-STAR system



MPI: Message Passing Interface
generally used for distributed-parallel computing

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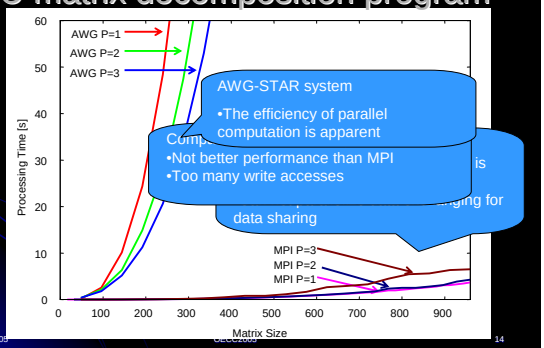
Experiment configuration

- Specification of the computing node
  - The maximum number of computing nodes: 3
  - Distance between computing nodes: 20 m
  - CPU: Xeon 3.0 GHz
  - OS: Redhat 7.3
- Specification of the shared memory board
  - Network interface: 2Gbps
  - Transmission frame size: 1KB
  - Processing delay of a token on each node: 500 ns
  - Access speed to shared memory from local host: 60MB/s
- Application: SPLASH2
  - LU matrix decomposition program
    - Many accesses to shared memory
  - Radix sort program
    - Few accesses to shared memory

Experimental result: LU matrix decomposition program

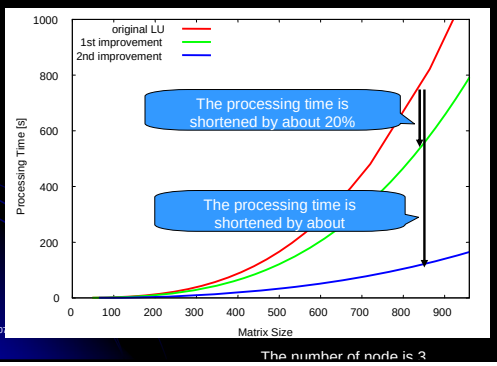


P: the number of node

Performance improvement strategy

- Hardware improvement
  - Undergoing
- Software improvement
  - Decrease the number of accesses
  - Access to shared memory in unit of blocks not in elements (first improvement)
  - Utilize the local memory as cache for shared memory (second improvement)

Experimental result: improved LU matrix decomposition program



The number of node is 3

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Conclusion and future work

- Implementation of shared memory system on λ computing environment
  - AWG-STAR system
- Evaluation of the shared memory system
  - The number of accesses to the shared memory influence its performance
  - Improve performance by software level tuning
- Future work
  - Hardware level improvement
  - Investigating end-host architecture suitable to the photonic-based computing environment.