

# Media Delivery Network Simulator

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# Project Background Presentation

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- Project background
  - State of the art
  - What's the gap?
  - Preliminary study
  - Proposed methods
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# Project Background

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- Erisson purchased Mediaroom from MS on 12/2013
    - Mediaroom is the world's most deployed IPTV platform, serving almost 13 million consumer households
    - Acquisition confirms Ericsson as a world leader for cutting edge TV-over-IP delivery with a combined market share of around 25%
    - <http://www.ericsson.com/news/1727445>
  - Company strategy
    - Future that helps realize the greatest advantage, and most amazing consumer experience in a highly dynamic environment that demands true agility in any solution and services offering.
    - Cloud-based TV anywhere
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# Ericsson

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- Communications technology provider
    - network equipments, software and services to mobile and fixed network operators
  - TV and Media industry
    - It is predicted that within 5 years, **50% of the mobile data traffic will be video content**
    - Ericsson interests - enabling operators and content owners to **efficiently deliver** and monetize video content
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# Delivering Media - Key Question

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How to deliver video (and other media) in real time (or even recorded) to millions of subscribers without any delay, packet loss or jitters in a cost-effective manner?

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# Answer - Media Delivery Network

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- Designed to enable operators to manage the rapid growth in managed and unmanaged content, especially the massive growth in Over-The-Top services and applications
  - Built differently as compared to existing networks (CDN or mobile) & specially for media (video) delivery
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# MDN - Benefits

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- User-aware video optimization & delivery, saving bandwidth and enabling greater use of network capacity and richer experiences
  - Single platform approach which offers converged visibility and control
  - Smart routing driven by system heuristics and customer business logic
  - Agile framework to launch innovative services, which enables monetization and fast time to market for new services
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# How to improve MDN?

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- Experimentation with different algorithms and different types of loads
  - without using customers real networks
- Project - Media Delivery Network Simulator

# Project Goal

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Build a “life sized” simulation of Internet-based media distribution, with a flexible **framework** that will allow tinkering, experimentation and evolution

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# Goals...

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- Create different parts of MDN
  - Generate different types of Traffic
  - Consume that Traffic
  - Monitor Key Metrics like end-to-end delay, packet loss, CPU Usage, Memory Usage
  - Report Metrics in real-time
  - Ability to script the simulator (configurable)
  - Ability to extend the simulator
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# CDN vs MDN

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# Challenges in Enterprise Applications

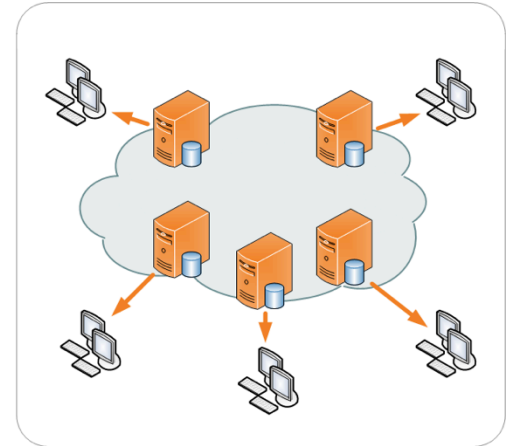
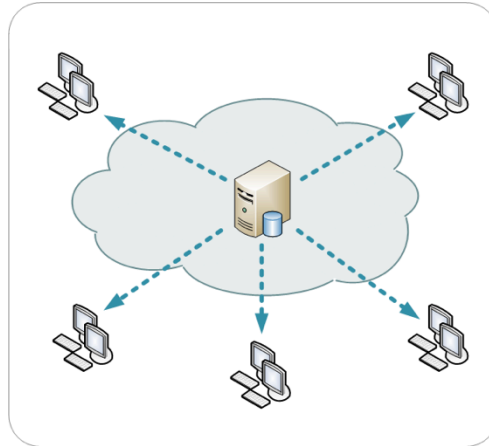
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1. Low Robustness
  2. High End-to-End Latency
  3. Limited Bandwidth
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# Content Delivery Network (CDN)

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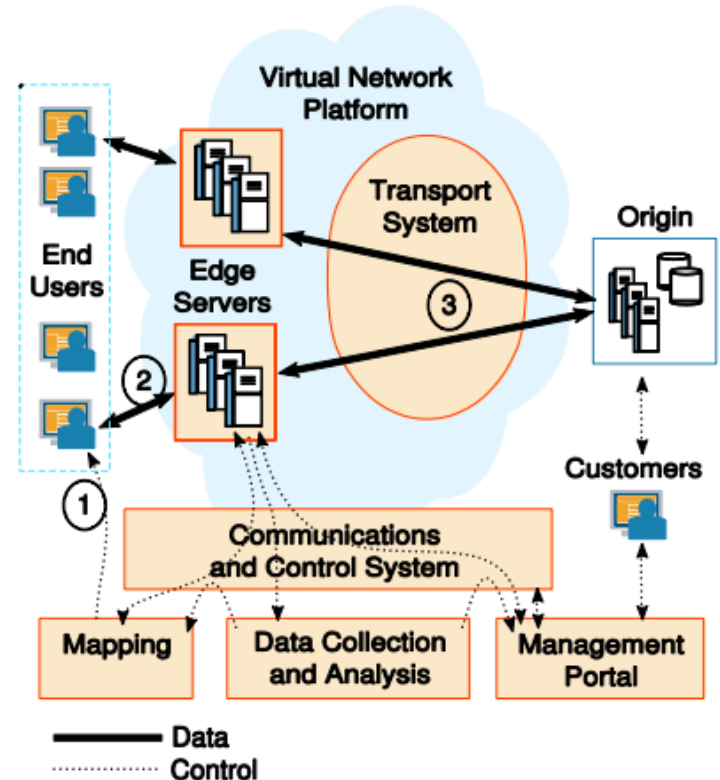
- Overlay Network over Internet
- Highly Distributed Deployed





# Anatomy of CDN

- Mapping Systems
- Edge Servers
- Origin Servers
- Transport System
  - Pull or Push
  - Collaborative or not



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# Key Metrics of Streaming

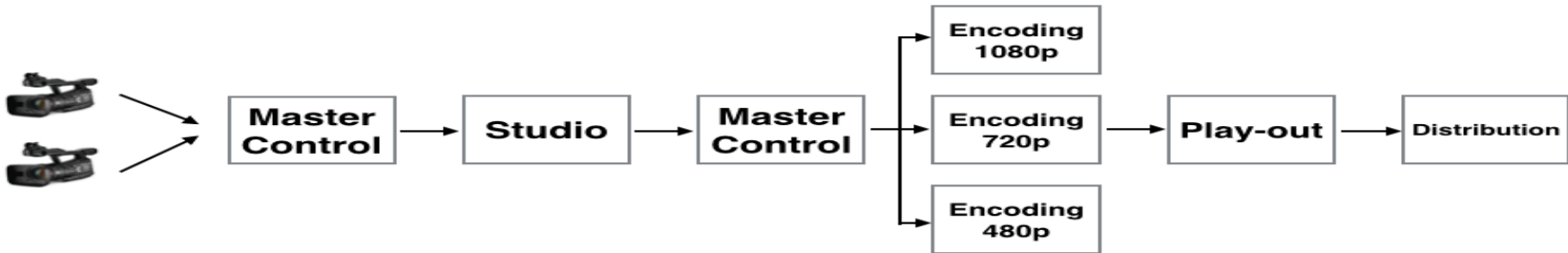
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- End-to-End Delay
  - Aimed at less than 60s
- Packet Loss
  - Adaptive Streaming Quality
  - Packet Recovery

# Challenges in Live Streaming

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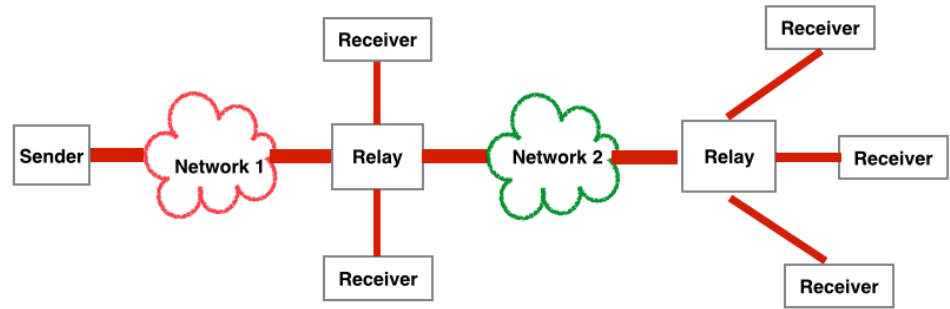
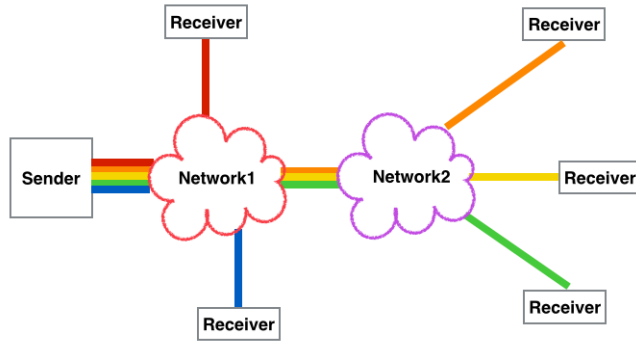
- No Prefetching
- Intensive Computing at Nodes
  - Subtitle addition
  - Ads Insertion
  - Encoding (different resolutions, recovery corrections)



# Media Delivery Network

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- Application-Layer Multicast
  - Unicast v.s. Multicast
  - IP-Layer Multicast v.s. Application-Layer Multicast



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# Existing Solutions and Limitations

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# Available Network Simulators

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- Ns2
  - Gns3 / NetSim
  - Mininet
  - Omnet++
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# Network Simulators Comparison

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| Network Simulator | Pros   | Cons   |
|-------------------|--|--|
| NS-2/3            | <ol style="list-style-type: none"><li>1. Be able to integrate with real network device</li><li>2. Good for L1 and L2 layers simulation</li></ol>                         | <ol style="list-style-type: none"><li>1. Not scalable (memory intensive and computation intensive)</li></ol>               |
| Omnet++           | <ol style="list-style-type: none"><li>1. Has parallel simulation capabilities</li><li>2. Has modular extensible framework</li></ol>                                      | <ol style="list-style-type: none"><li>1. Event Driven simulator, therefore cannot represent real packet transfer</li></ol> |
| CDNSim            | <ol style="list-style-type: none"><li>1. Has most common components, e.g. node types represented in CDNSim are similar to source, processing, relay and client</li></ol> | <ol style="list-style-type: none"><li>1. Unavailable</li><li>2. Does not represent media traffic</li></ol>                 |
| NetSim            | <ol style="list-style-type: none"><li>1. Represents the packets and capture them from the simulator network.</li></ol>   | <ol style="list-style-type: none"><li>1. Not Scalable: Can represent up to 200 nodes on one machine</li></ol>              |

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# Network Simulators Summary

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| Network Simulator | Real Traffic | Scalable | Extensible | Memory Intensive |
|-------------------|--------------|----------|------------|------------------|
| NS-2/3            | √            | ×        | √          | √                |
| Omnet++           | ×            | √        | √          | ×                |
| CDNSim            | √            | √        | √          | ×                |
| NetSim            | √            | ×        | ×          | √                |

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# Advantages of existing simulators

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- Provide scripting tools for describing the configuration of network elements, network topology and network traffic load
  - Support for large number of network protocols
  - Provide packet level detail of network events
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# Disadvantages

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- Not Scalable: Simulations run on a single machine
  - Cannot simulate dynamic load of a real network
  - Nodes simulate L2 to L4 of the network stack and don't have functionality to simulate L7 processing
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# CDNsim

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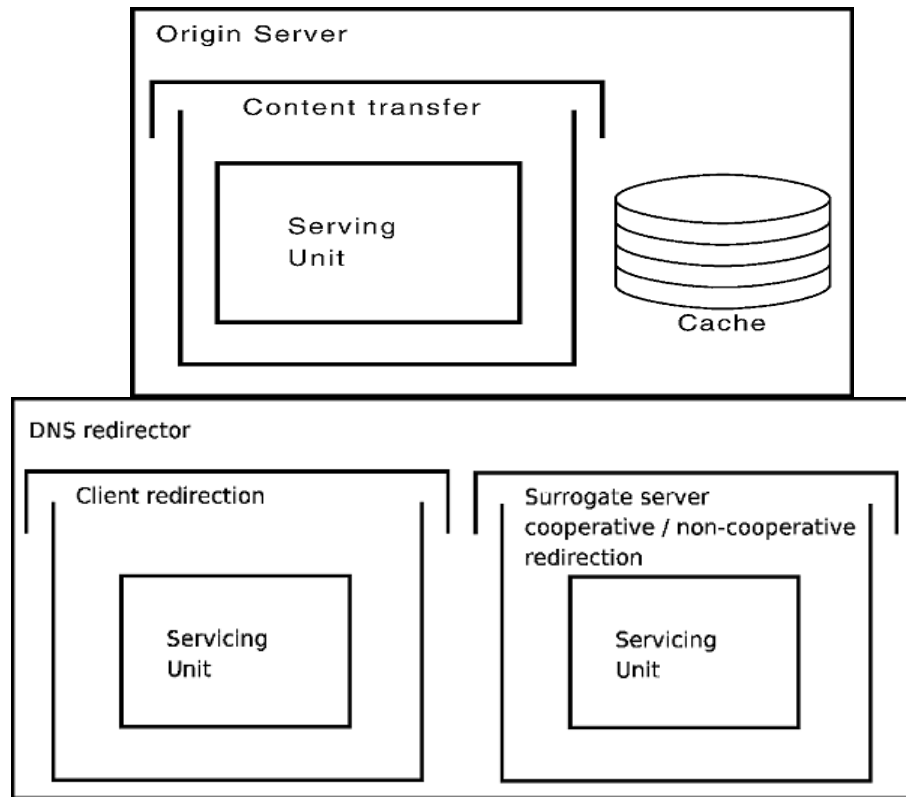
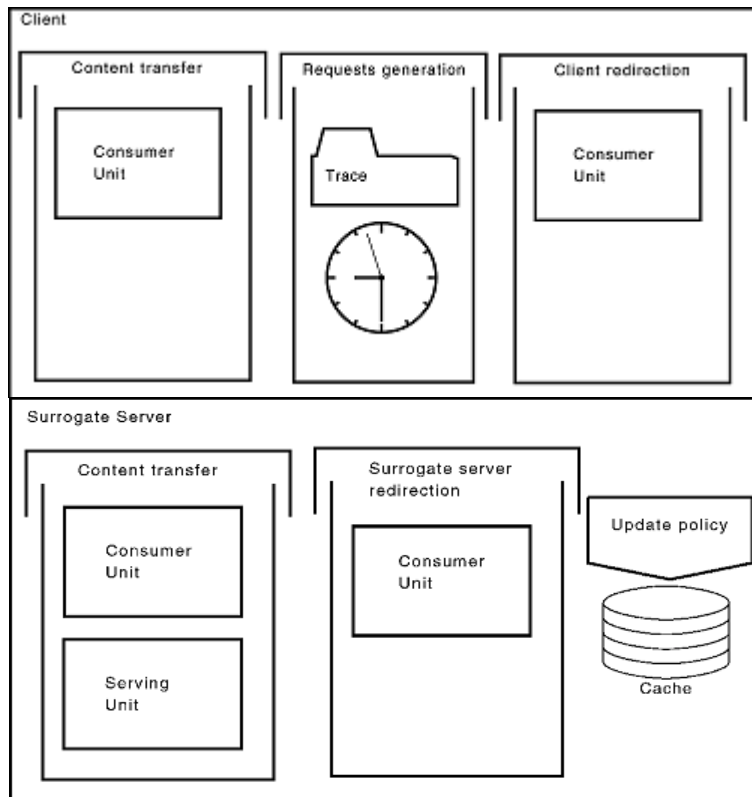
- Designed to support research in broad coverage CDN services
  - Parallel discrete event trace-driven network simulation package that provides utilities and interfaces for content delivery on the Web
  - Ability to simulate peer-to-peer (p2p) services as well as various internetwork configurations
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# CDNsim and MDN

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- Streaming Audio/Video content is highly sensitive to delay and packet loss than normal content
  - CDNsim does not have functionality to model streaming media content and node types like processing nodes (encoding, ad-insertion, etc)
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# Service oriented architecture of CDNsim



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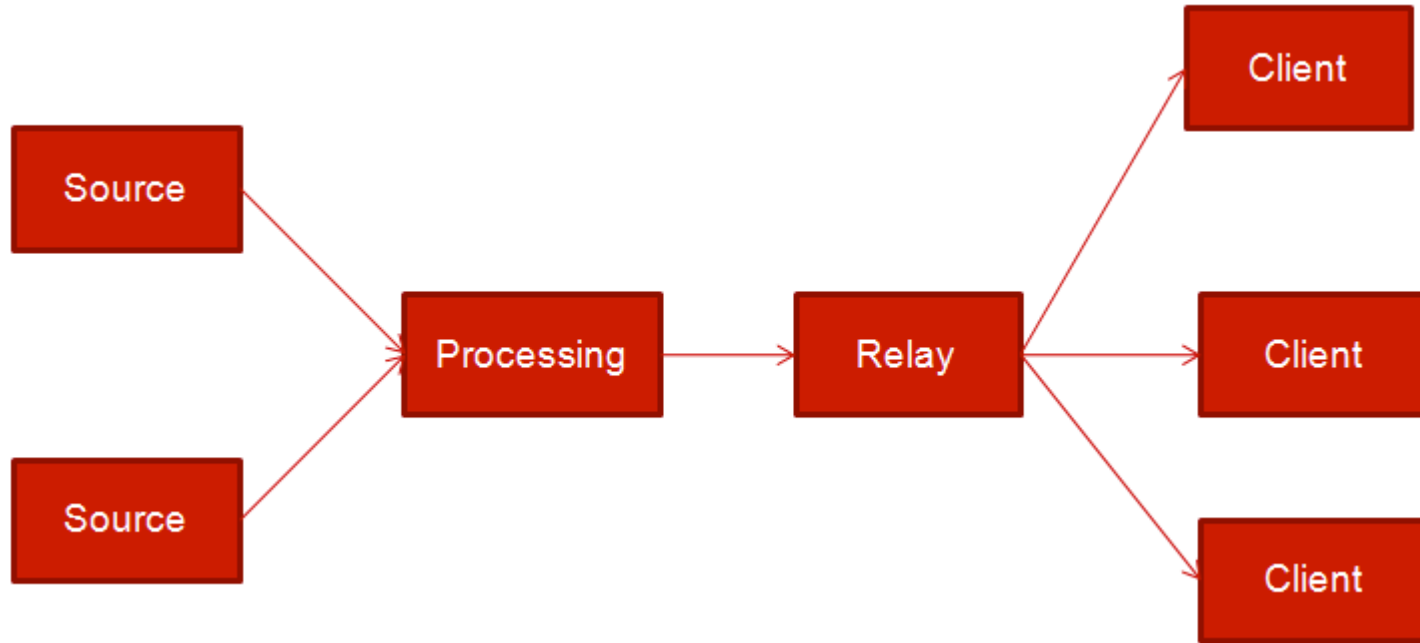
# Initial Approach

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- Try out open source simulators and build on top of that, if possible
  - Four kinds of nodes
    - Source
    - Processing
    - Relay
    - Client
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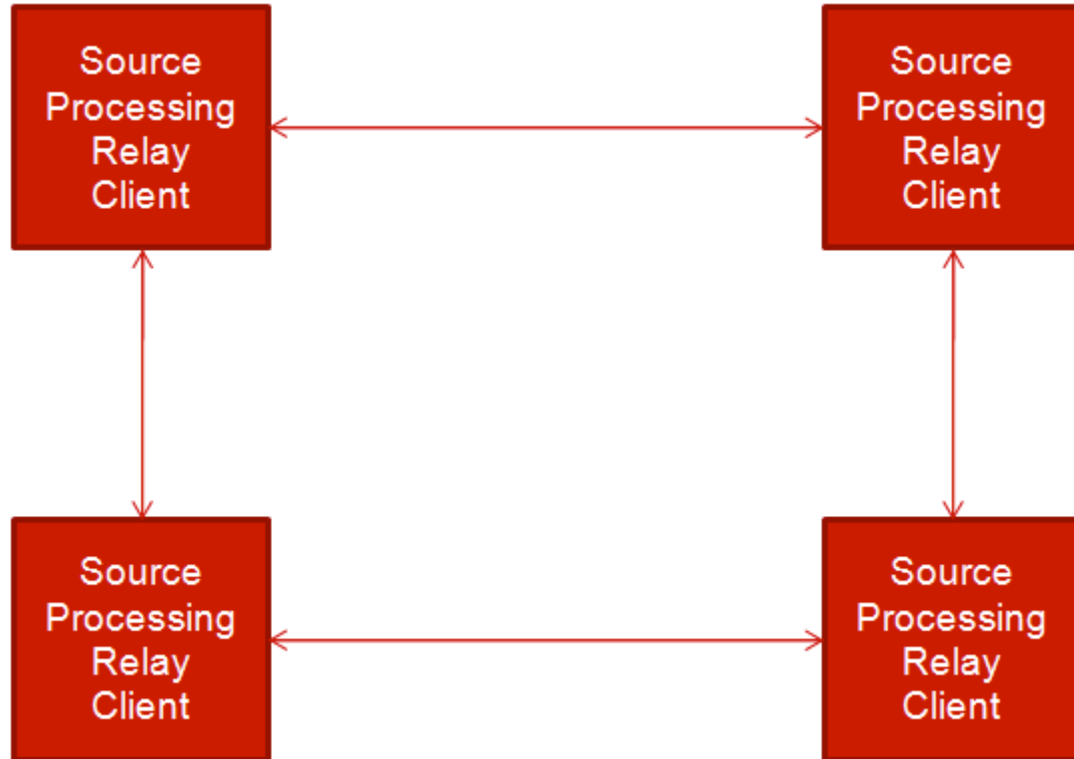
# System structure, Server-Client

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# System structure, peer to peer

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# Our Goal

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- A framework
  - Implementation of components
    - Four kinds of nodes
  - Highly configurable
    - Bandwidth
    - Delay
    - Package loss
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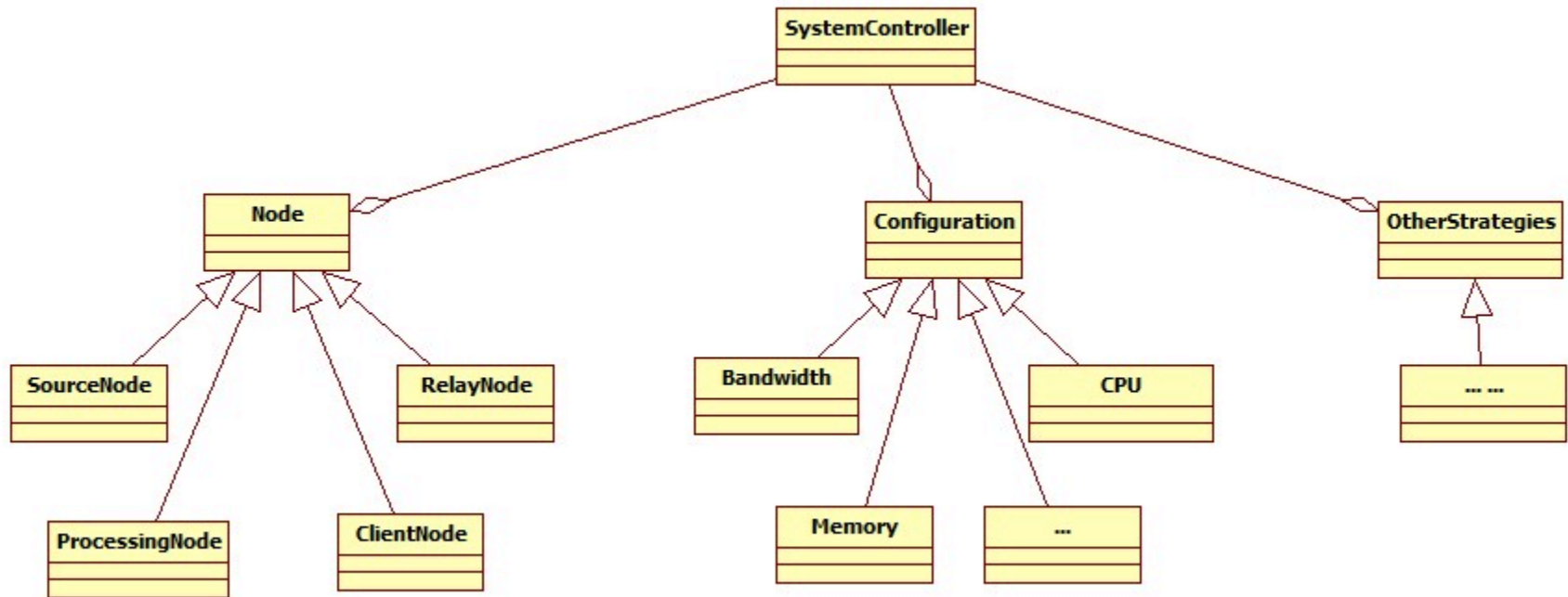
# Our Goal

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- Scalable
    - Up to thousands of machines
  - Generic
    - Plug in extra kinds of nodes
  - Easy to use
    - Configuration file
    - RESTful API
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# Scratch Design

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# Questions?

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