

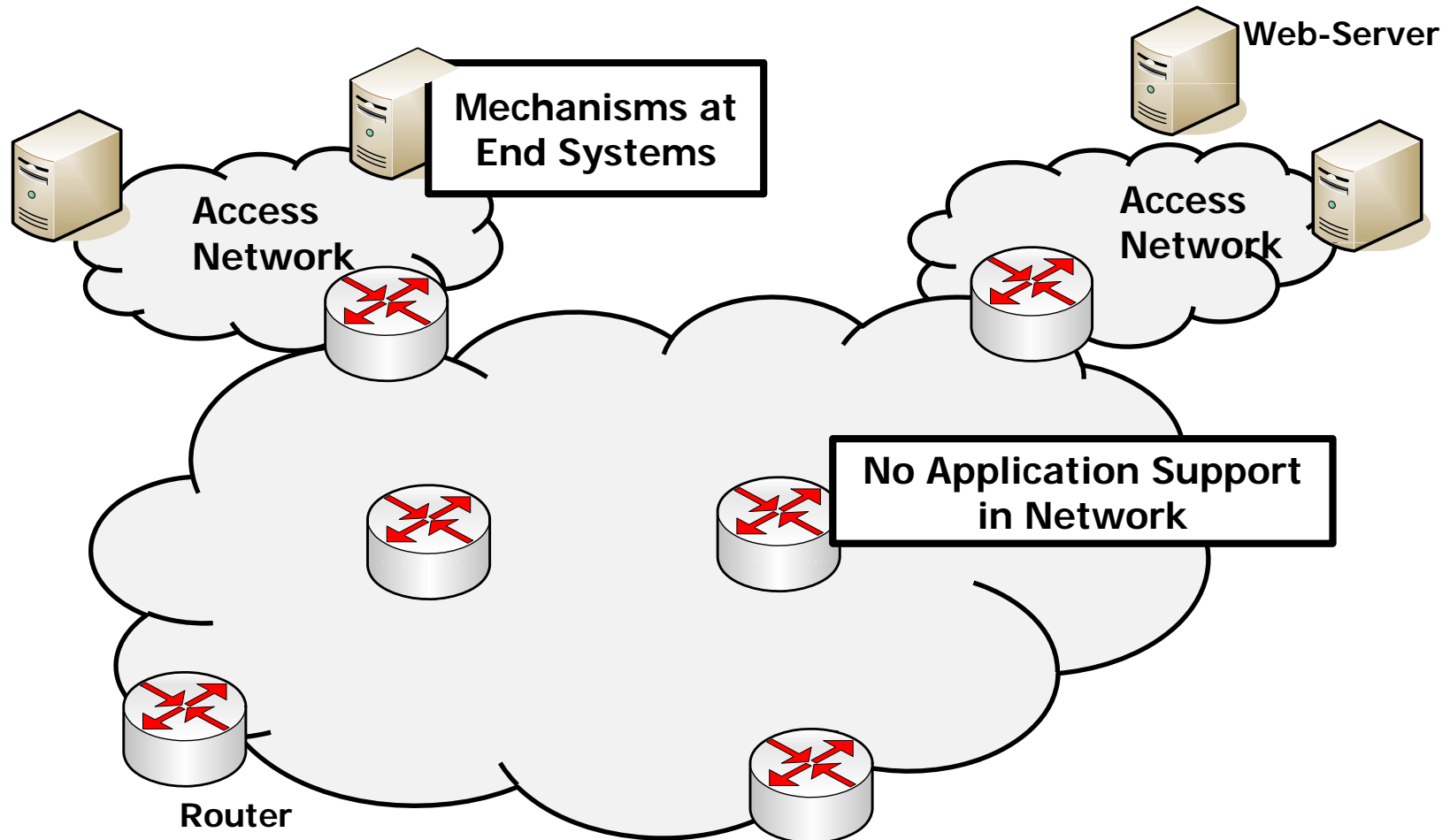
Presentation and Demo:

Flow Valuations based on Network-Service Cooperation

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Today: End-to-End Principle



Internet Problems

■ Security Threats

- Immense monetary loss
- Fast adapting attack patterns

■ Management costs

- Increasing network size
- Increasing heterogeneity (technical, administrative)

■ Lack of support for users and applications

- Quality, security levels, route options, privacy, etc.

Reconsider Internet Design Principles

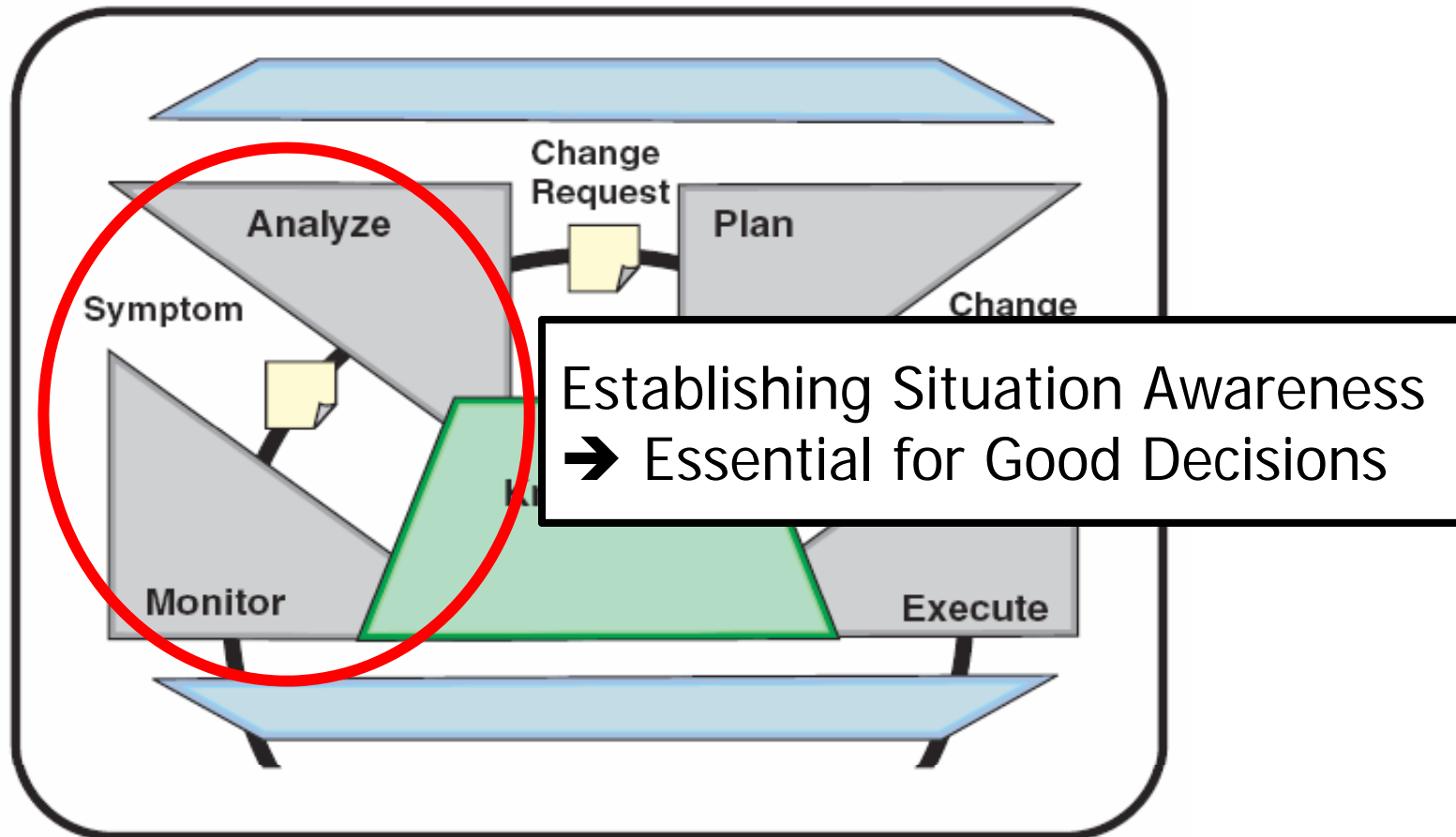


The Idea of Autonomic Networking

- Bring *decision cycles* in network nodes
 - Establish situation awareness
 - Enable decision processes beyond routing
- Objectives:
 - Support for Applications in the network
 - Flexible levels for quality, security, etc.
 - Self-Management
 - Reduction of human intervention
 - Self-Protection
 - Protection of network and applications



Decision Cycle

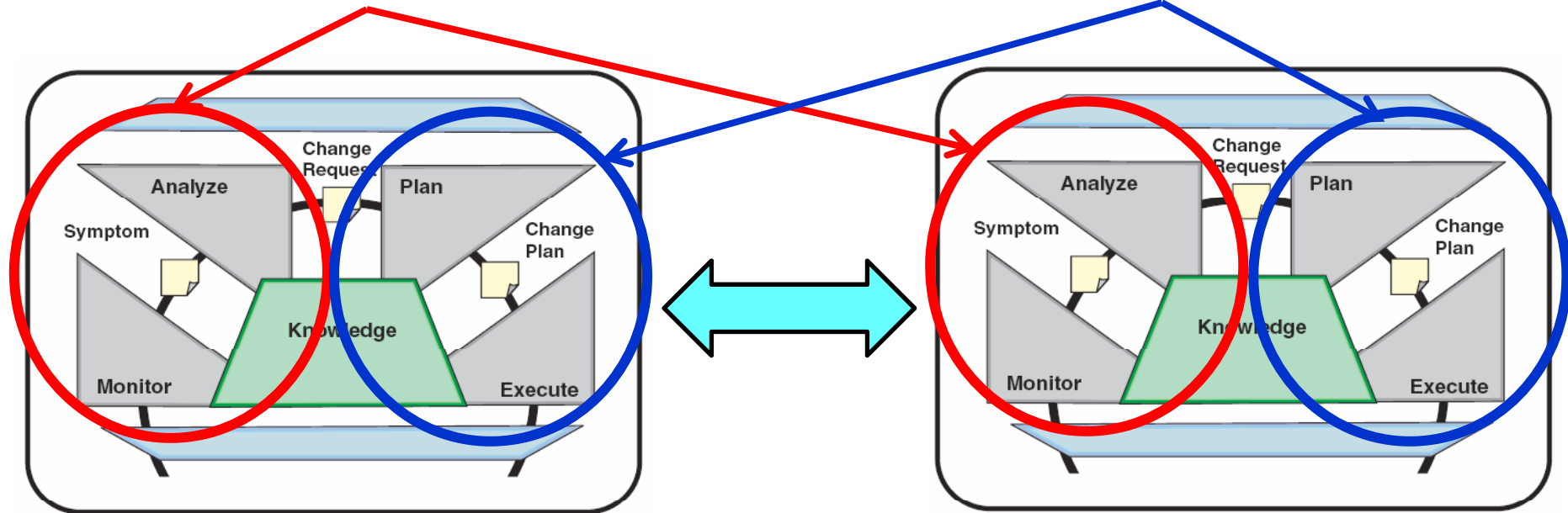


Autonomic Computing [IBM]: MAPE
Monitor-Analyze-Plan-Execute

Enabler: Node Collaboration

Improve Situation Awareness

Enforce Joint Strategy



Provide Different Viewpoints

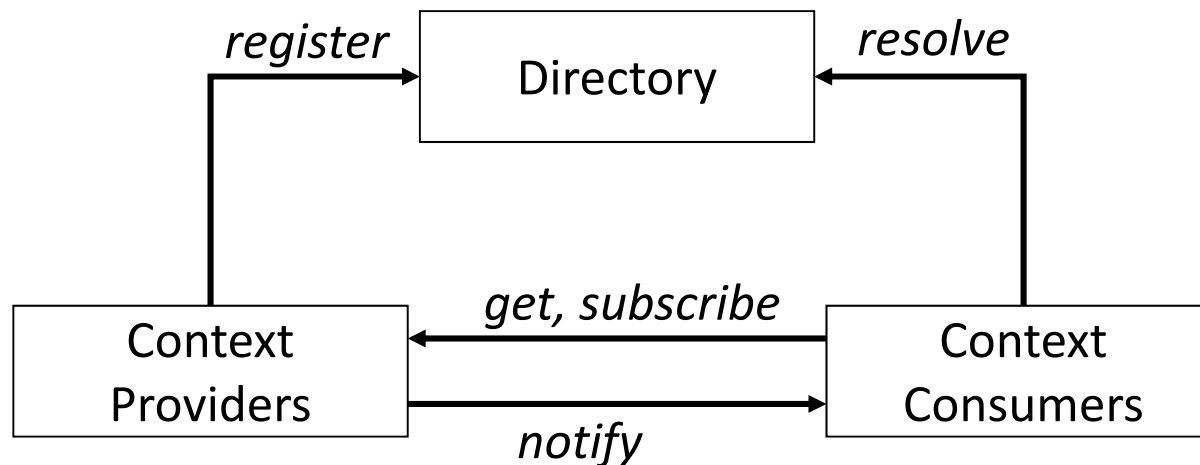
Learn from Others



Node Collaboration System (NCS)

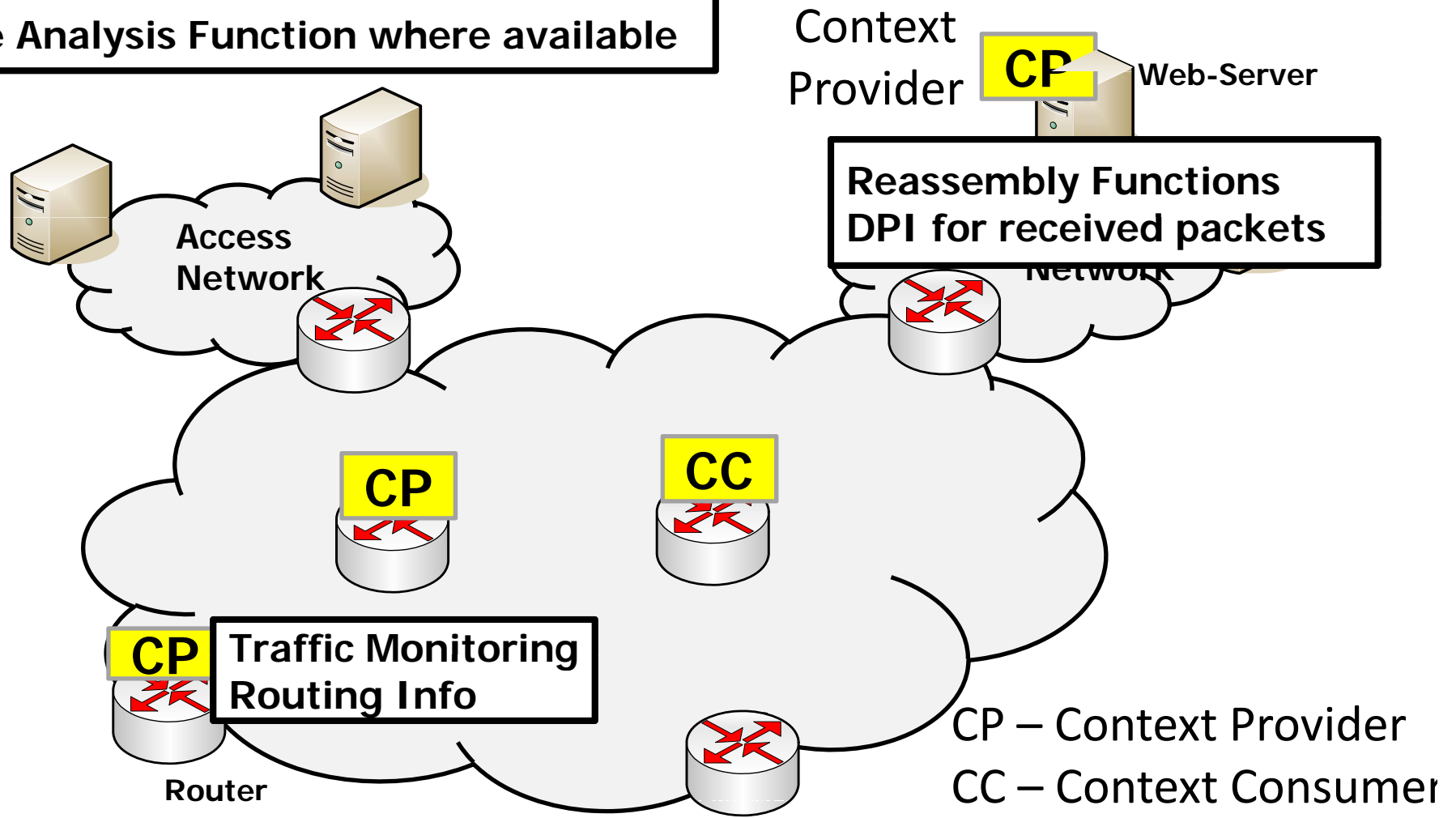
■ Nodes that want to collaborate

- Register with directory
- Provide location of information they can offer (context provider)
- Can get location of network information from others (context consumer)



Node Collaboration System

Use Analysis Function where available

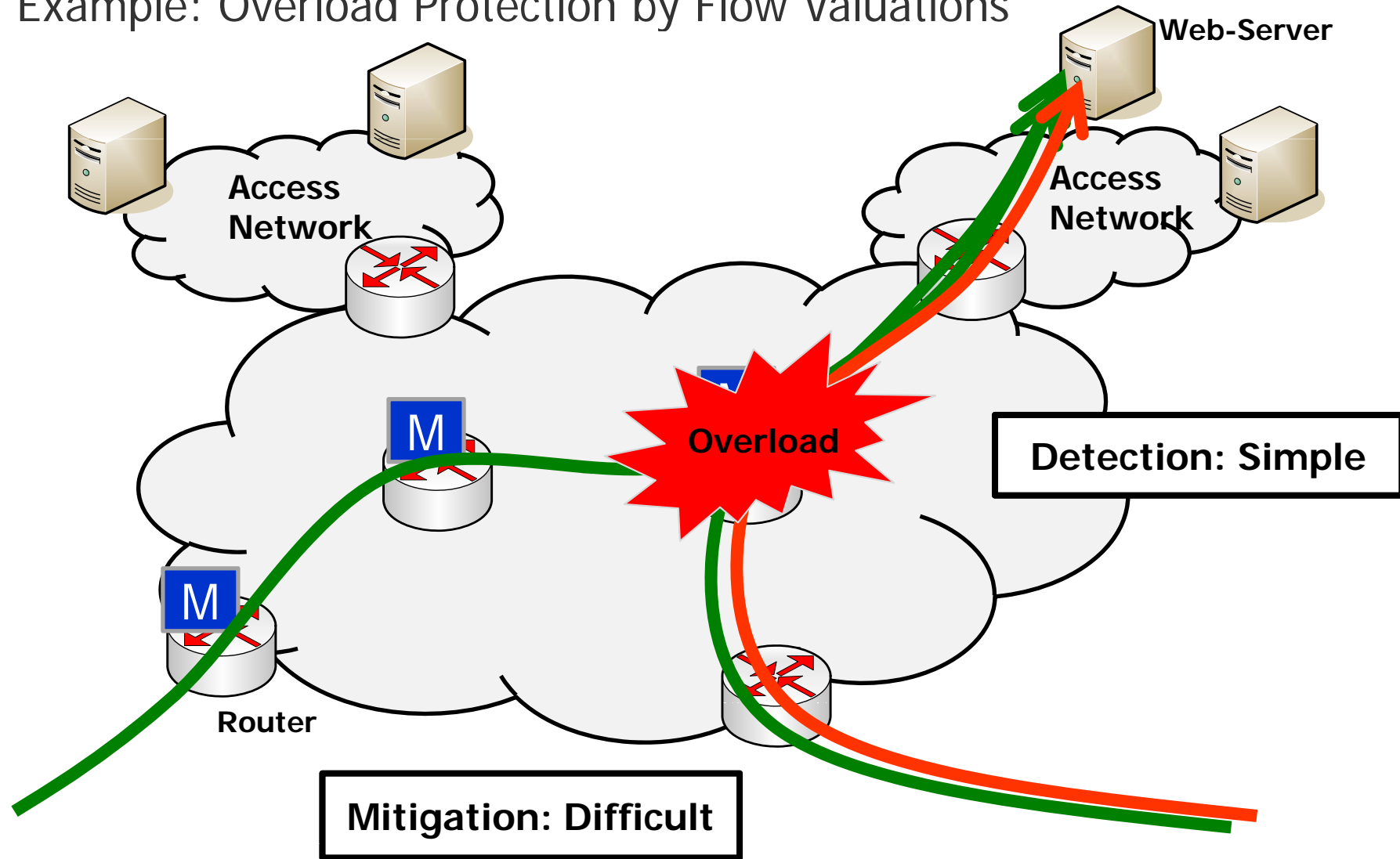


Implementation

- Registration and Resolve
 - HTTP-like Protocol
 - Unified Resource Identifier for addressing info
- Actual Information transfer with different protocols
 - Push (subscribe to CP) or pull (explicitly request info)
 - IP Flow Information Export (IPFIX)
- Additional support for
 - Invoking new measurements
 - Artificial context providers (situation generation for assessing new decision algorithms)



Example: Overload Protection by Flow Valuations



Objectives

- Protect access links and servers
 - Detect and mitigate overload situations in the Network
 - Mitigate before access or servers are affected
- Reduce collateral damage
 - Important traffic should be protected
 - Unimportant or malicious traffic can/should be filtered
- Mitigation as close to the originator as possible
 - Protect core from unwanted traffic
- Avoid:
 - Providers to decide about importance of traffic (net neutrality)
 - Deep Packet Inspection (high effort)



Challenge

- Overload may be originated by
 - Legitimate traffic (Flash Crowds)
 - Abusive DDoS

- Goal: Reduce traffic to prevent overload
 - Cause may be unknown
 - But: reduce collateral damage

Challenge: Which flows should be blocked?

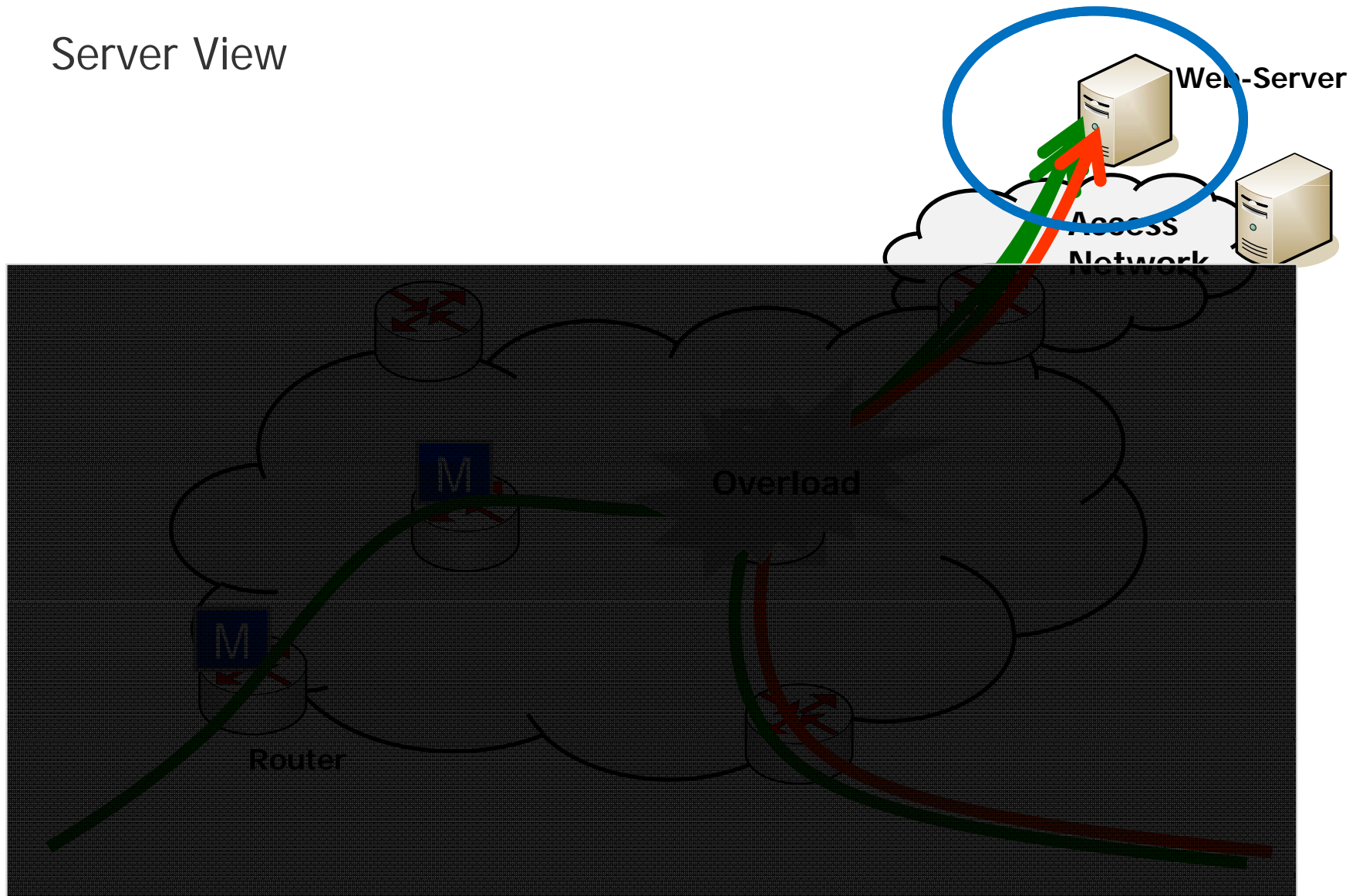


Conventional Solutions

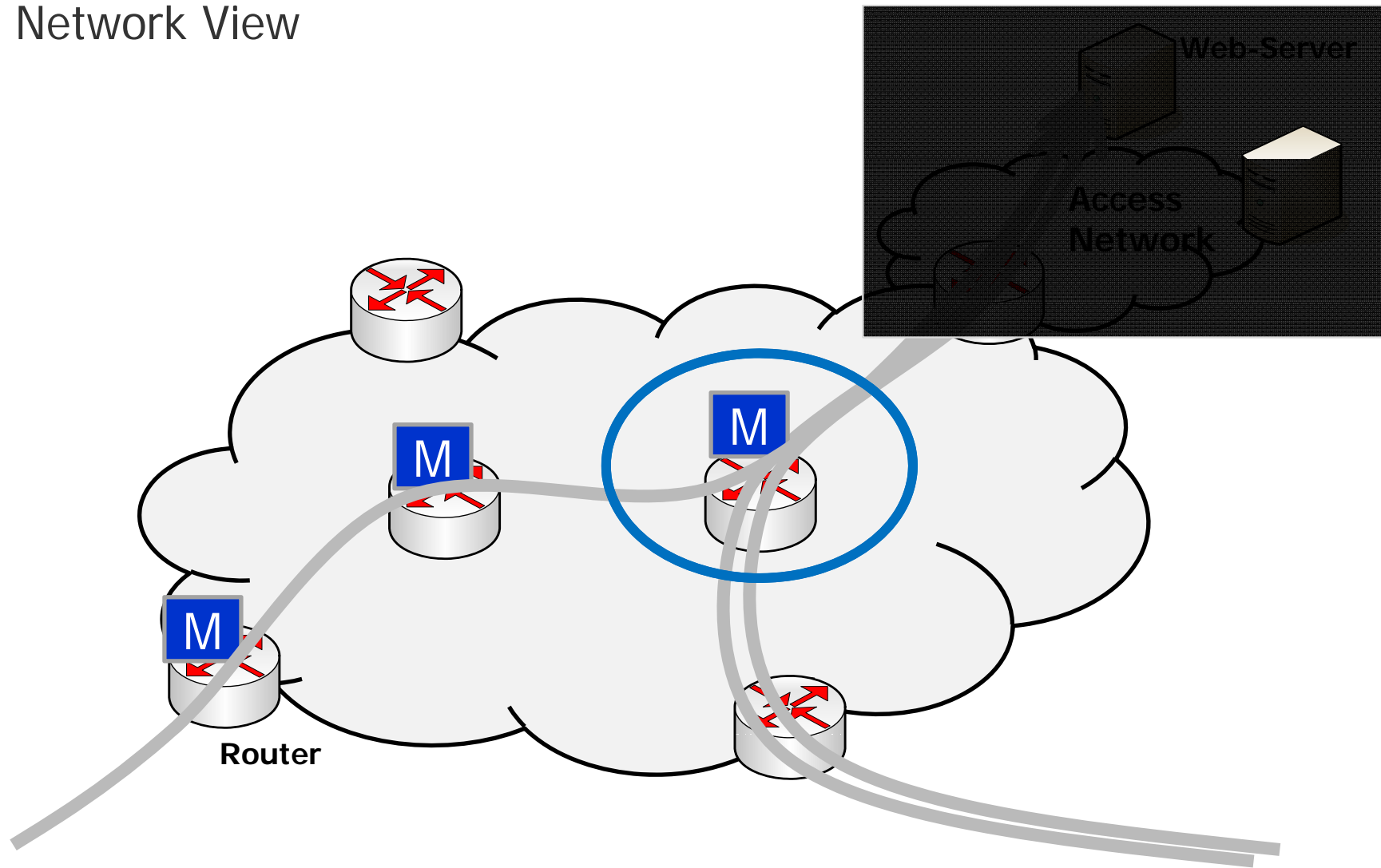
- Random Filtering
 - No separation between good and bad packets
 - Problem: High collateral damage (blocking of legitimate users)
- Intrusion detection systems
 - Attempt to separate good and bad packets by Inspection (DPI)
 - Problem: High Effort in Network
- Alternative: Network-Service Cooperation
 - Cooperate to establish situation awareness
 - Utilize analysis functions at application level
 - Combine information from multiple cooperative sources
 - Combine preferences to form a joint decision



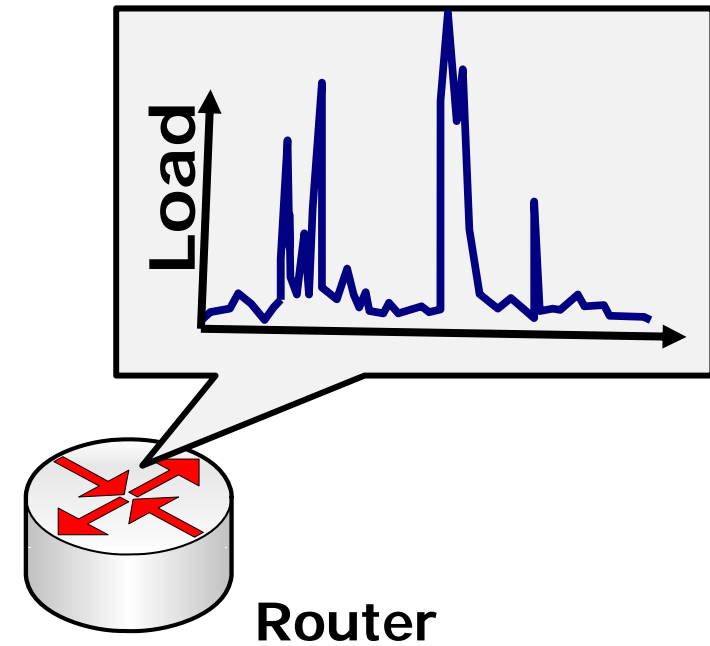
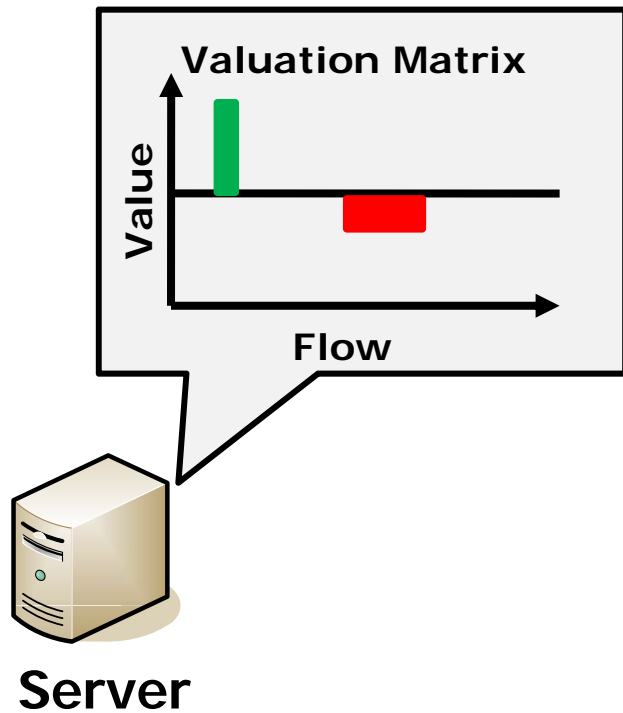
Server View



Network View



Approach: Network-Service Cooperation



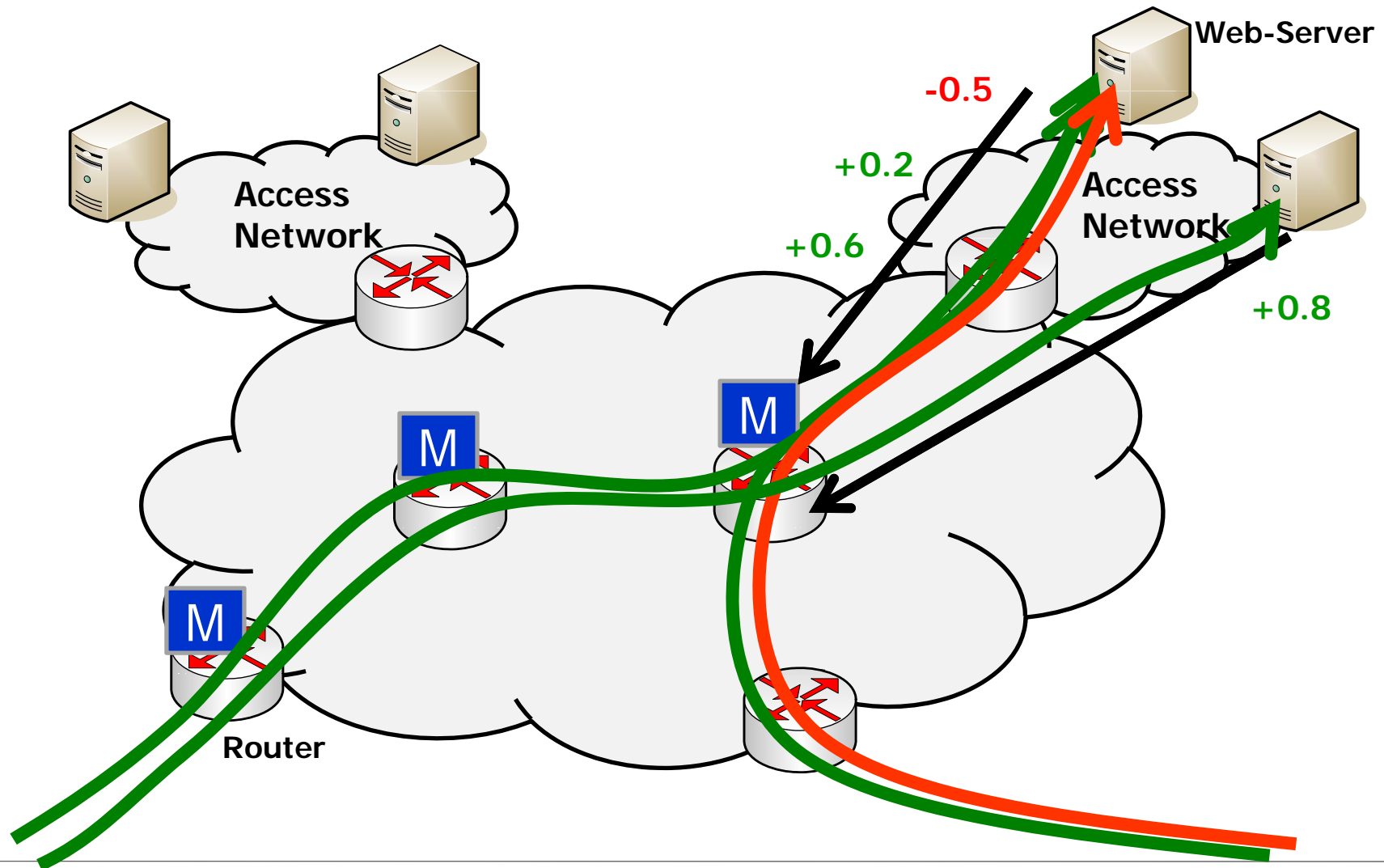
Servers
 - know the value of their user traffic

Routers

- Can detect overload
- Can filter before traffic enters access links
- But don't know the traffic value

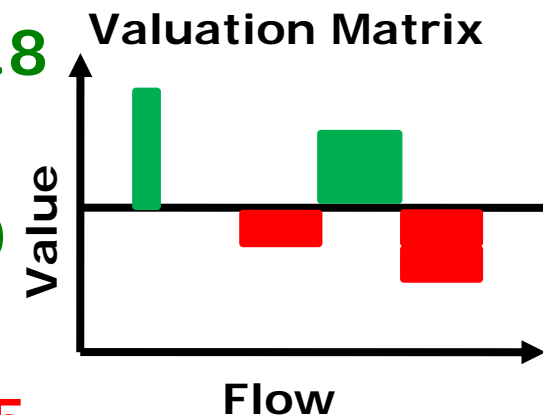


Normal Operation: Servers provide Valuation Reports

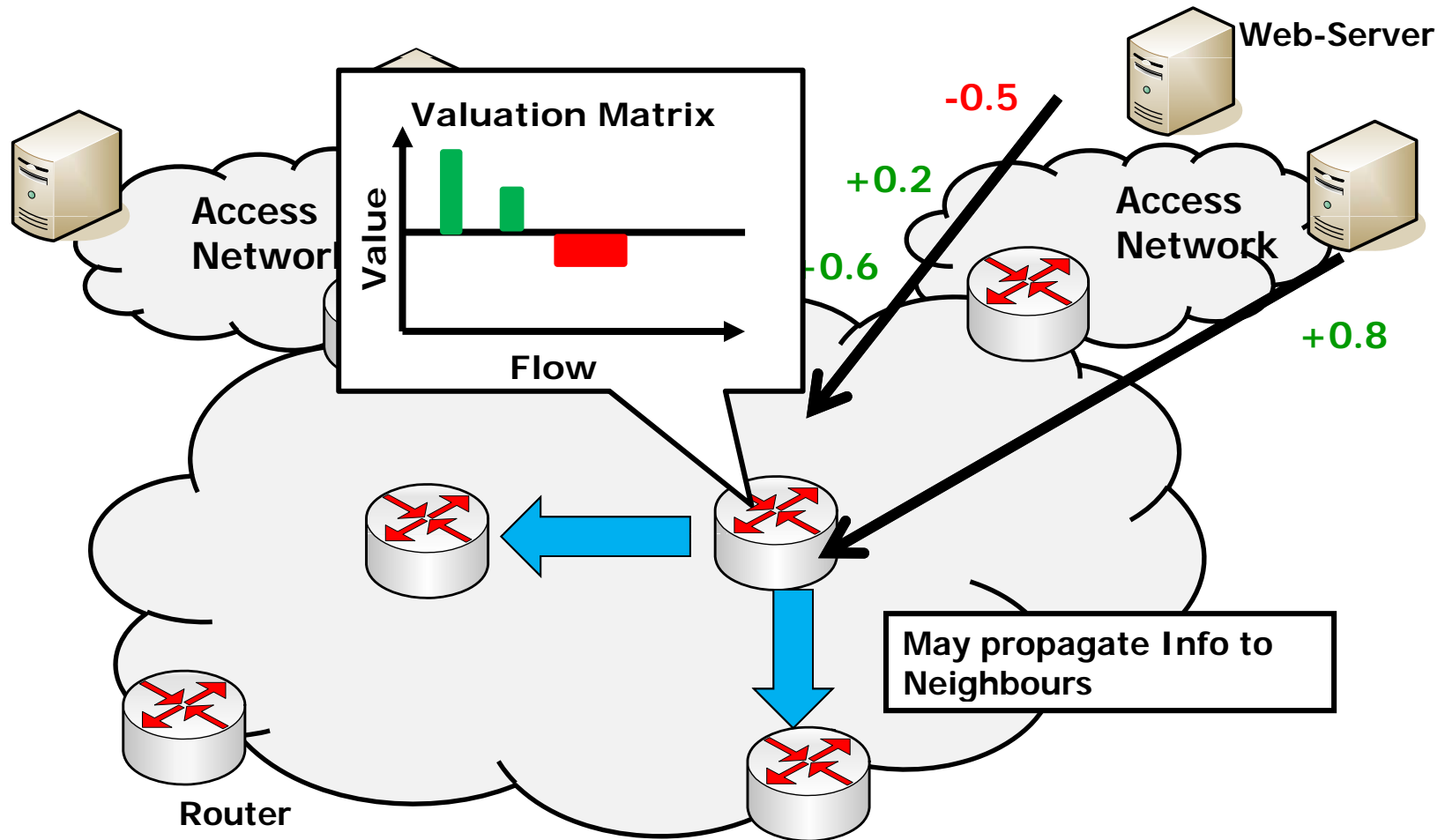


Flow Valuations

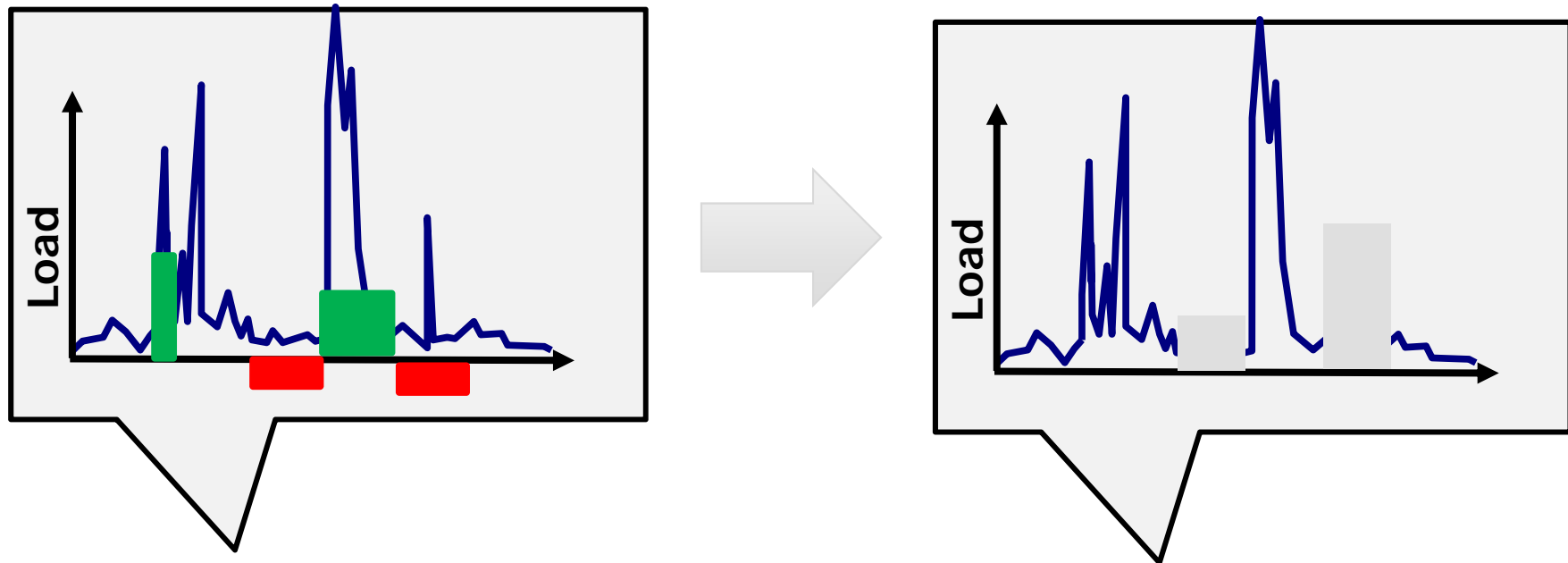
- Assessment of user traffic with simple system
- Example valuations
 - User logged in with password → **+0.8**
 - Regular browsing pattern → **+0.5**
 - Customer completed buying → **+1.0**
 - Failed login attempt → **-0.1**
 - Repeatedly loading single site → **-0.5**
 - Attempt to log into database server → **-0.9**



Normal Operation: Router aggregates Valuations

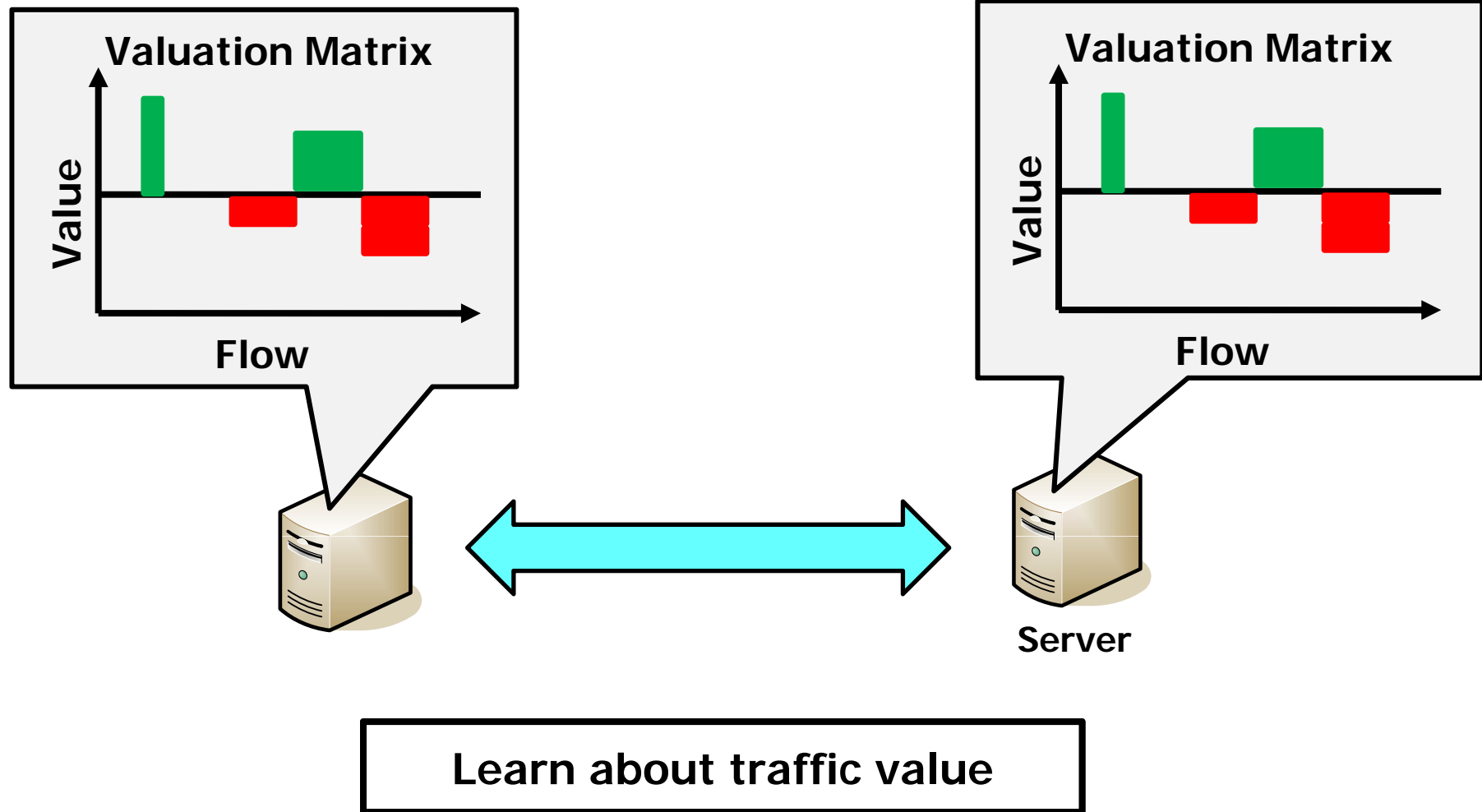


Overload Situation: Correlate Information

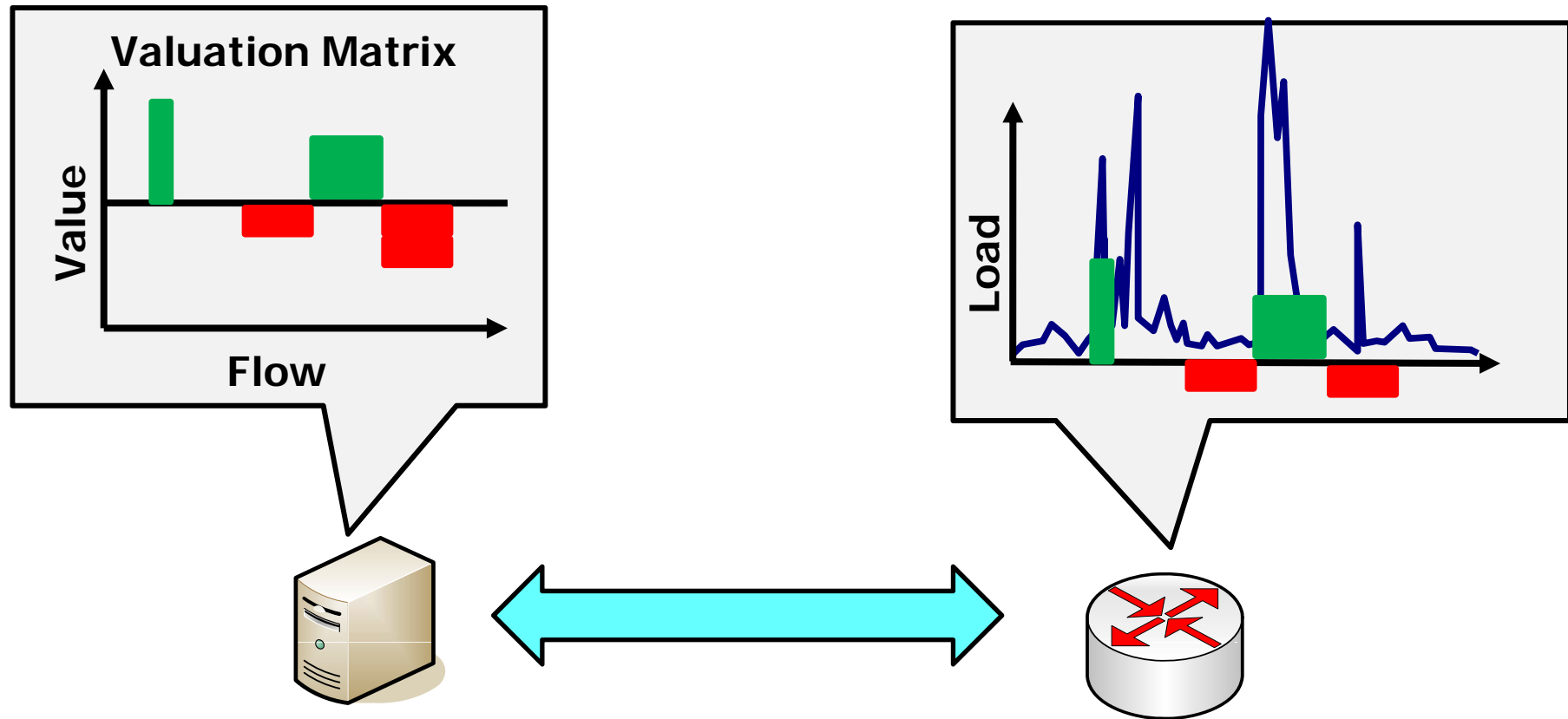


Blocking Decision based on aggregated valuations

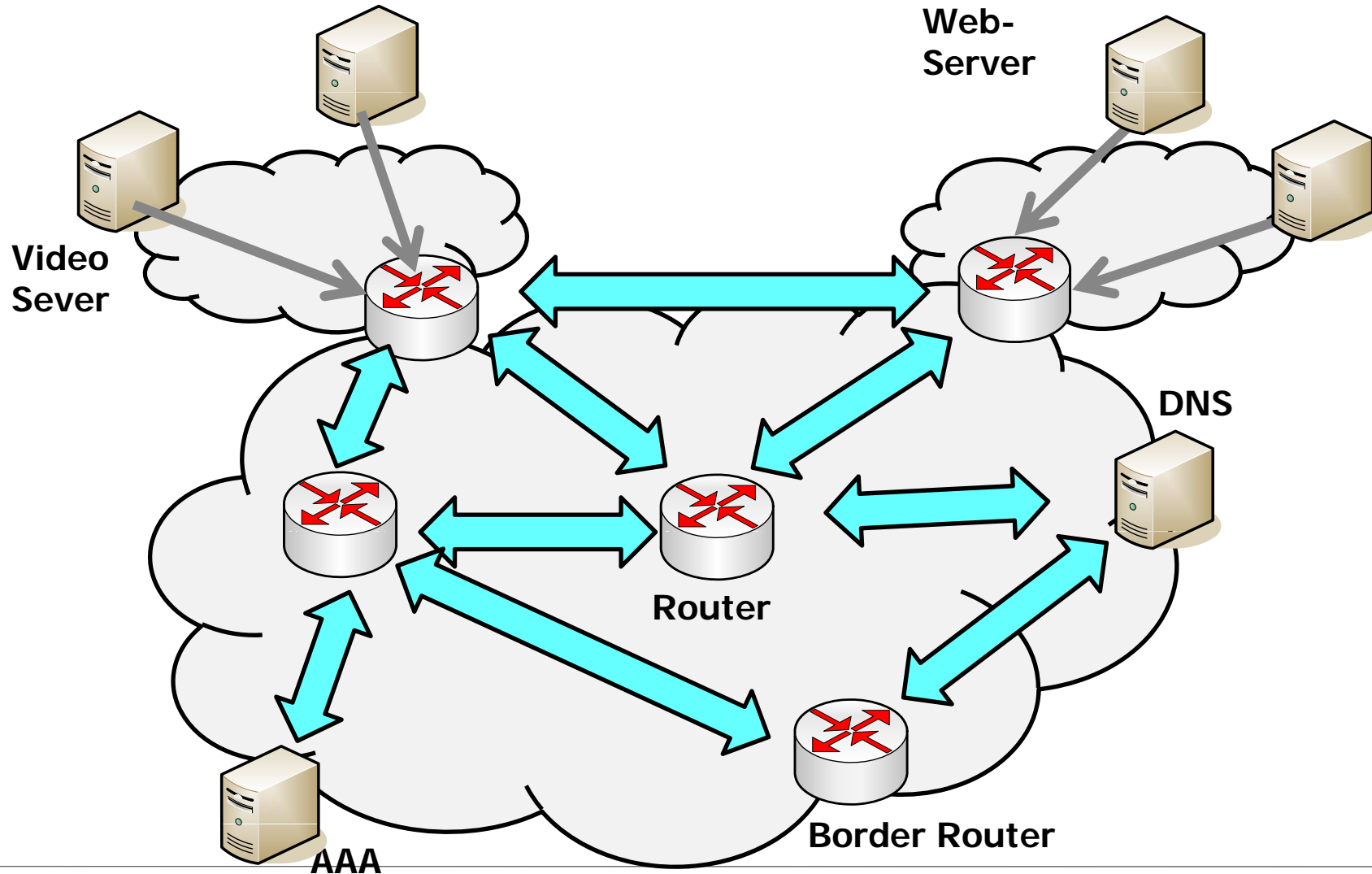
Good: Collaboration of Nodes



Better: Collaboration of Different Nodes



Unbeatable: A Heterogeneous Collaborative Team



Status and Future Work

- Node Collaboration System for Flow Valuations
 - Implemented on Cisco AXP routers
 - Using IPIFIX for information transfer
- Cooperation Incentives (in progress)
 - Incentives to provide information
 - Inter-domain exchange
- Integration of further sources
 - Information from sophisticated sources (IDS, AAA,...)
 - Worm detection information from enhanced DNS



Thank You!

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