WebCom: A Web Based Distributed Computation Platform

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Outline

Outline

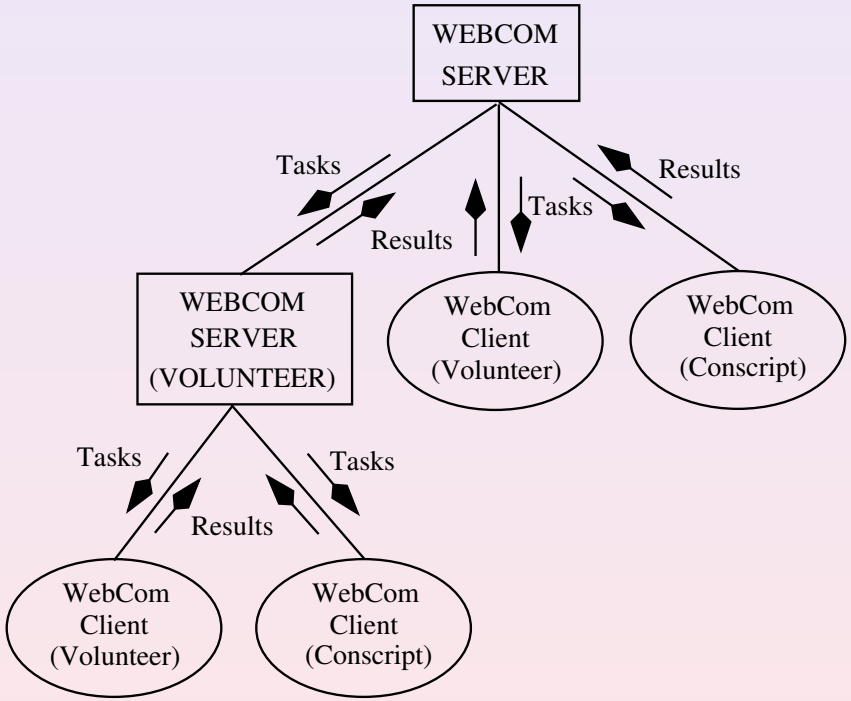
WebCom - Web Communicator

Developed by : Centre for Unified Computing, Cork, Ireland.
Based on: client/slave model with multi-tier bidirectional topology
Developed for: Execution of programs expressed as Condensed Graphs.
Environment: Distributed environment of the World Wide Web and the Internet.
Achieved : Utilizing Java applets, with different applet types for different tasks.
Communication: Remote Method Invocation and Object Request Broker

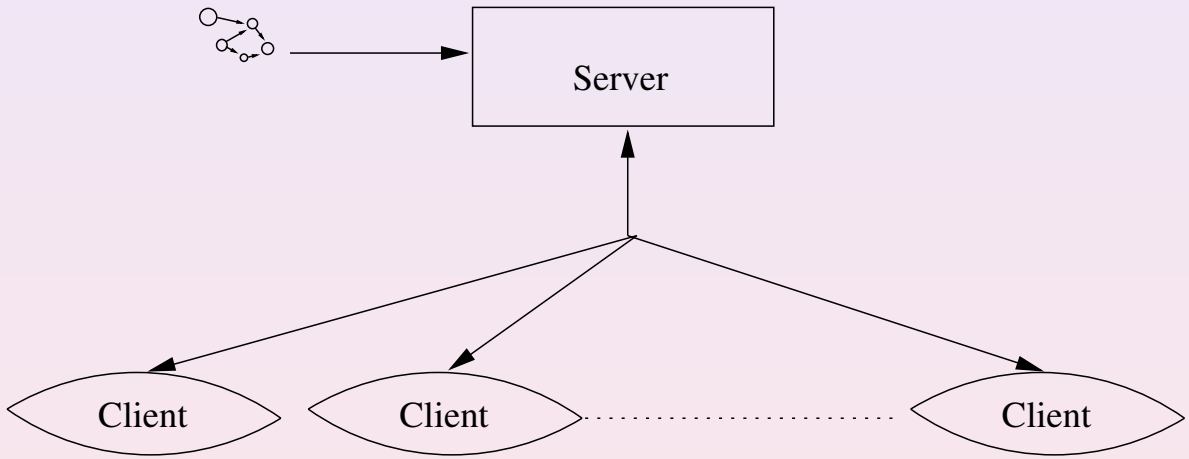
WebCom Components

- Servers: submit tasks
  - implemented as a multi-threaded Java application
  - only trusted machines
  - if no client, execute tasks
- Clients: executes the tasks
  - java applet is downloaded
  - Volunteer or Conscript
  - Promotable or Non-promotable

WebCom Client/Server connectivity



Evolution of P2P network



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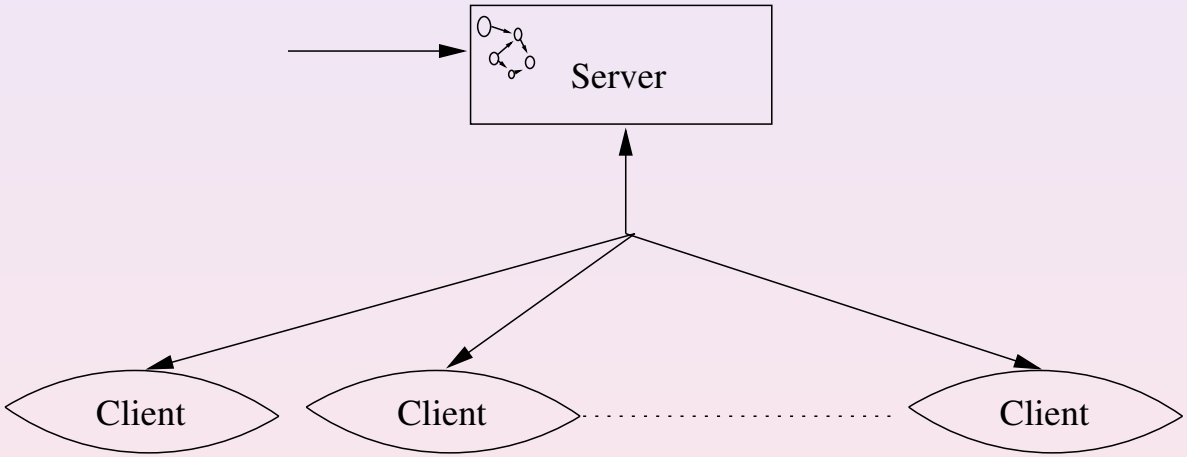

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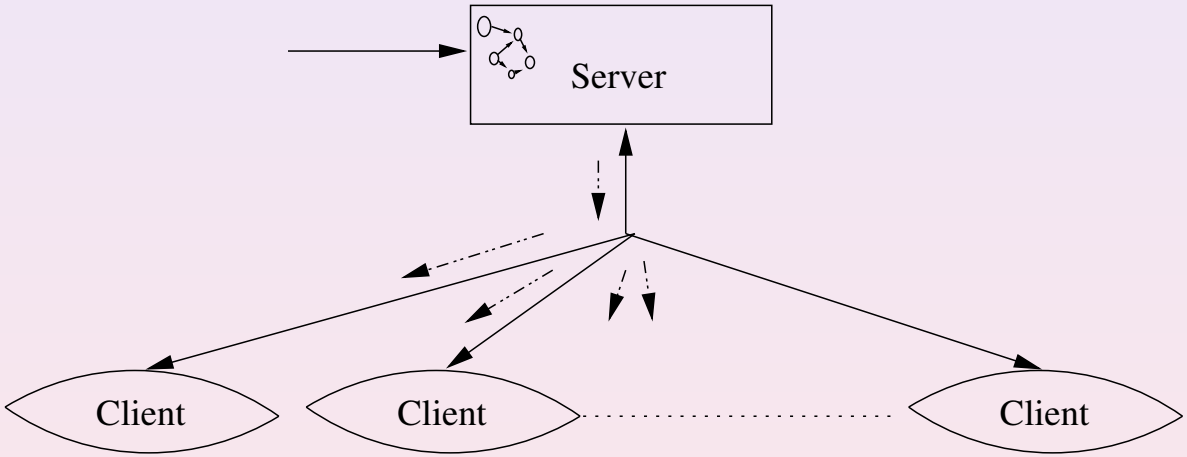

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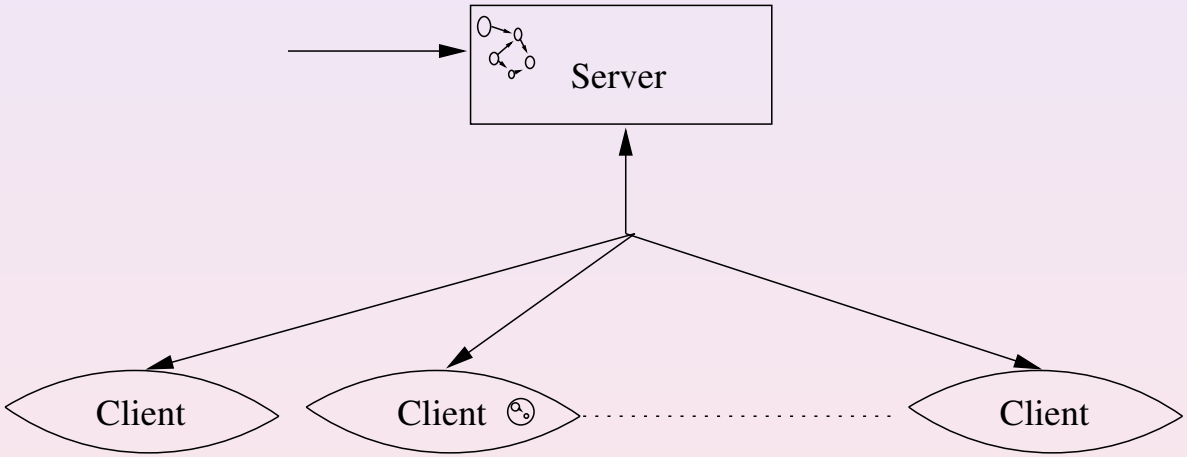

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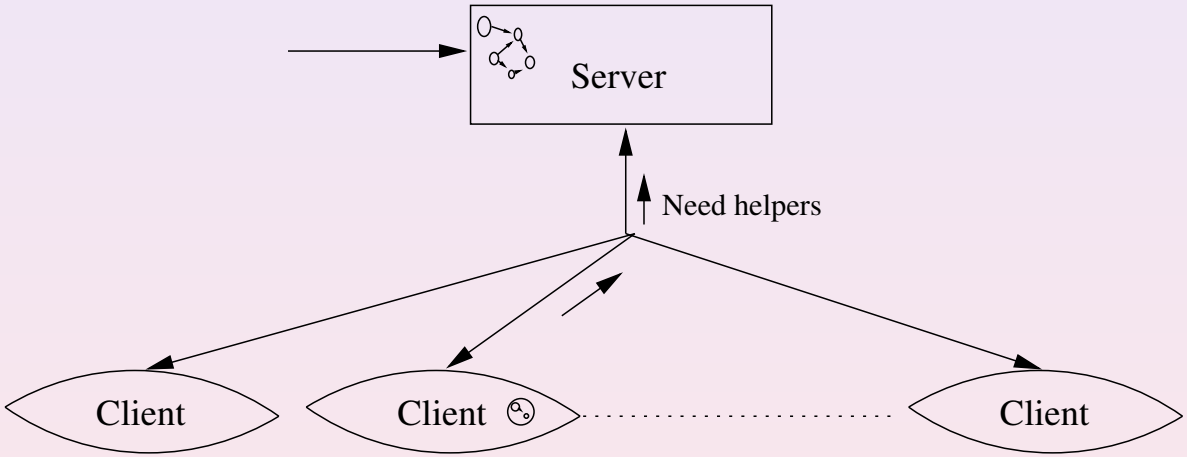

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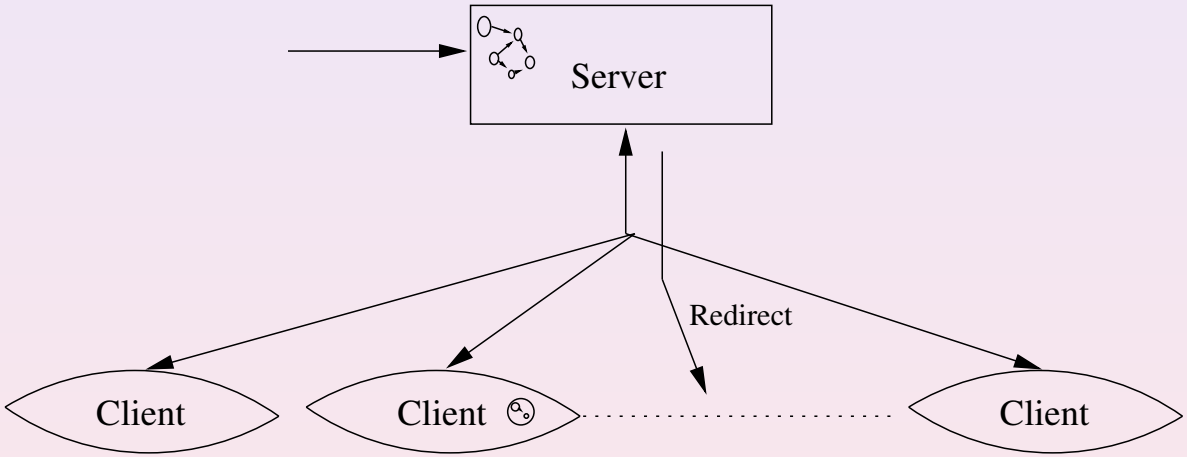

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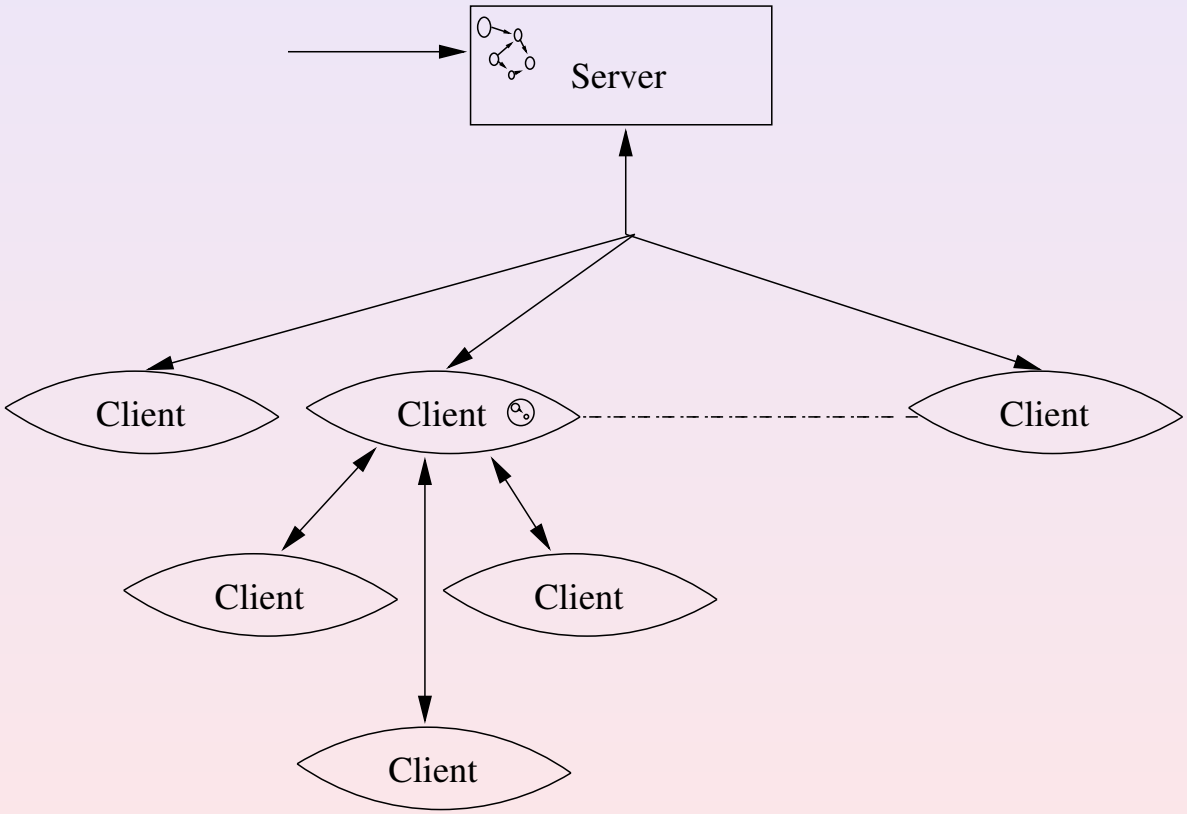

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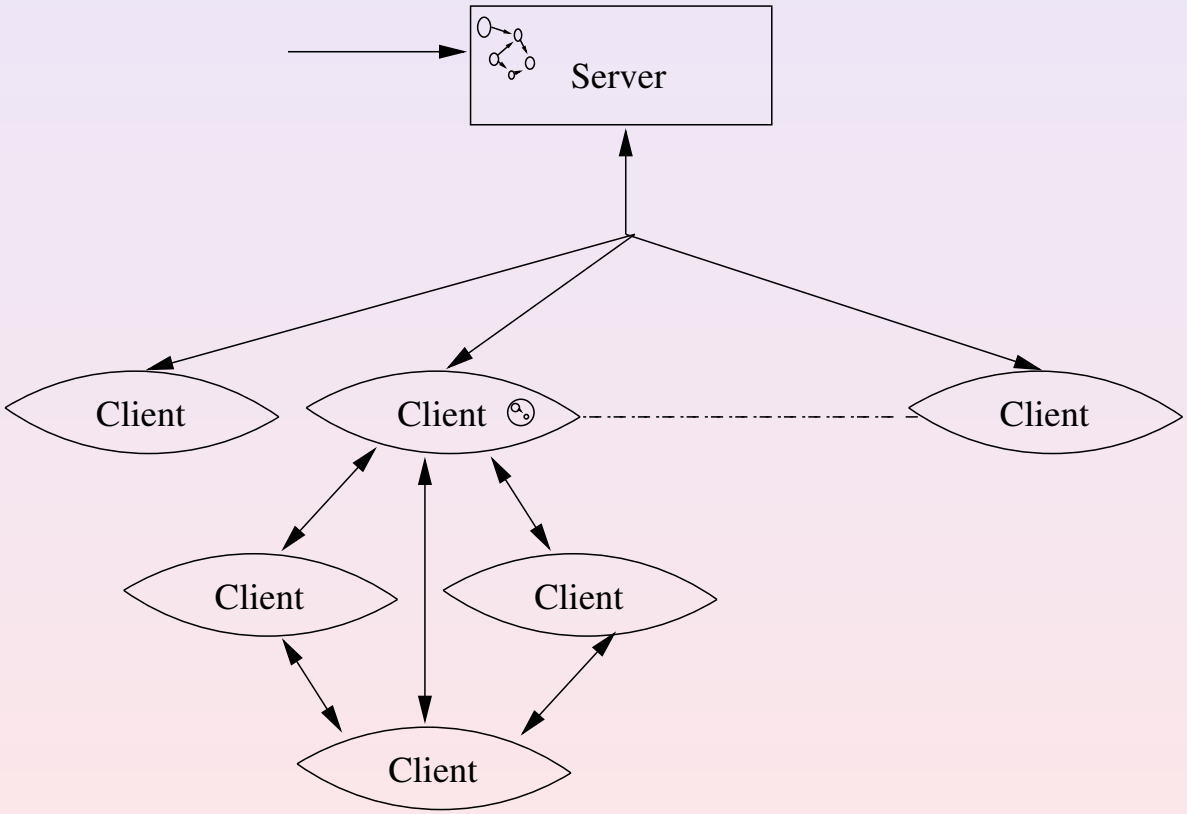

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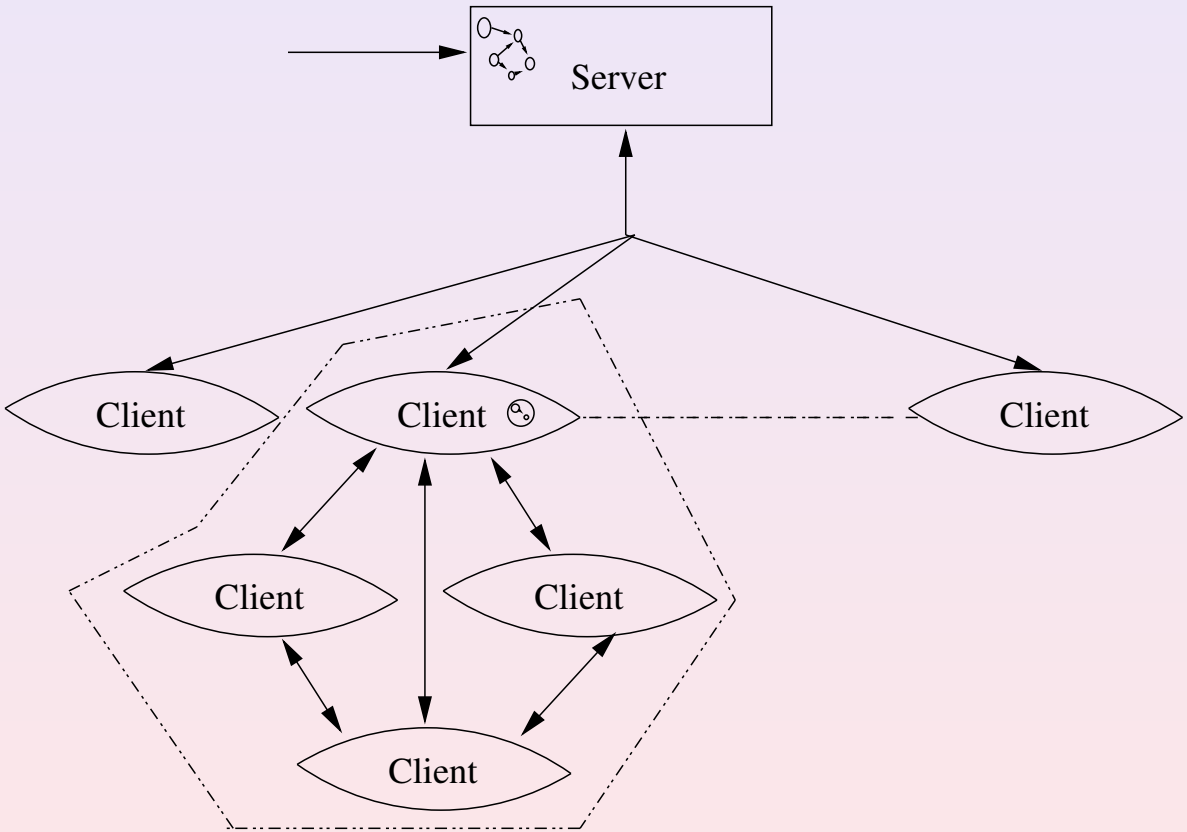
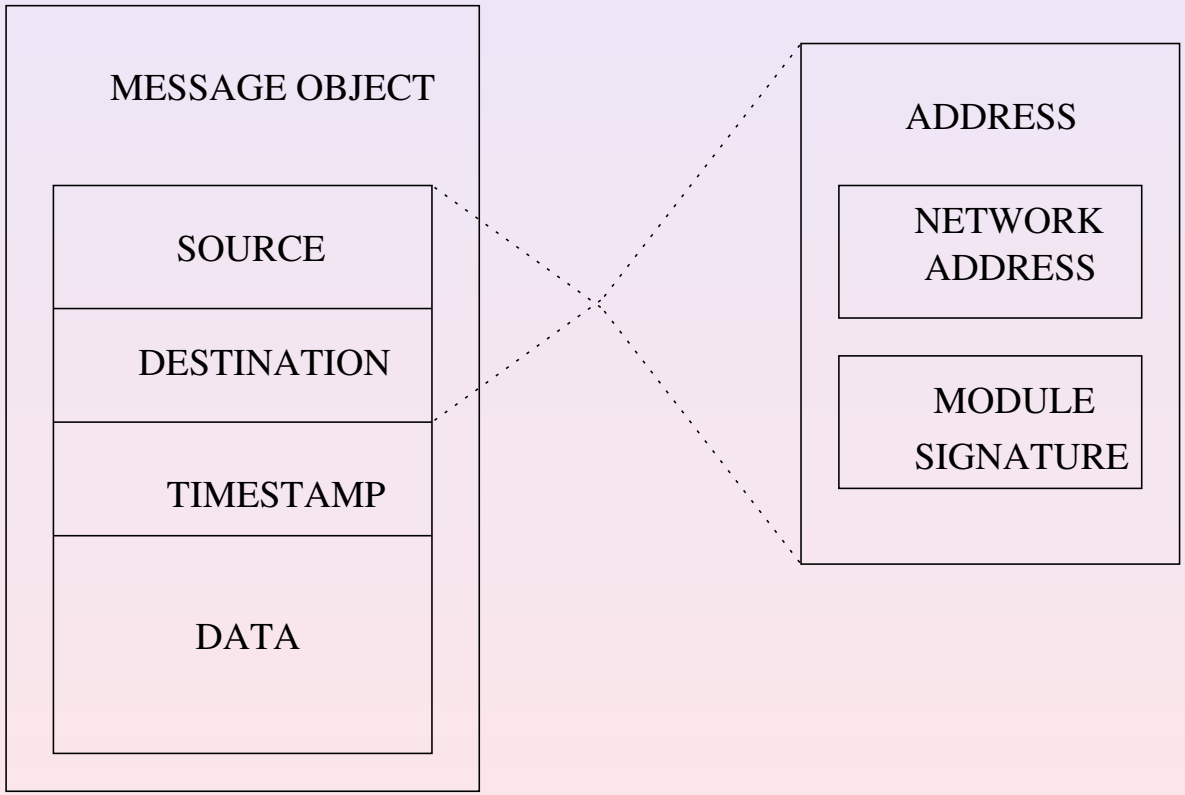


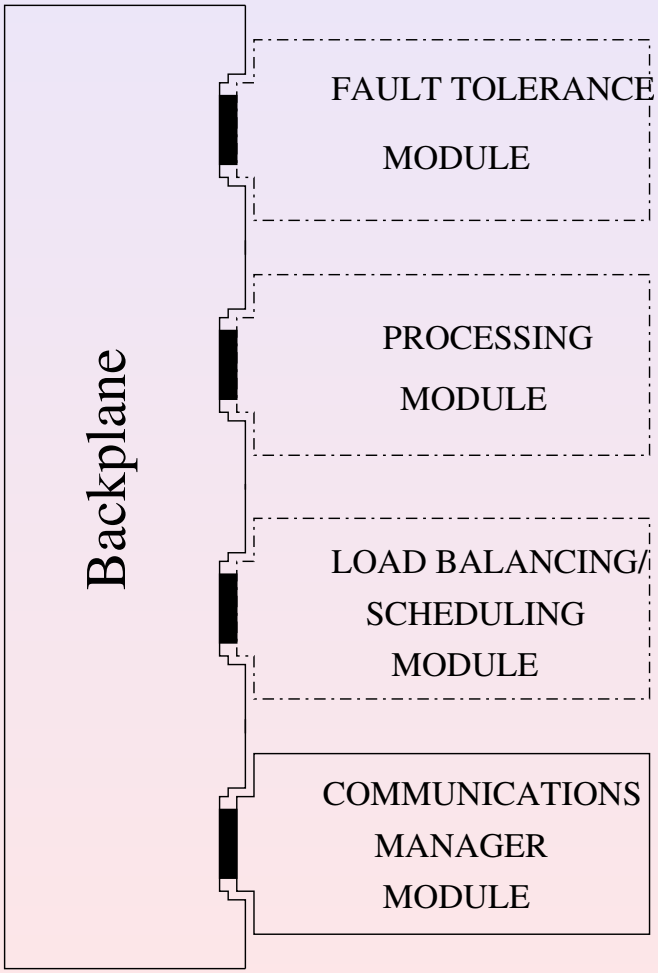
The message object

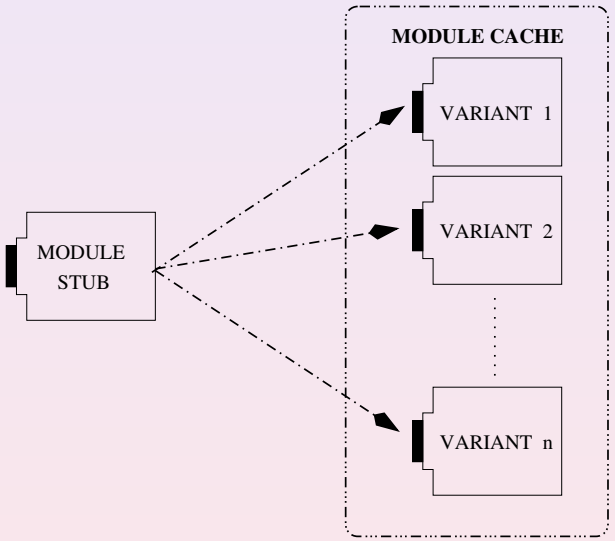


WebCom Architecture

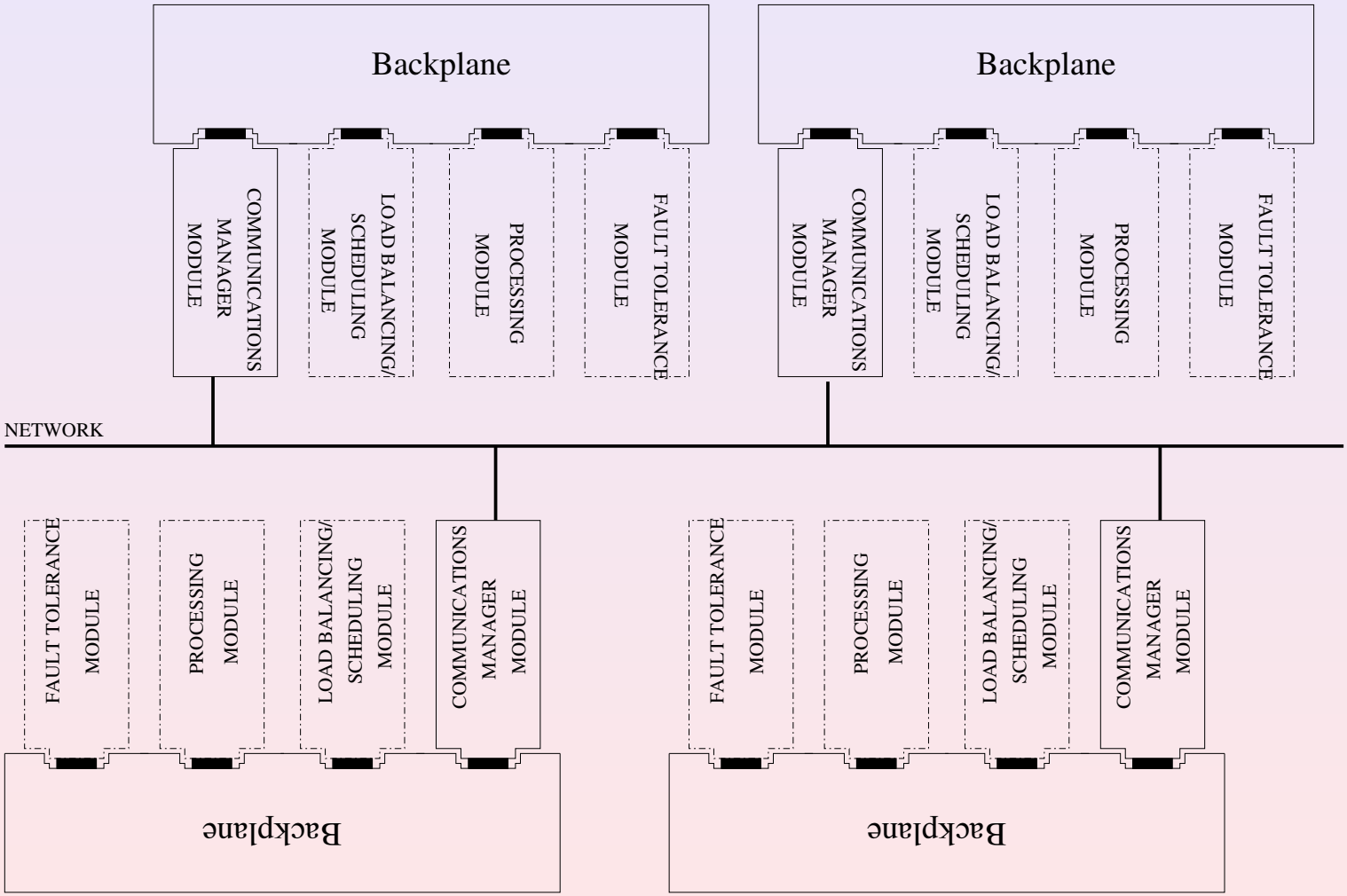
- Computing Platform (Abstract Machine)
  - Manage the network connections
  - uncover and schedule tasks
  - load balancing across the system
  - faults handling
  - execution of tasks
- Development Environment
  - develops the applications
  - specific for Condensed Graphs

Abstract Machine





Abstract Machine connected over a network



Outline

Functions of Backplane

- Initialisation - initial static configuration
- Interconnection - between modules
- Manage queue - processing tasks queue
- Pass tasks between modules

Processing Module

- inspects the message data
- determine the type of message
- add tasks to queue for execution
- execute the task
- send results to non local address
- list of partial results is maintained
- pass the uncovered tasks to the Backplane

Strandard Communication Manager Module

- Maintains two (client + server) distinct lists of connection descriptors
- descriptor facilitates the bidirectional communication between client and server.
- each client have one descriptor
- utilization falls with connections > 30

Advanced Communication Manager Module

- Maintains two descriptors
  - one maintaining an arbitrary number of incoming connections
  - other maintaining an arbitrary number of outgoing connections
- each connection have its own state
  - Available / Unavailable
  - Busy
- A client can indicate different status on each connection

Scheduling Tasks

Push Mechanism: Server transmit tasks

- check the status of client
- client should have sufficient buffer space

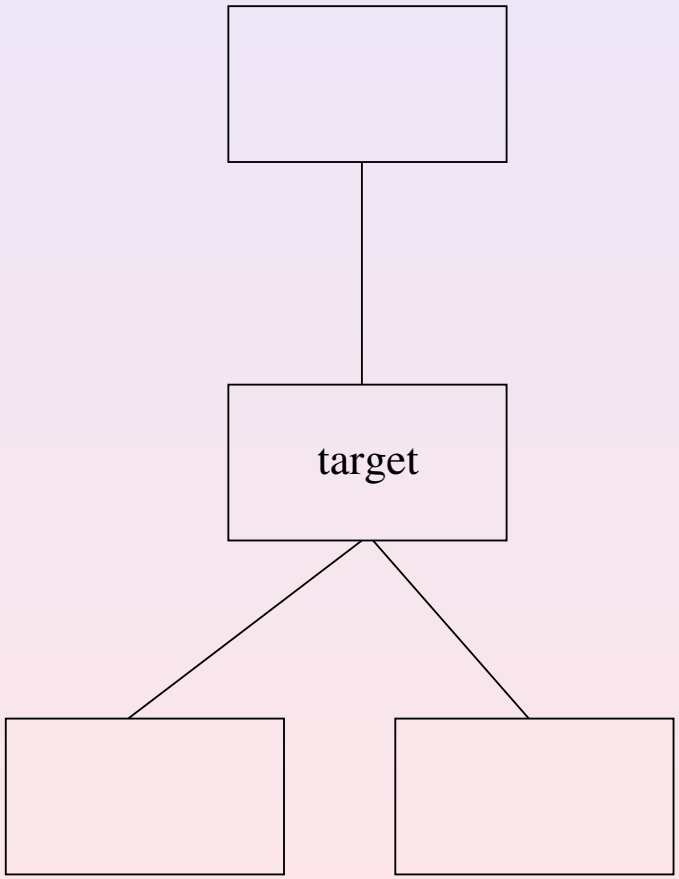
Pull Mechanism: Client take task for execution

- server maintained a queue of scheduled tasks for each client
- queues can be rebalanced for better scheduling

Machine depart from WebCom

- Soft disconnection
  - machine process scheduled tasks offlined
  - temporarily unavailable
  - tasks can be scheduled to be transmitted later
- Hard disconnection
  - connection is closed
  - removed from the descriptors
  - pending tasks will be handled by Fault Tolerance Module

Processor Replacement Procedure



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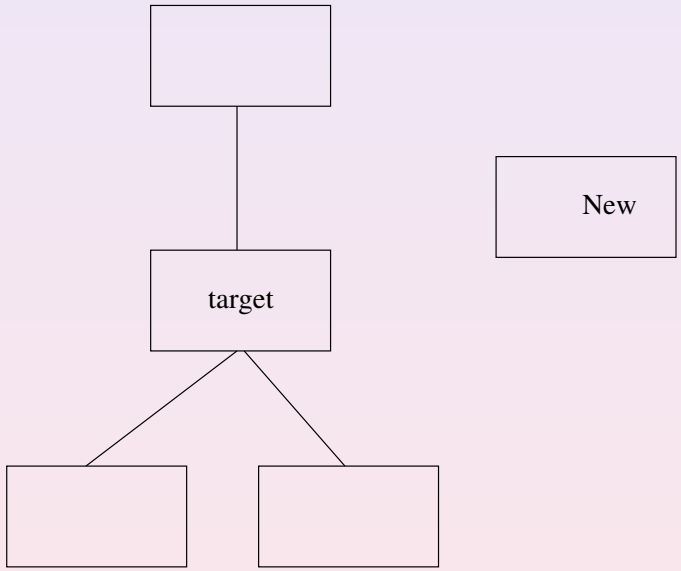

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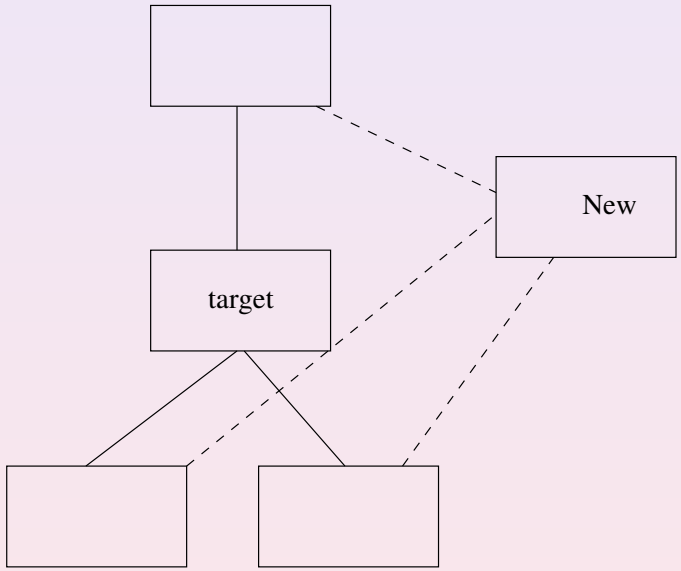

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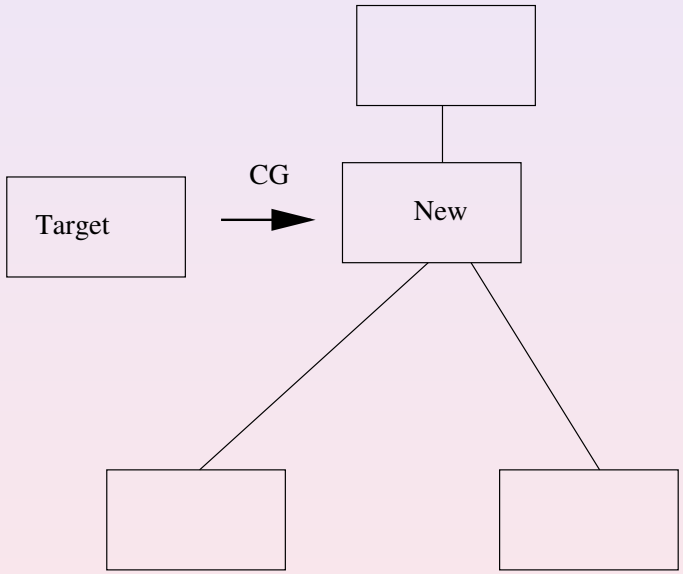
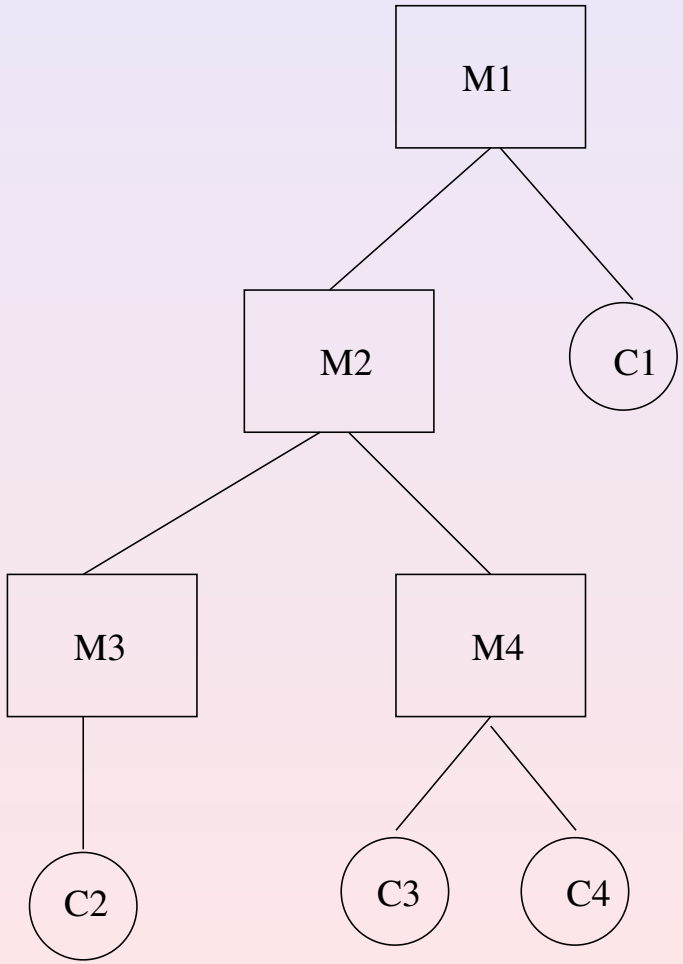


Information on each processor

- knows nodes - parent, children, grandparent and peers
- history list - purge periodically
- size of history list - max no. of instruction in each CG

Fault Recovery Procedure



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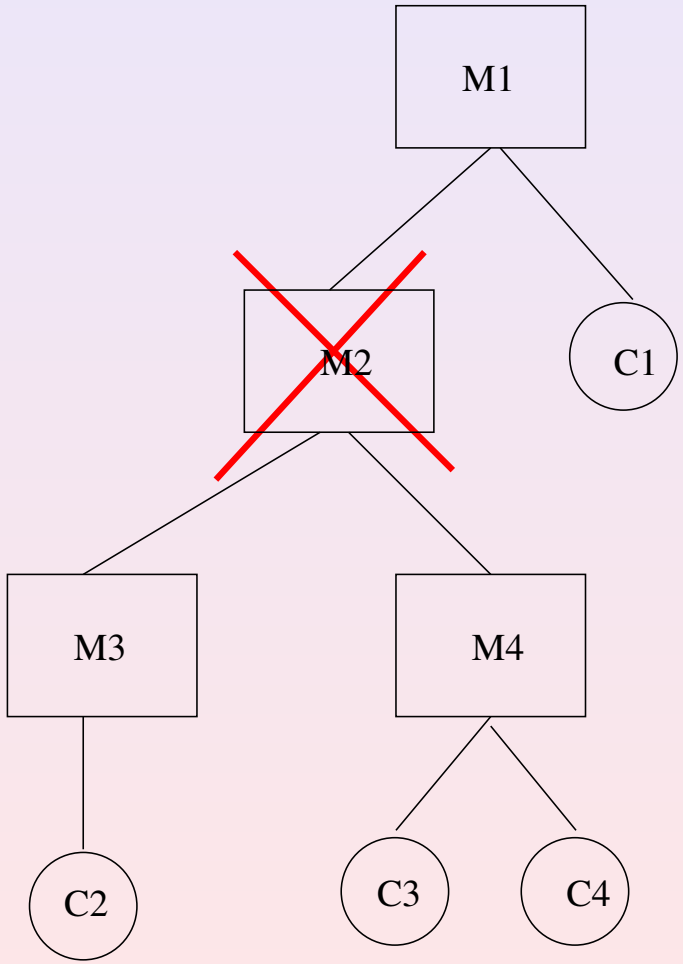

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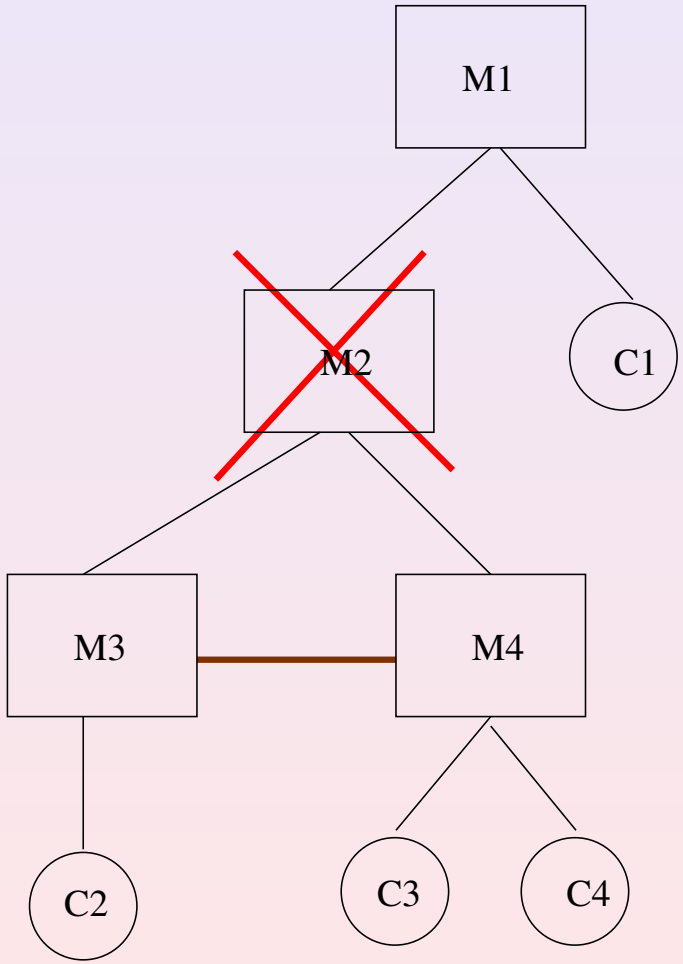

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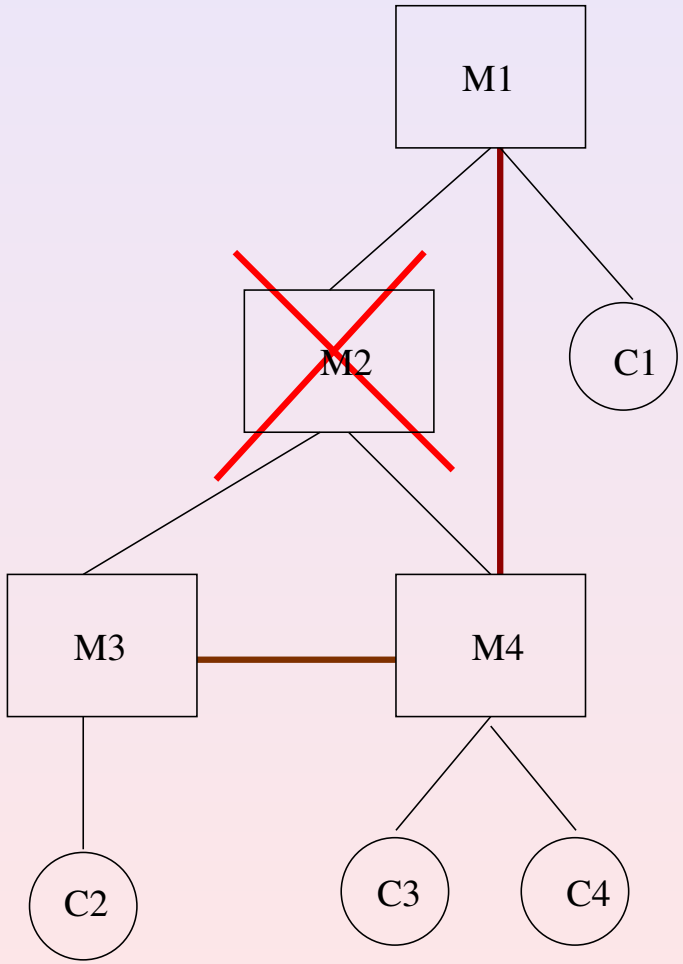

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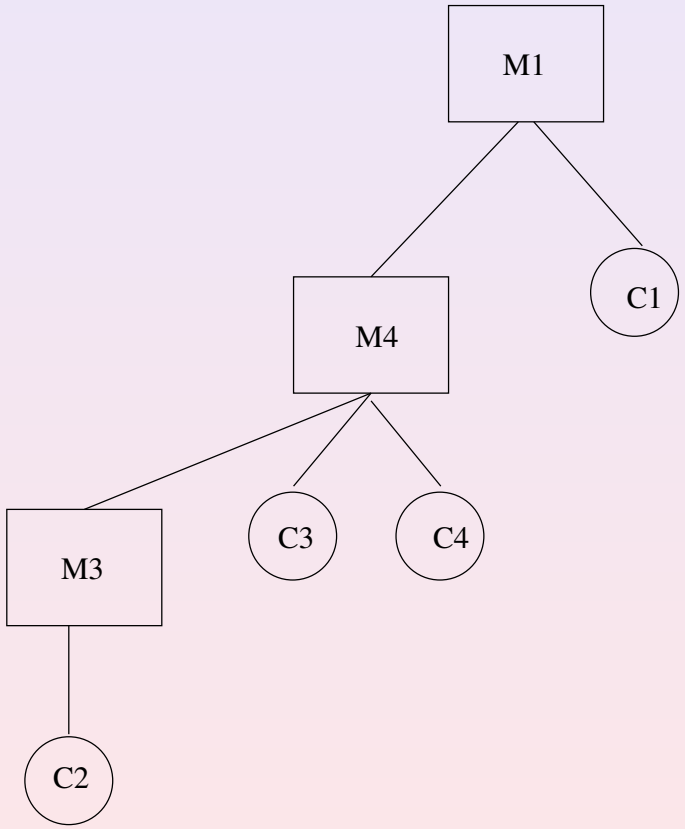

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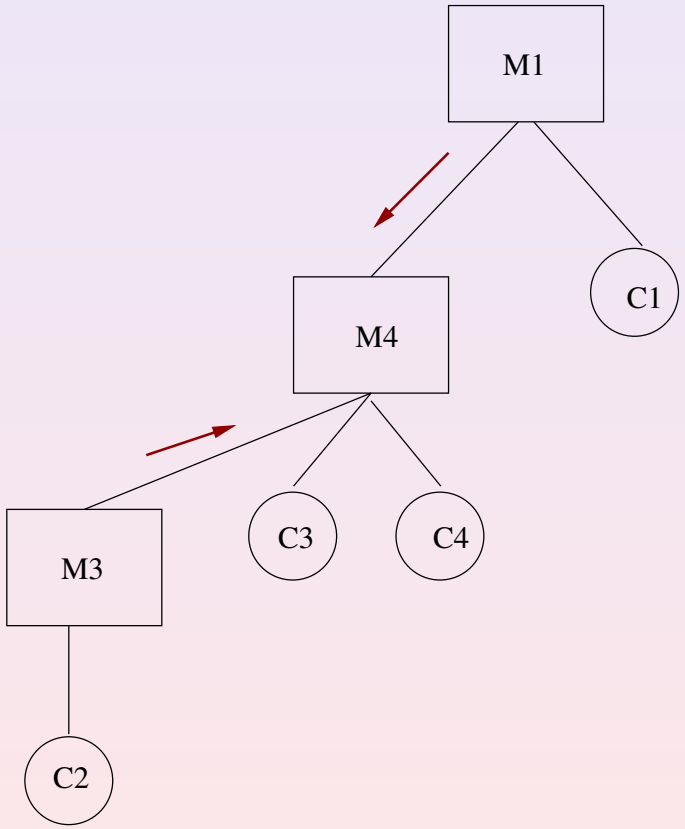
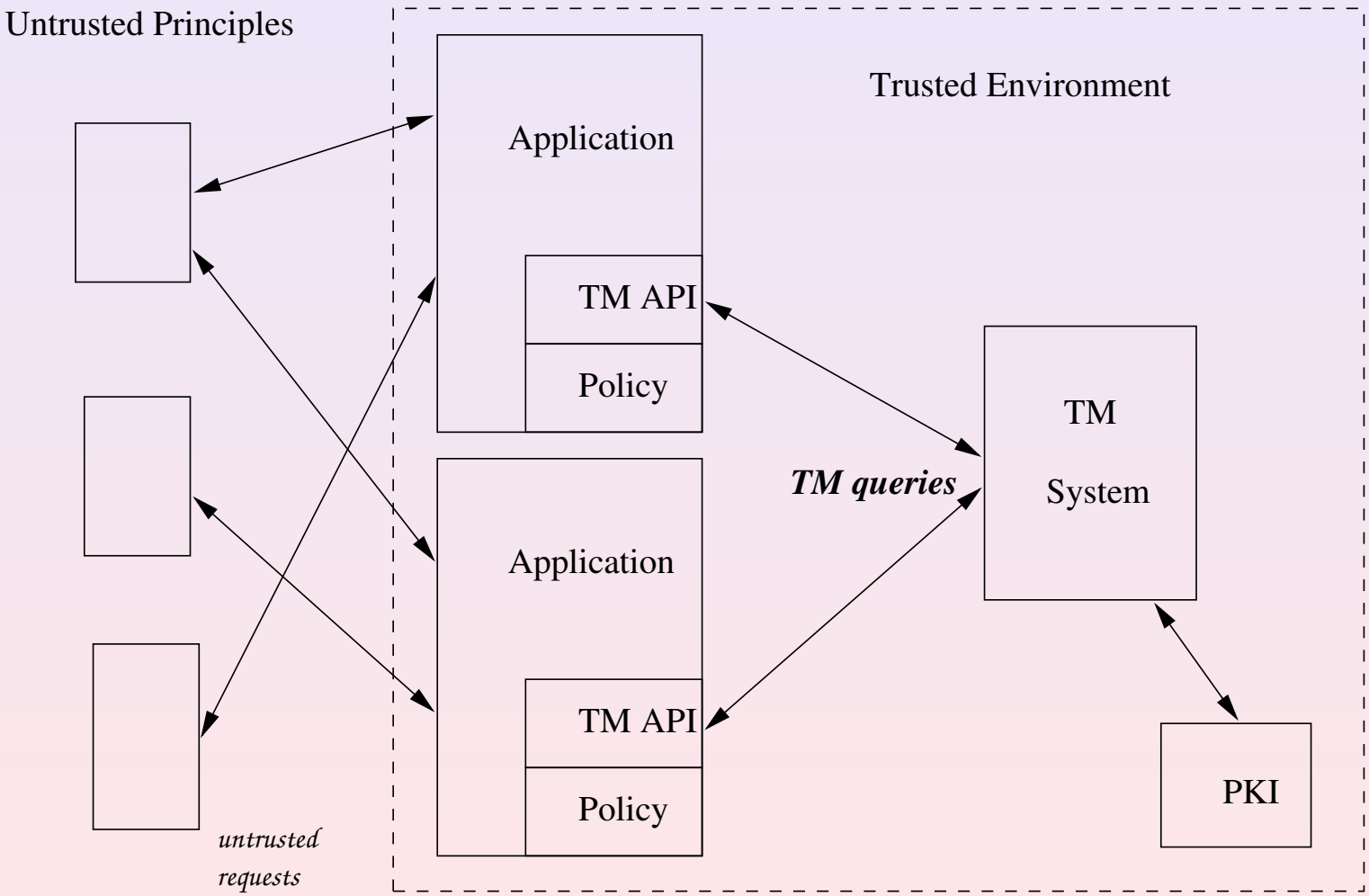


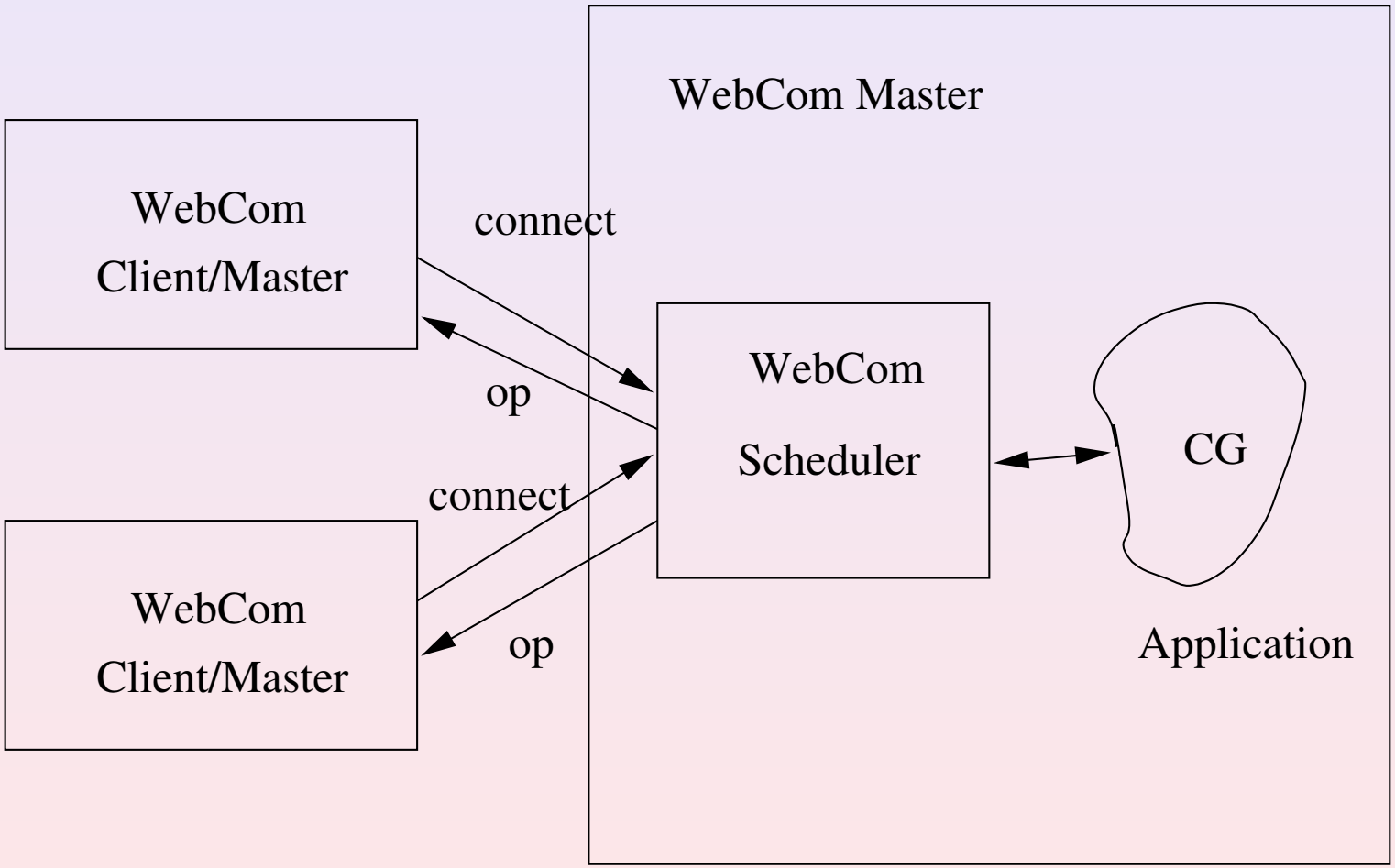
Trust Management System

- TM- construct and interpreat the trust relationships among public keys.
- Policy - credentials, representing the keys that are trusted
- Credentials - specify delegation of authority among public keys
- PKI - manage the credentials
- Master and Client Authorization

KeyNote Trust Management System

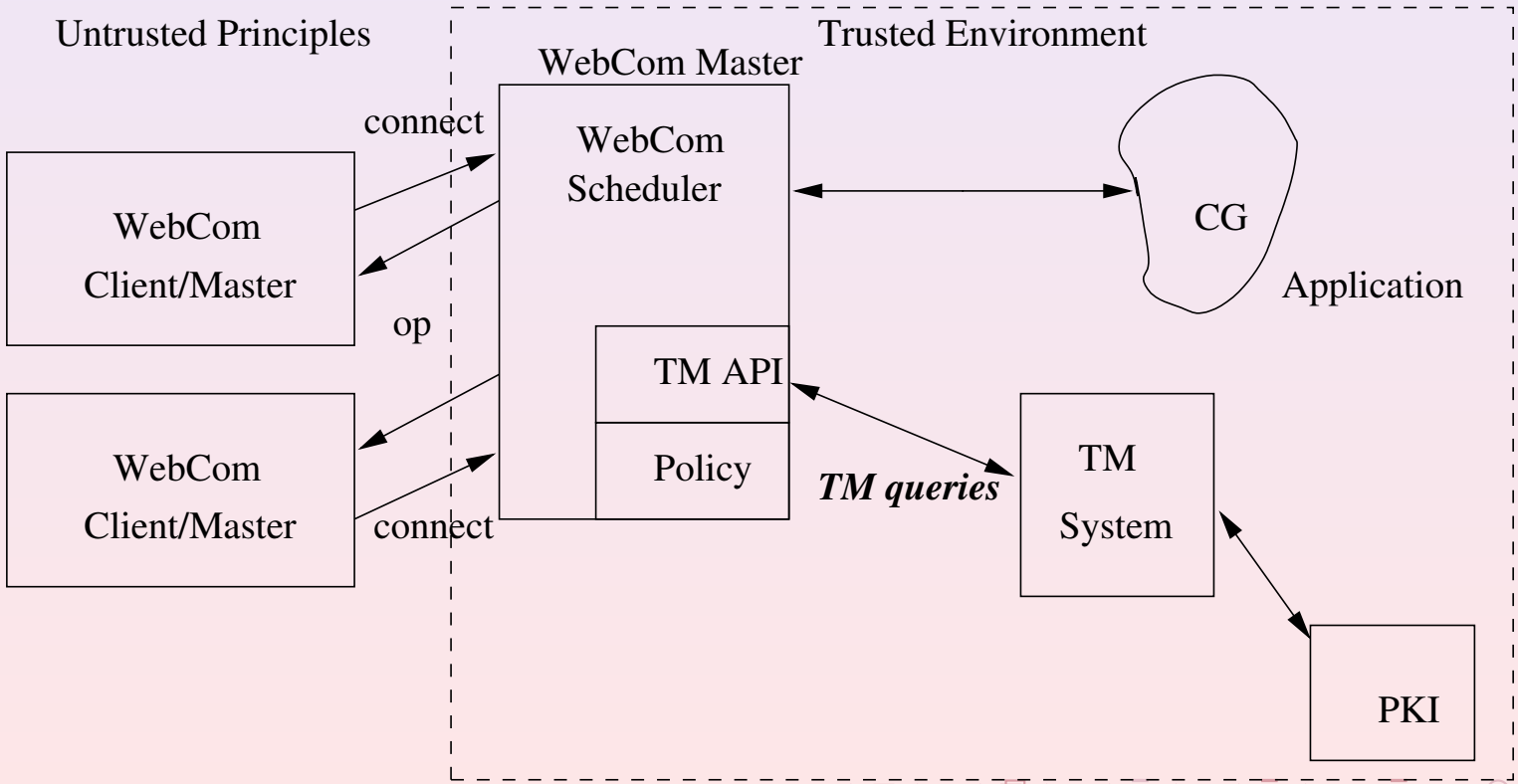


The WebCom Distributed System



KeyNote + WebCom

- X509 certificates are used for authentication
- KeyNote credentials are used for authorisation



load balancing strategies

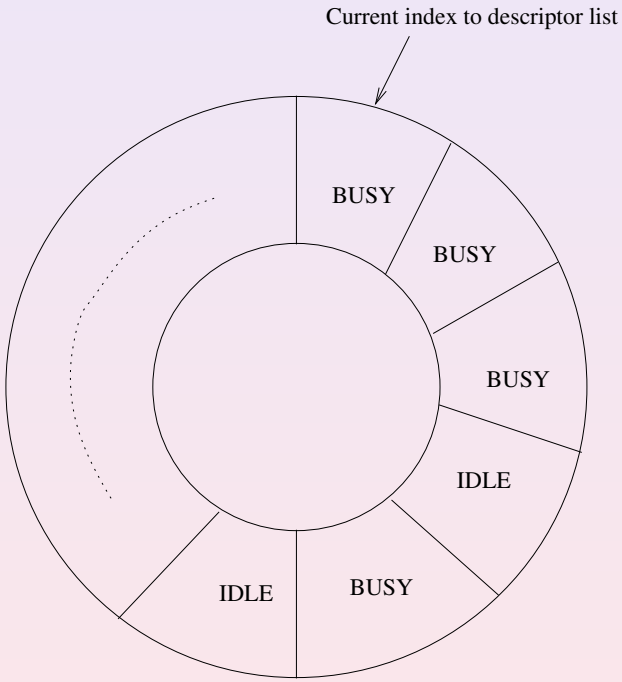
General

- static or dynamic
- centralised or distributed
- active or passive

WebCom strategies

- dynamic
- centralised
- passive

Round Robin fashion



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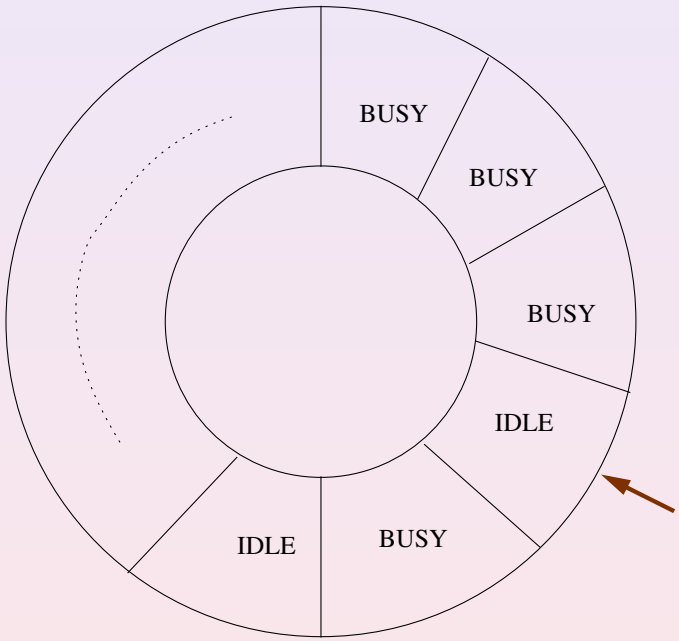

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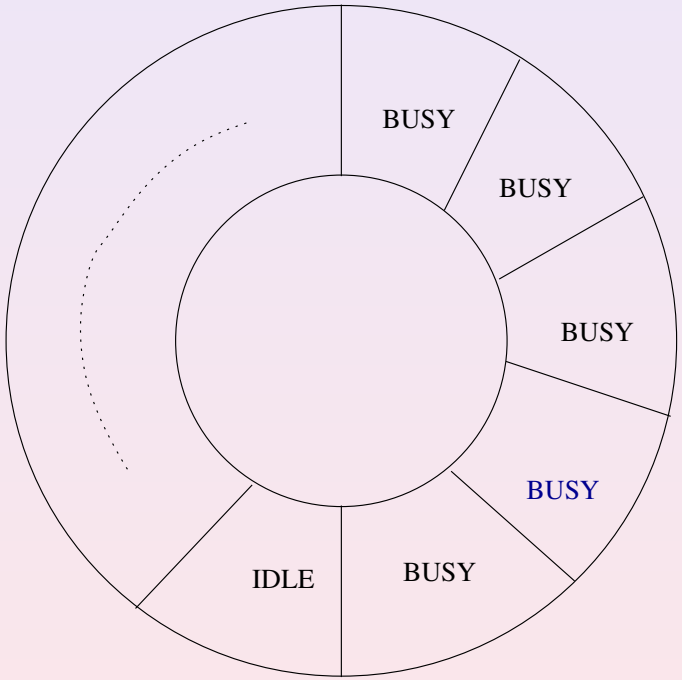
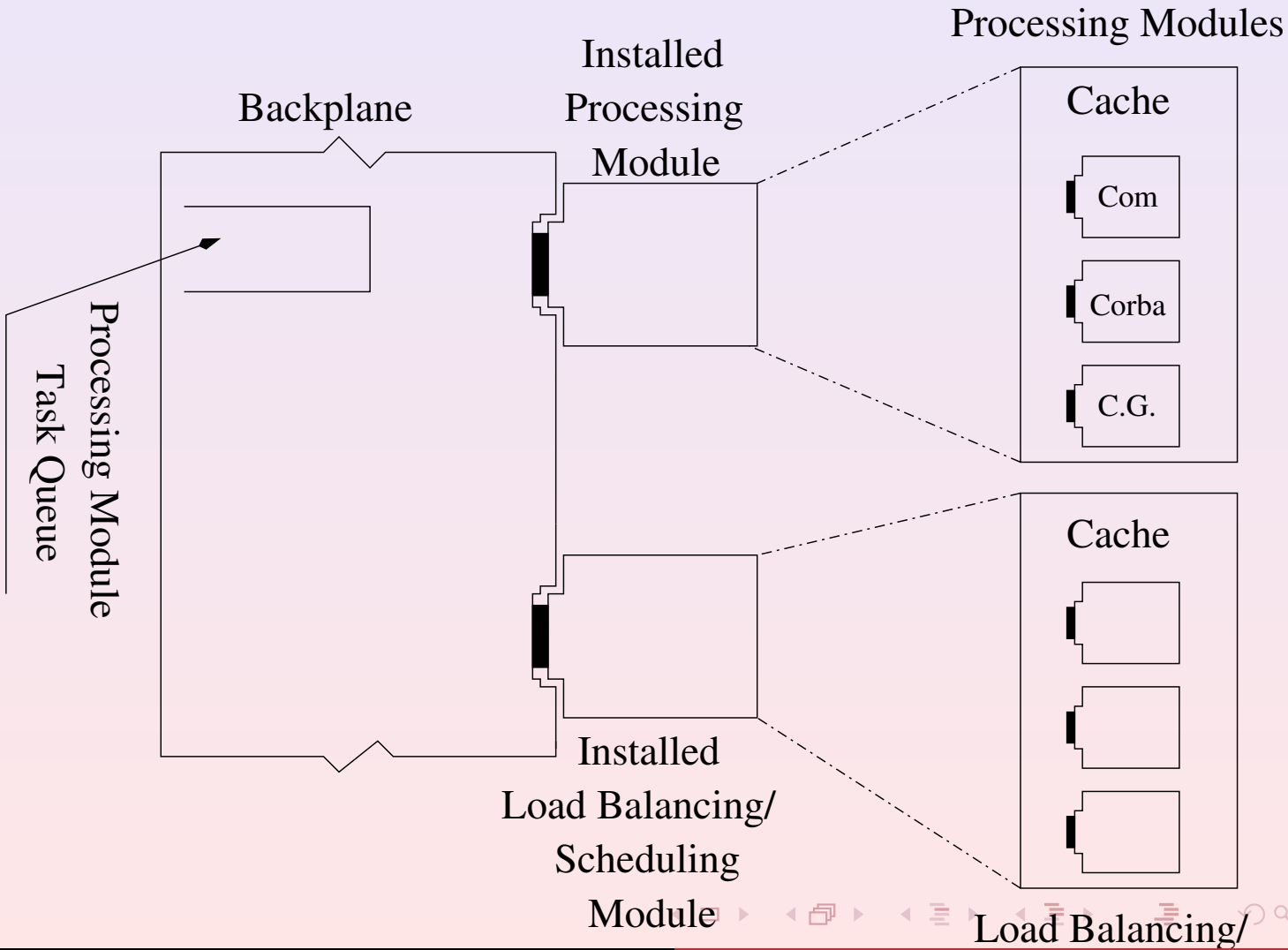


Scheduling - Locally or Remotely

- start with round robin
- expected execution time matching
  - $Lc_{(j)} = Tax_{(i)}c_{(j)} \times G_{(i)}$
  - $Tax_{(i+1)}c_{(j)} = Lc_{(j)} \times G_{(i+1)}$
  - $\Delta Exp_{(i,j)} = Tax_{(i+1)}c_{(j)} - G_{(i+1)}$
- 0 - doesn't matter
- Positive - Locally
- Negative - Remotely

Outline

Local execution of task



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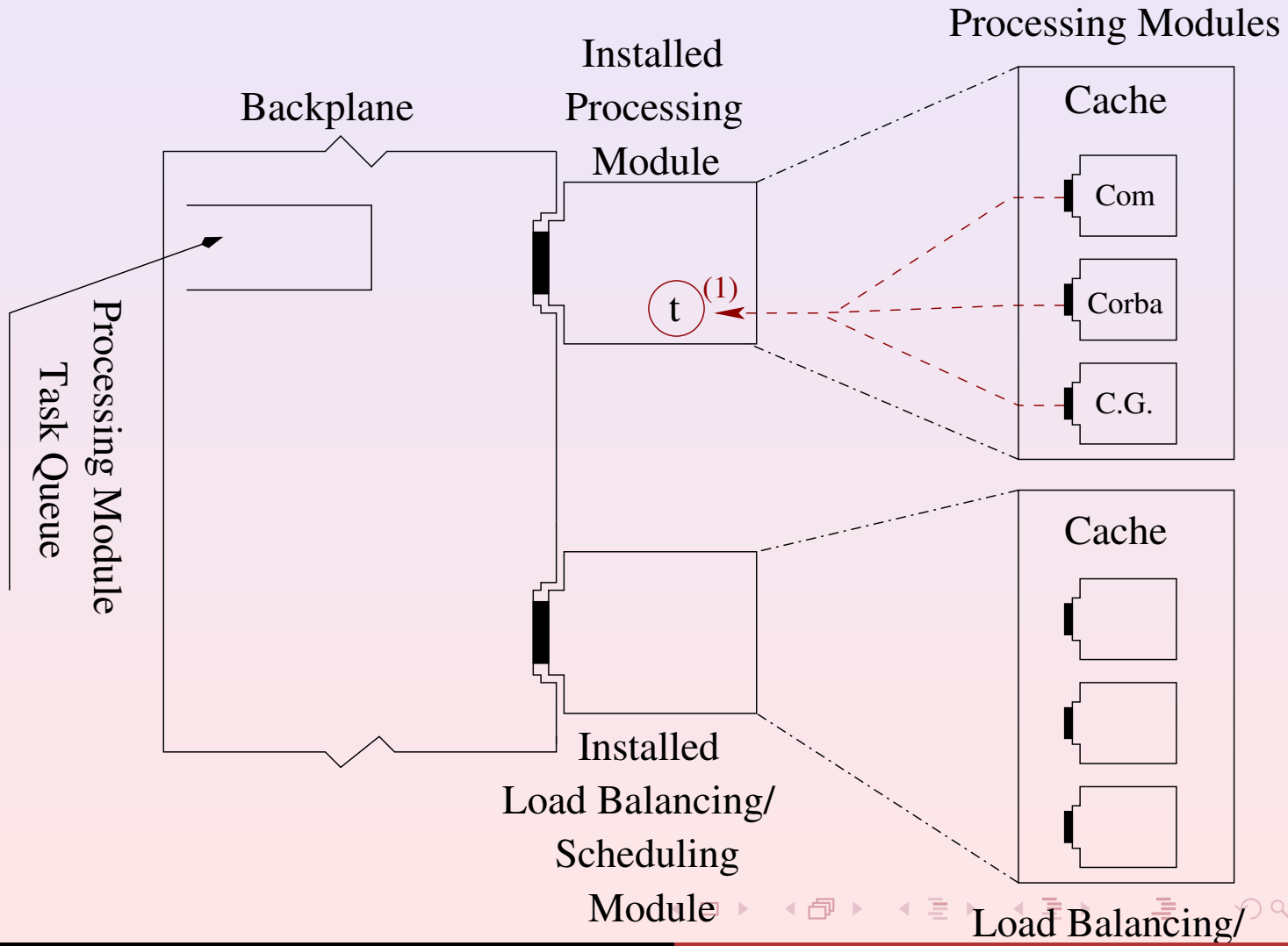

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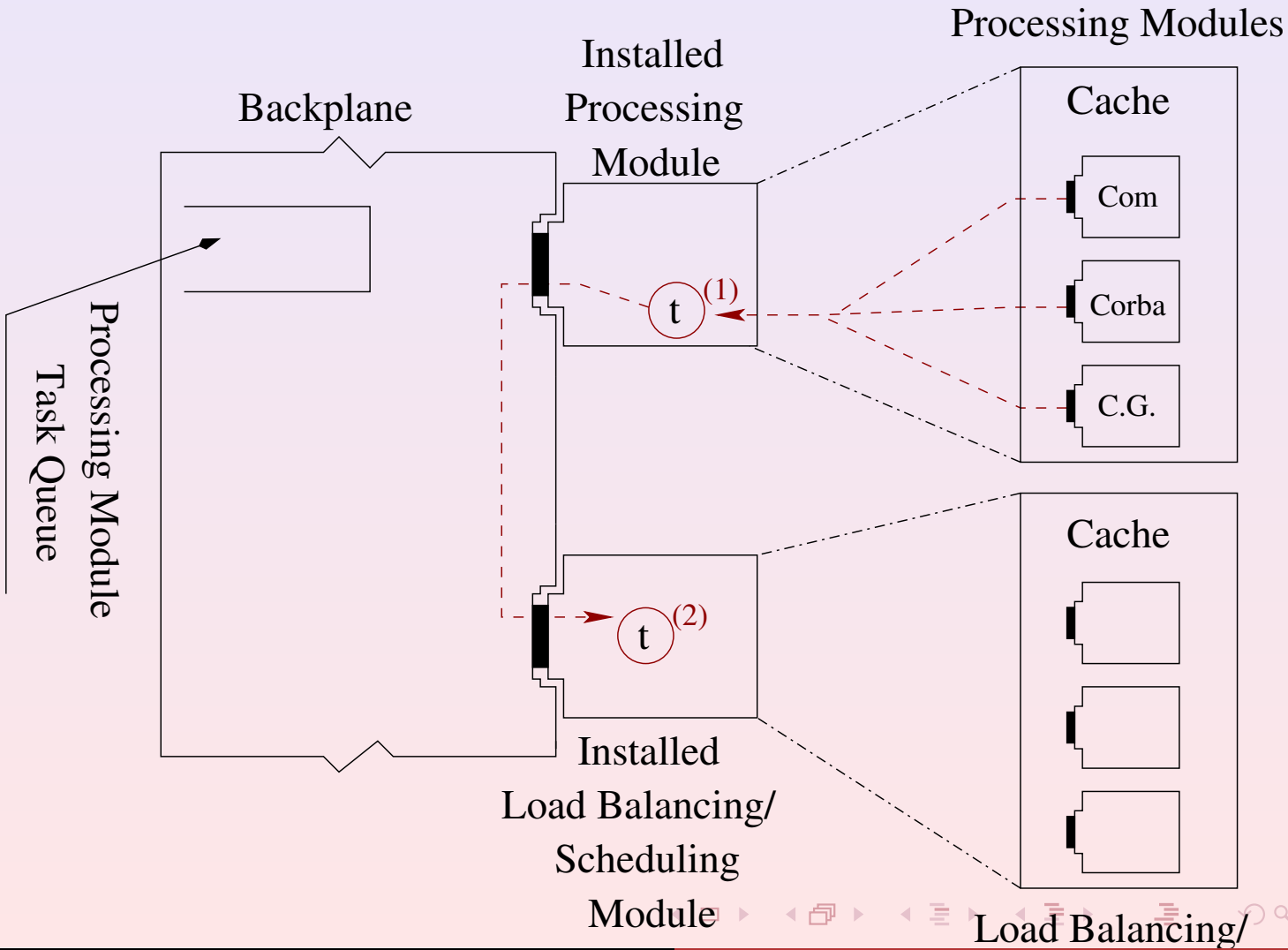

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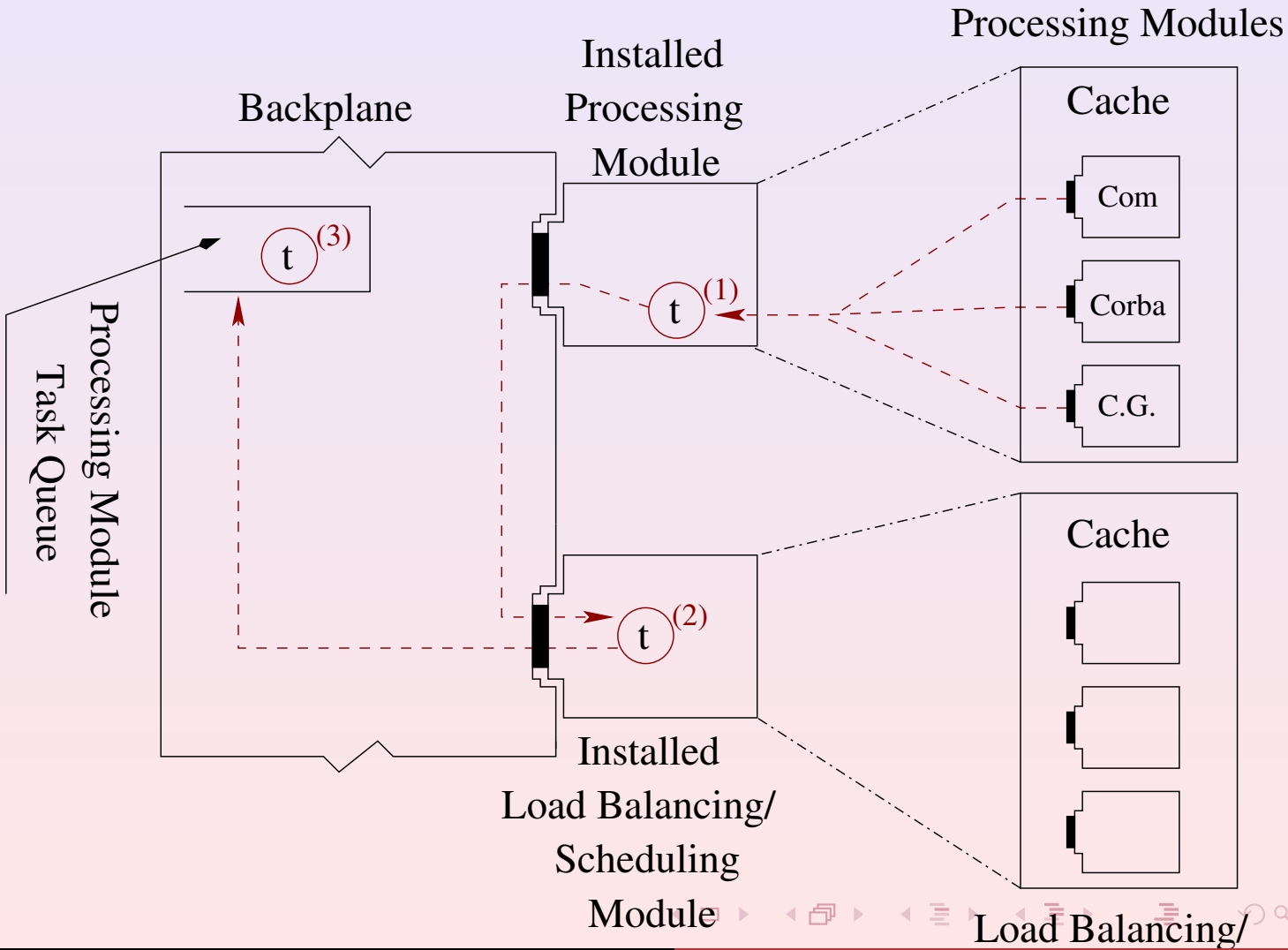

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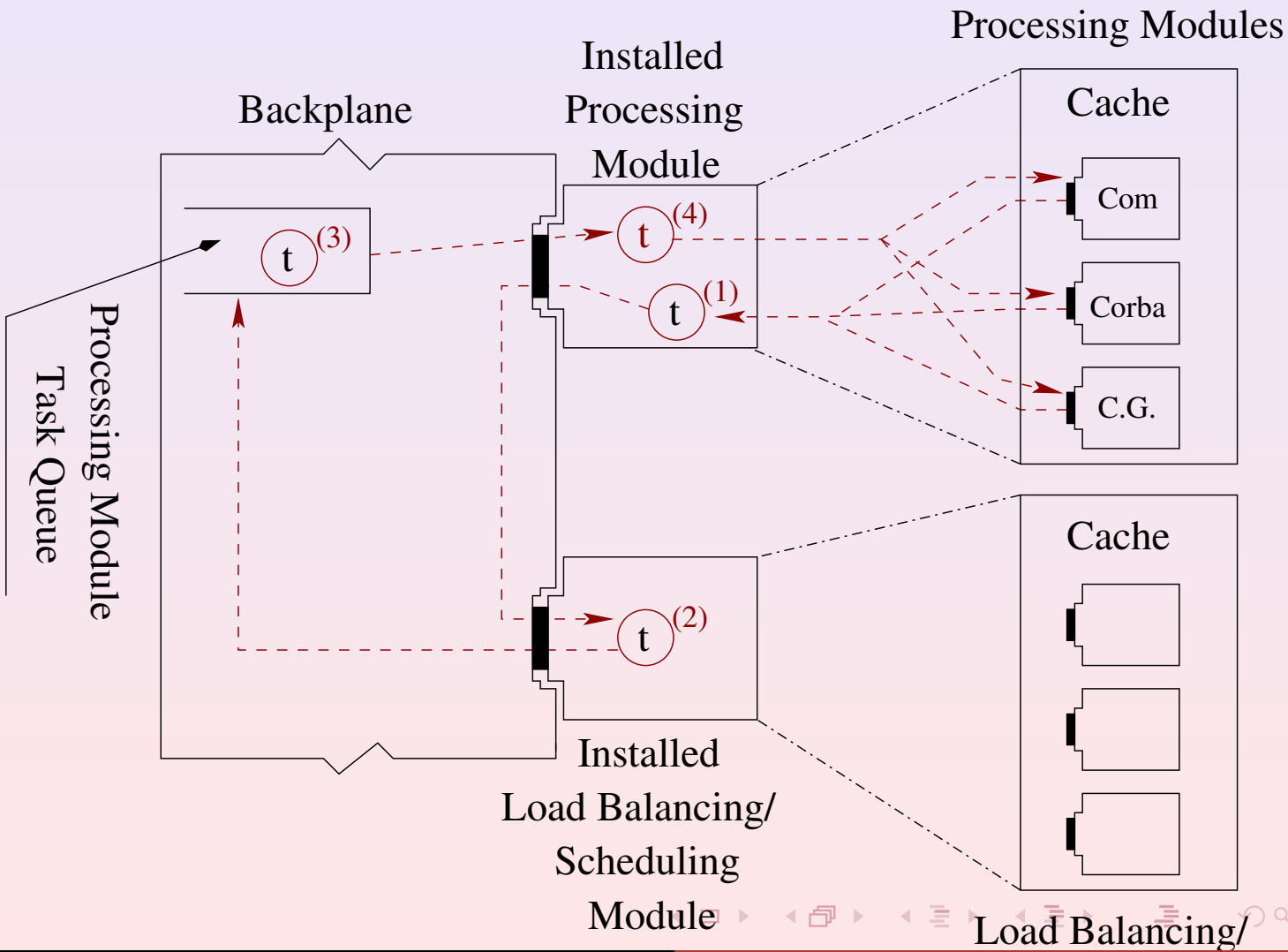
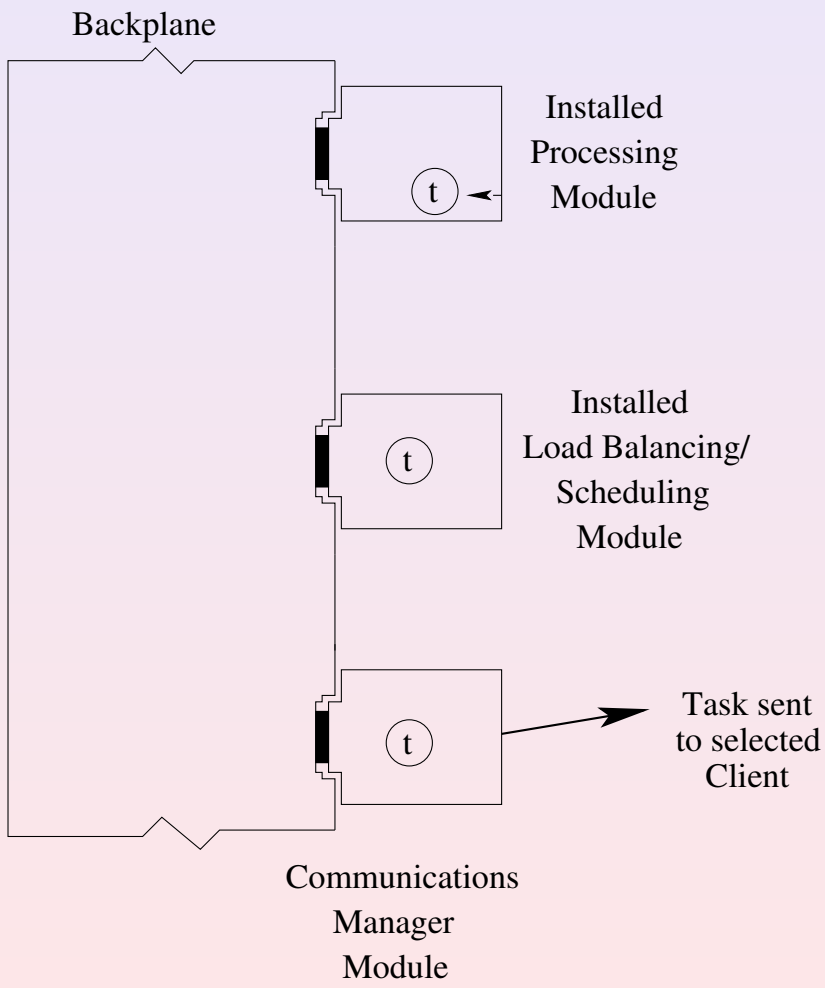


Remote execution of task



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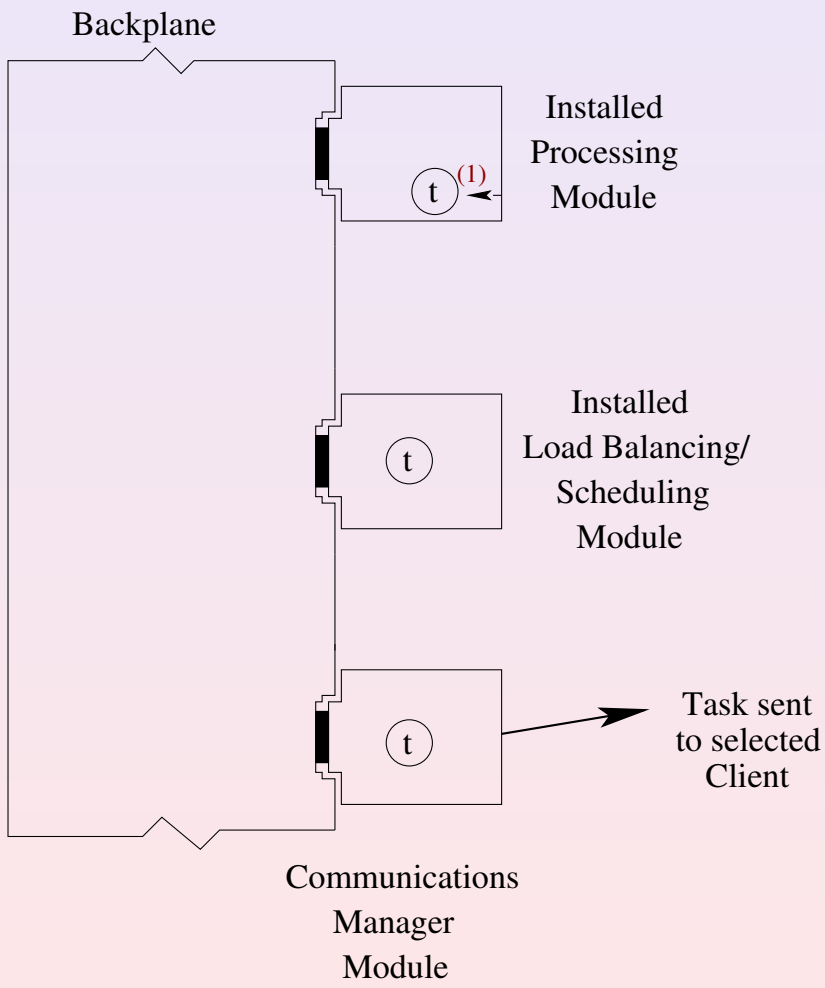

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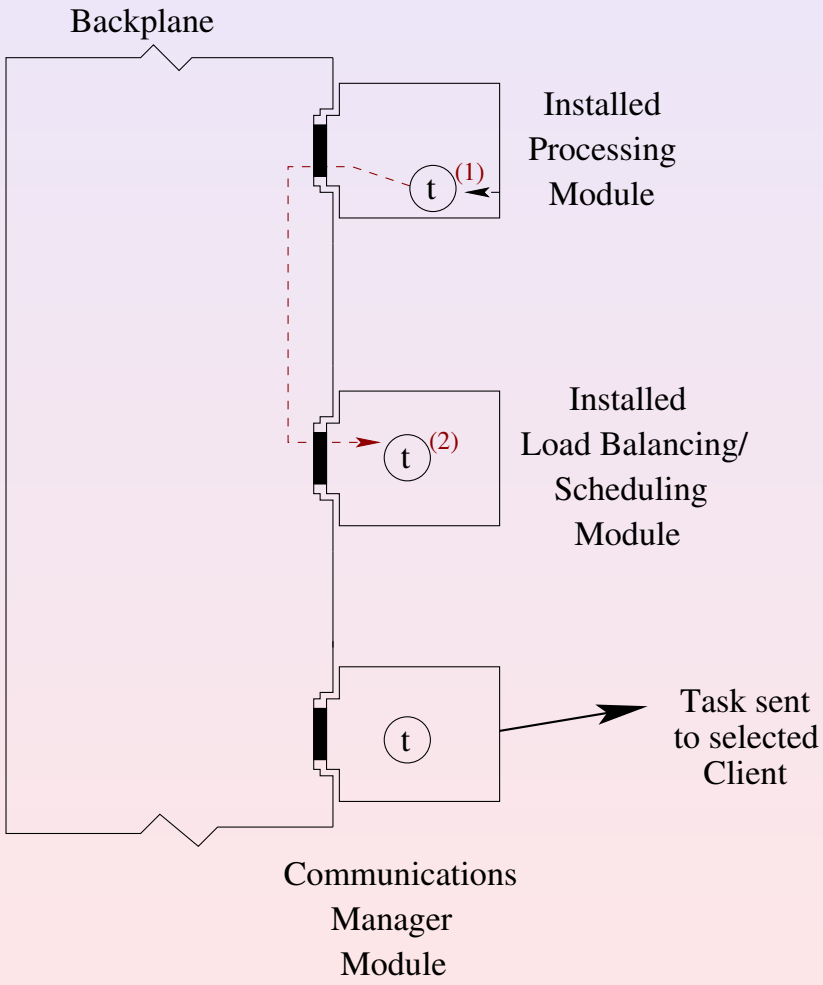

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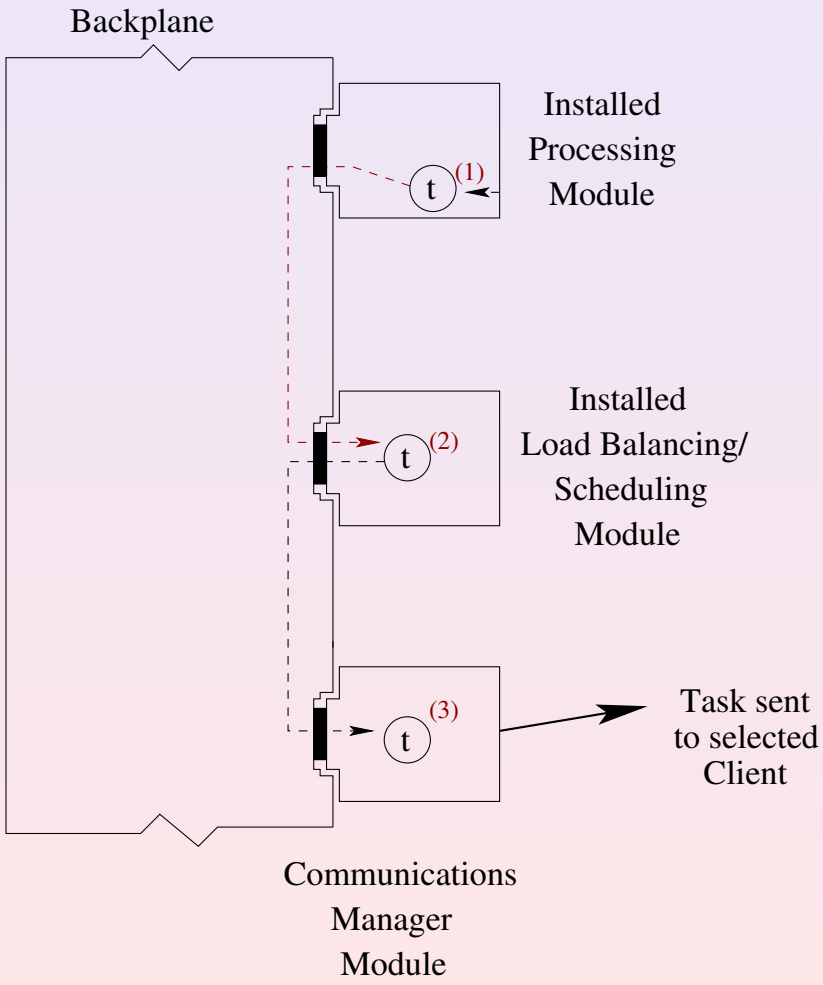
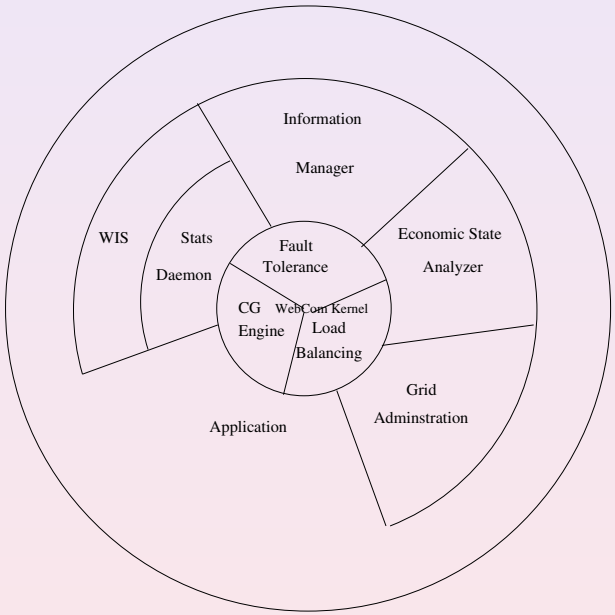


Outline

WebCom+Grid Operating System

- seamless interoperatibility with existing core grid middlewares
- operate between the system hardware and installed grid middleware
- select the appropriate middleware based on specific requirements of the application



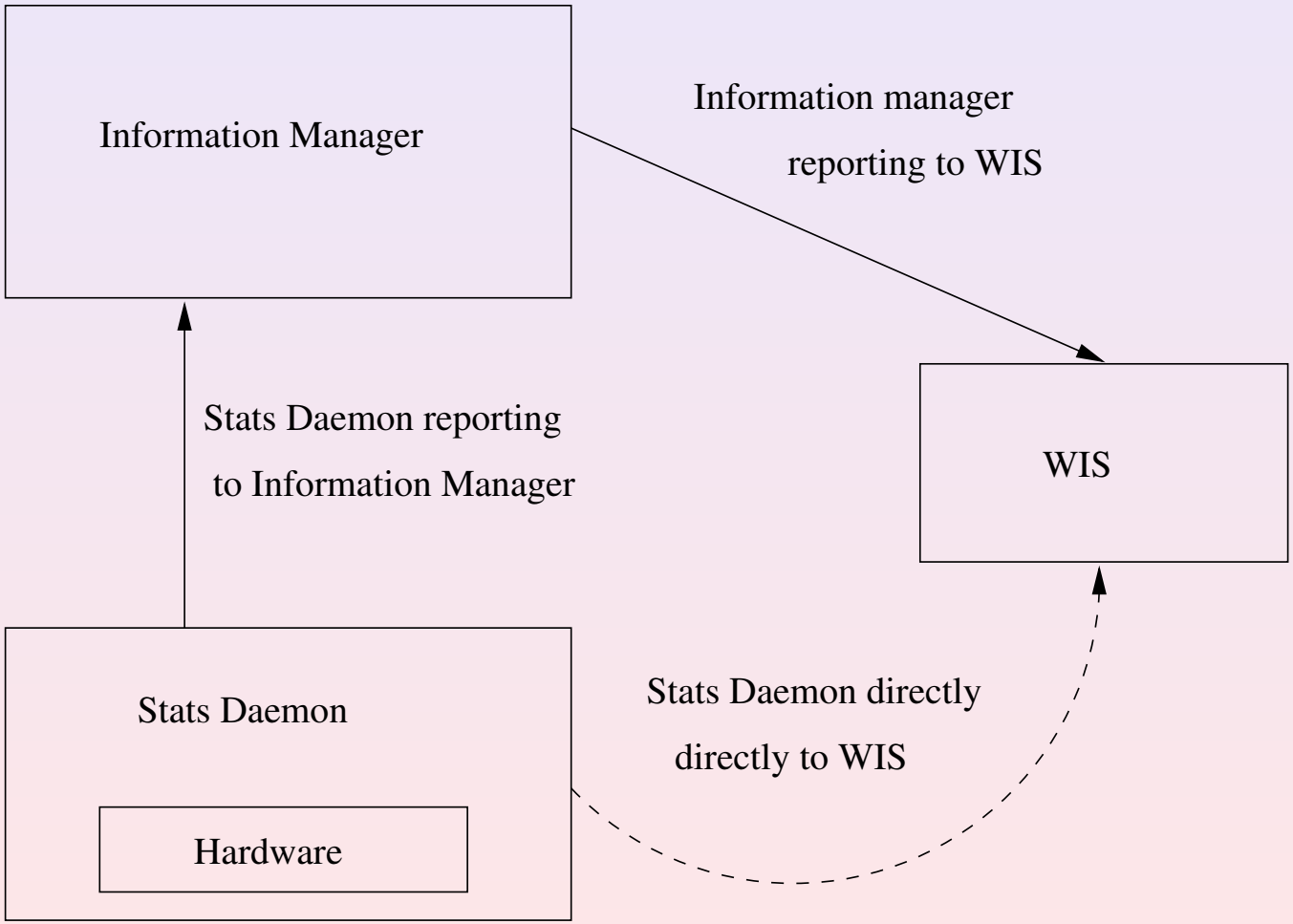
Components of WebCom-G OS

- Economy Status Analyser
  - collects overall resource status of the grid machines
  - evaluates total cost of utilization by using various algorithms
- Stats Daemon
  - uses standard system calls to retrieve system information
  - logs system usage to the hard drive

Components of WebCom-G OS

- WebCom-G Information Module
  - information gathering module within the WebCom-G OS
  - 3 components
    - low-level stats daemon to run directly on hardware
    - higher-level information manager
    - WIS proper communicate with single stats daemon or middlewares
- Grid Administration
  - allow administration by user or middleware
  - dynamically renice the processes

Architecture of WebCom-G Information gathering Module



Outline

Conclusion

- Push and pull connections
- Task targeting and forwarding
- Client promotion and redirection
- Load Balancing and fault tolerance
- Security throught trust management system
- Glue between system hardware and middlewares

Future Work

- DIET + WebCom
- Execute WebCom application on DIET
- Use WebCom fault tolerance for DIET