HY-SDR RESEARCH CENTER
Hangyang Software Defined Radio Research Center

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HANYANG UNIVERSITY

Implementation of MPI-based WiMAX Base Station System for SDR

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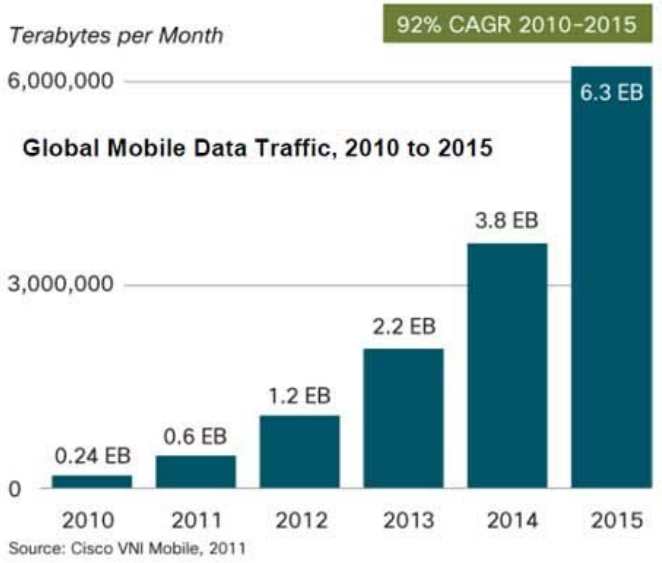
Introduction

- Software Defined Radio (SDR)
  - *"Radio in which some or all of physical layer functions are software defined"*
    - Flexibility, Upgradability, Scalability, Extensibility

- Increase in mobile data traffic
  - SDR base station requires a lot faster processing speed



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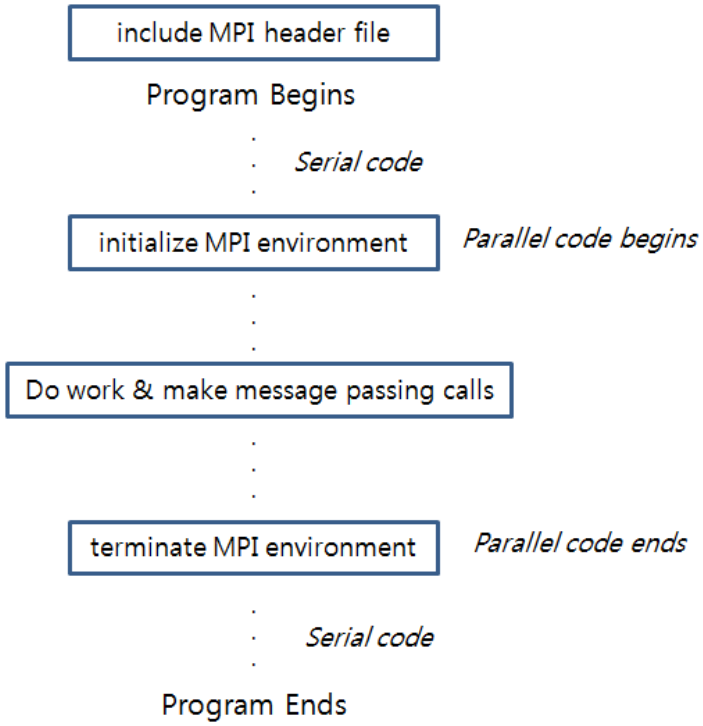
Description of MPI

- Message Passing Interface (MPI)
  - MPI is a message-passing library interface specification that allows multiple nodes to exchange messages with one another
- The reasons for using MPI
  - MPI is the only message passing library which can be considered a standard
  - MPI is supported on virtually all High Performance Computing (HPC) platforms.



< general MPI program structure >

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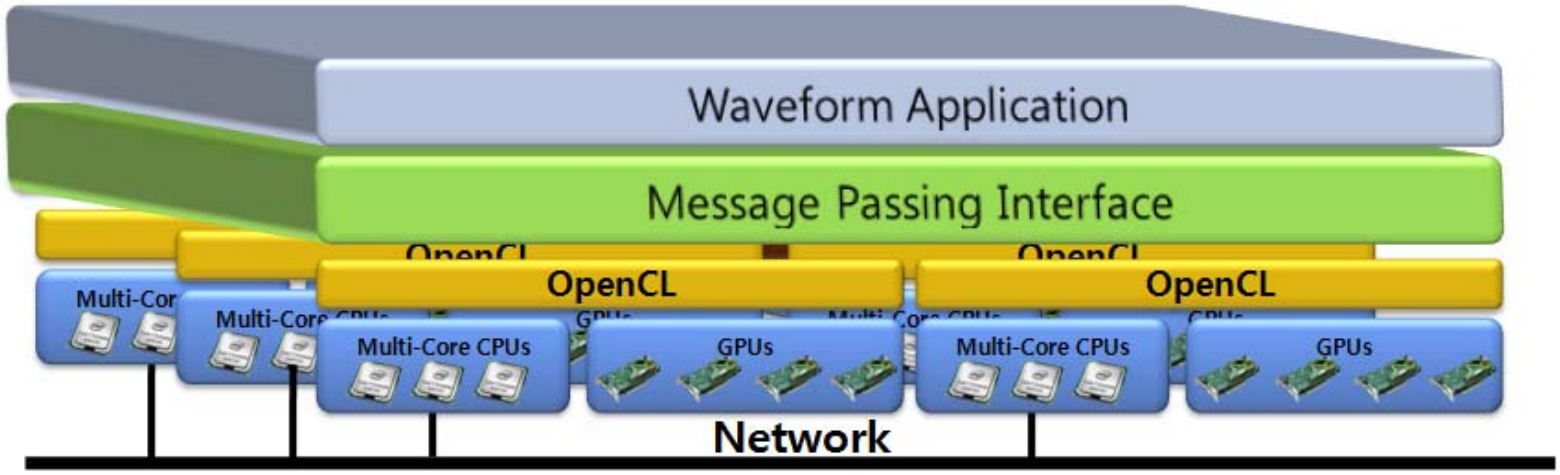
MPI based Parallel Computing

- MPI (Message Passing Interface)
  - MPI is a language-independent communication protocol used to parallel computing
  - Bind multiple GPU based digital unit to achieve faster processing speed



< MPI-based digital unit architecture >

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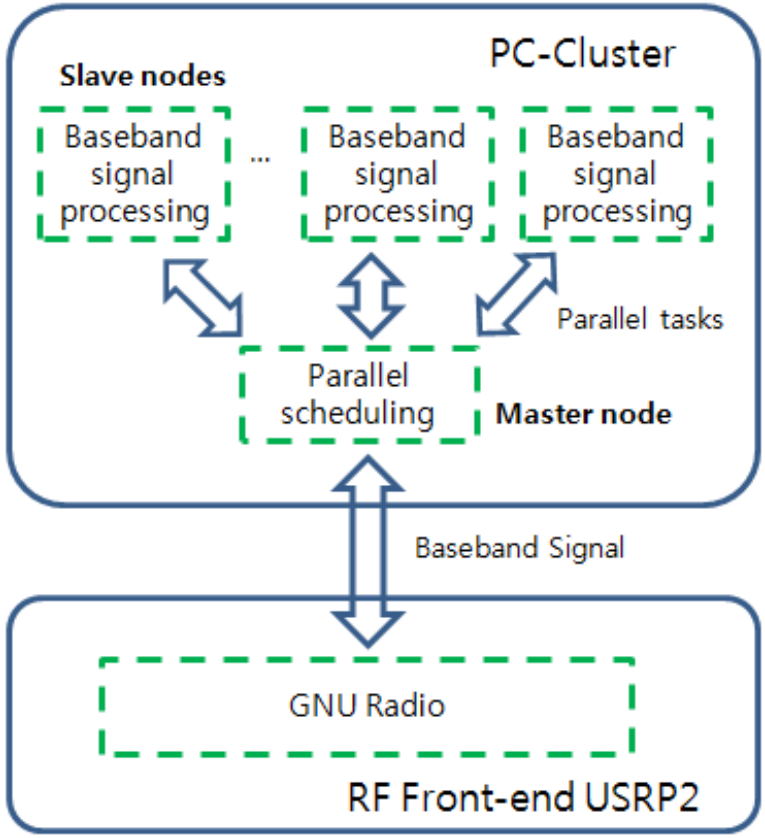
System Architecture

- Hardware Components
  - General PCs : each node
  - USRP2 : RF transceiver
- Software Components
  - Parallel scheduling
  - Baseband signal processing
  - GNU radio



< system components and architecture >

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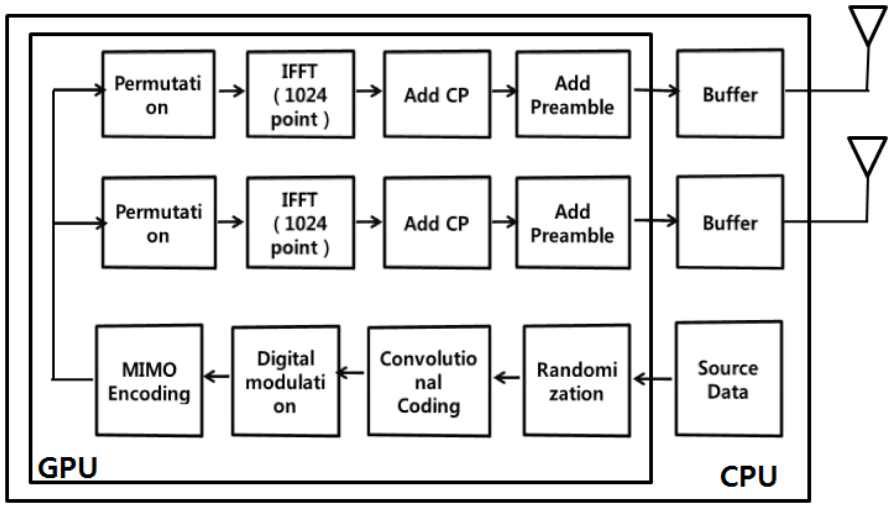
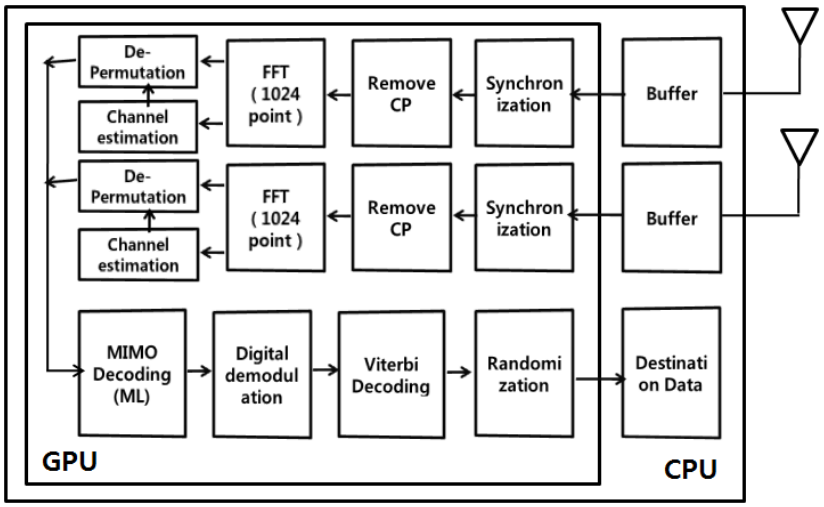
Implementation of WiMAX System

- Structure of entire system



(a) transmitter



(b) receiver

< block diagram of 2X2 SM MIMO WiMAX system >

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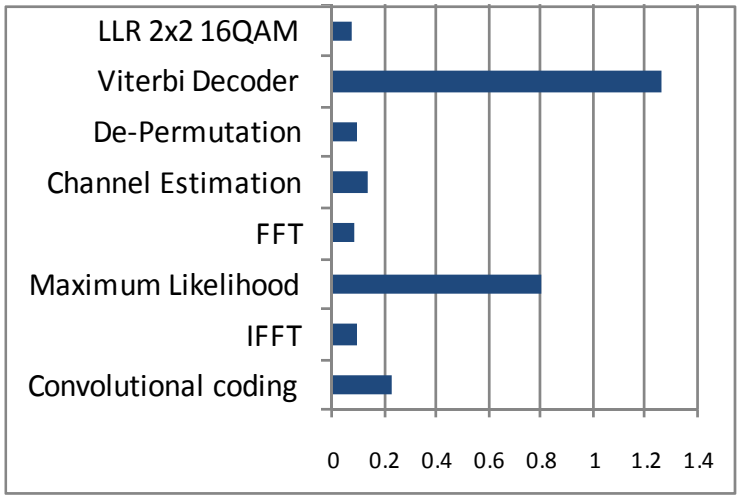
Implementation of WiMAX System

- Parallelization of baseband signal processing
  - To reduce the computation time of the entire system, MPI is used to process Viterbi Decoder and ML block
  - Synchronization block for finding the frame start takes 7.8ms, so it is also designed to use MPI



< computation time (ms) of 2X2 SM MIMO WiMAX system >

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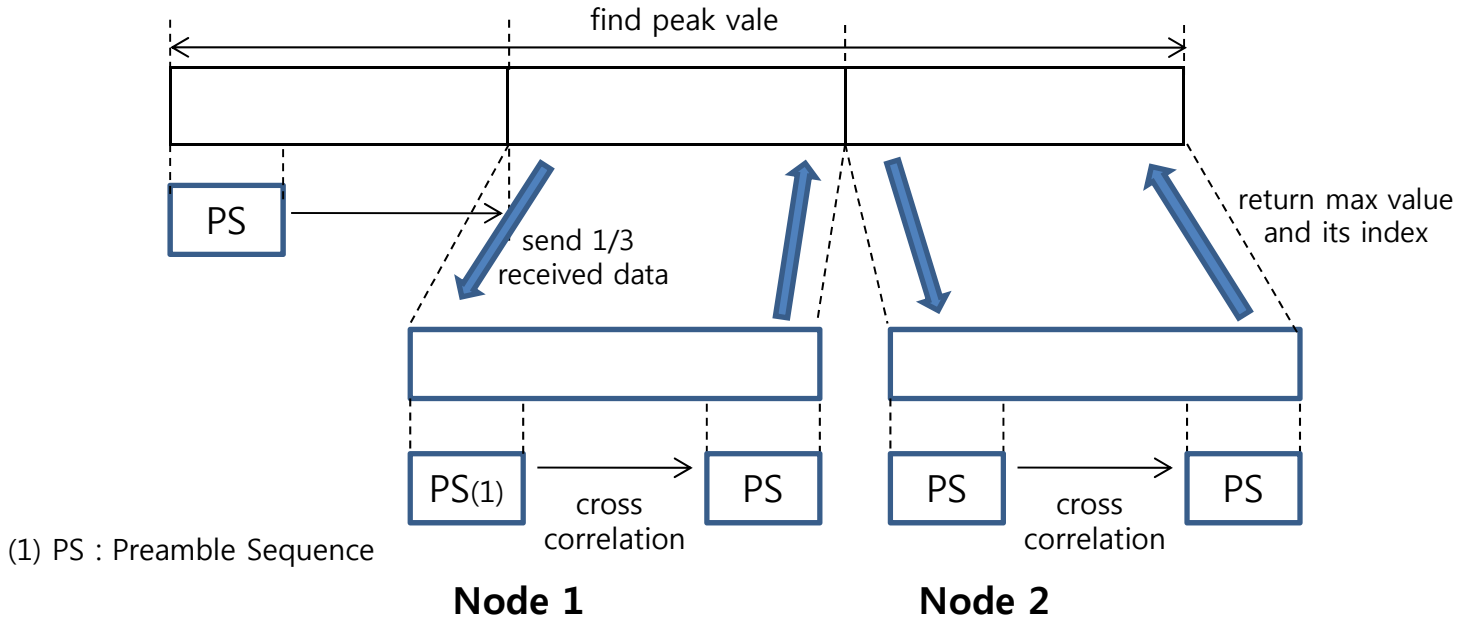
Implementation of WiMAX System

- Synchronization
  - The frame start can be found through a cross correlation between received samples and preamble sequences



< MPI-based synchronization algorithm >

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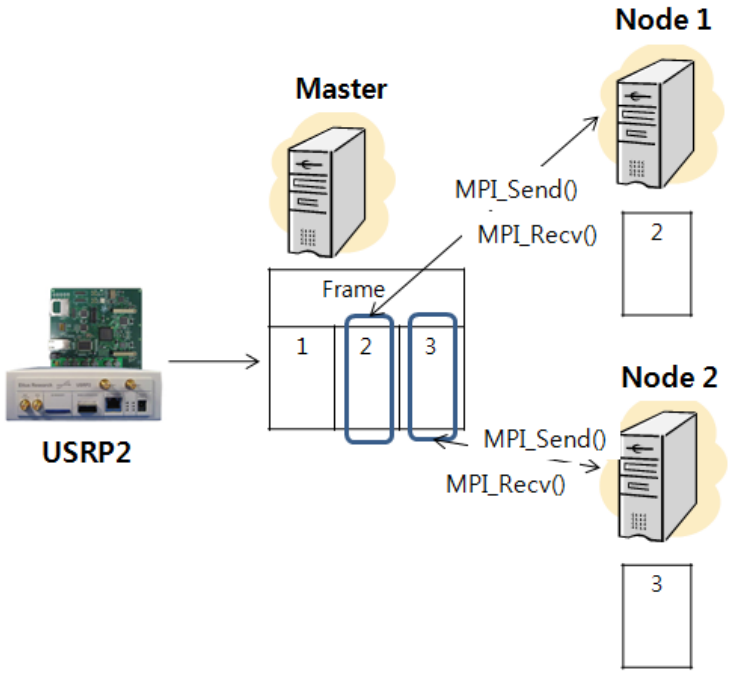
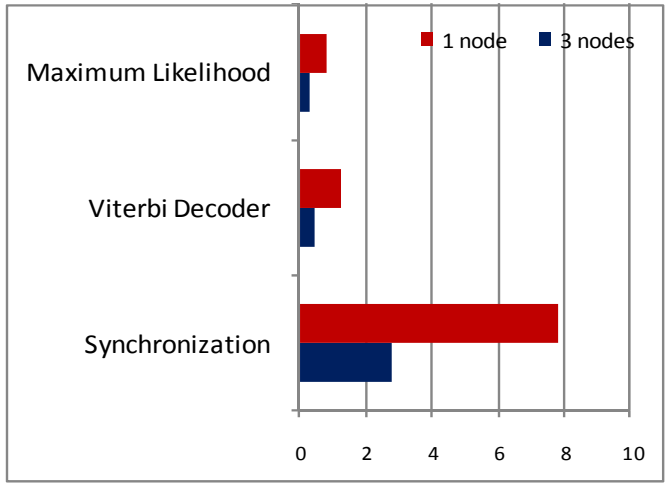
Implementation of WiMAX System

- Experimental Results



< Inter-node data transmission using MPI >



< Algorithm processing time(ms) according to the number of nodes >

	1 node	3 nodes
Synchronization	7.8 ms	2.81 ms
Baseband signal processing	4.554 ms	1.715 ms

< Processing time for 1 frame according to the number of nodes >

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Conclusion

- SDR base station has been hailed as an appropriate technology to 4G environment which aims at a convergence of various kinds of communication standards
- However, there is a limit on the amount of operations that can be supported by a single base station due to physical constraints at each resource
- Applying the MPI-based parallel processing technology to the SDR base station for 4G or even beyond-4G, we will be able to achieve extremely high operation speed

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Q & A

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