ns-2 201

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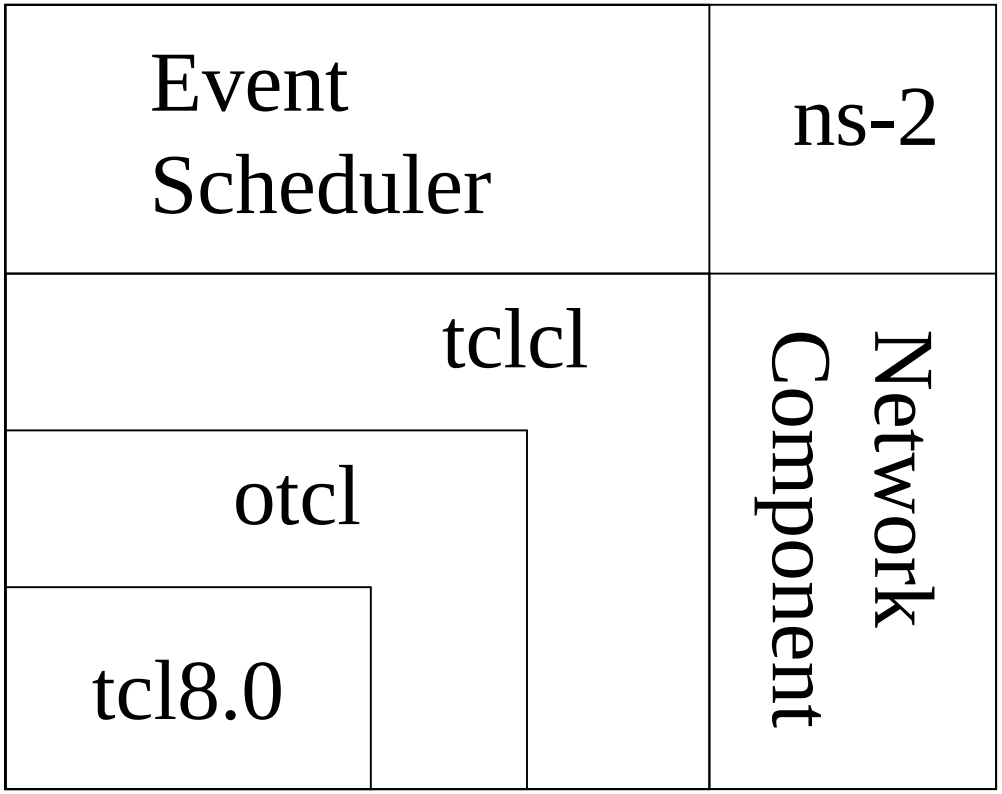
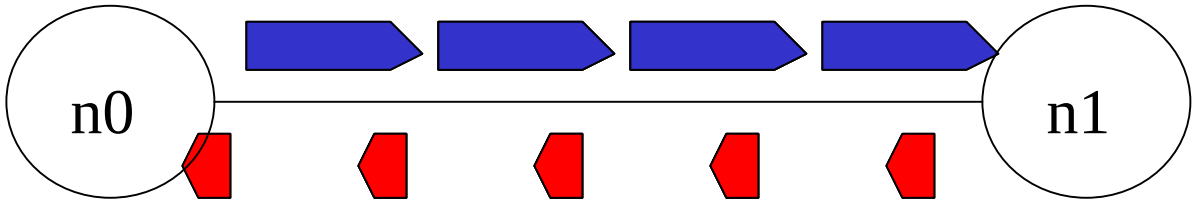
tcl Interpreter With Extensions



Example Script




```
set ns [new Simulator]
set n0 [$ns node]
set n1 [$ns node]
$ns duplex-link $n0 $n1 1.5Mb
    10ms DropTail
set tcp [$ns create-connection
    TCP $n0 TCPSink $n1 0]
set ftp [new Application/FTP]
$ftp attach-agent $tcp
$ns at 0.2 "$ftp start"
$ns at 1.2 ”exit"
$ns run
```

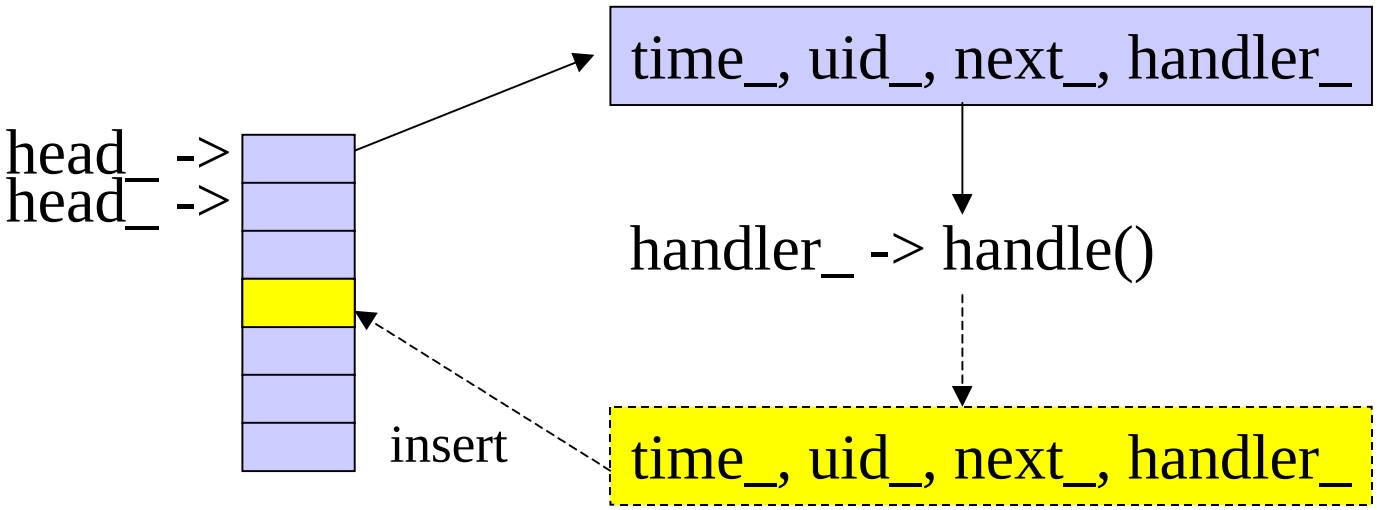
Outline

- **Internals**
- Making changes
- Creating new components

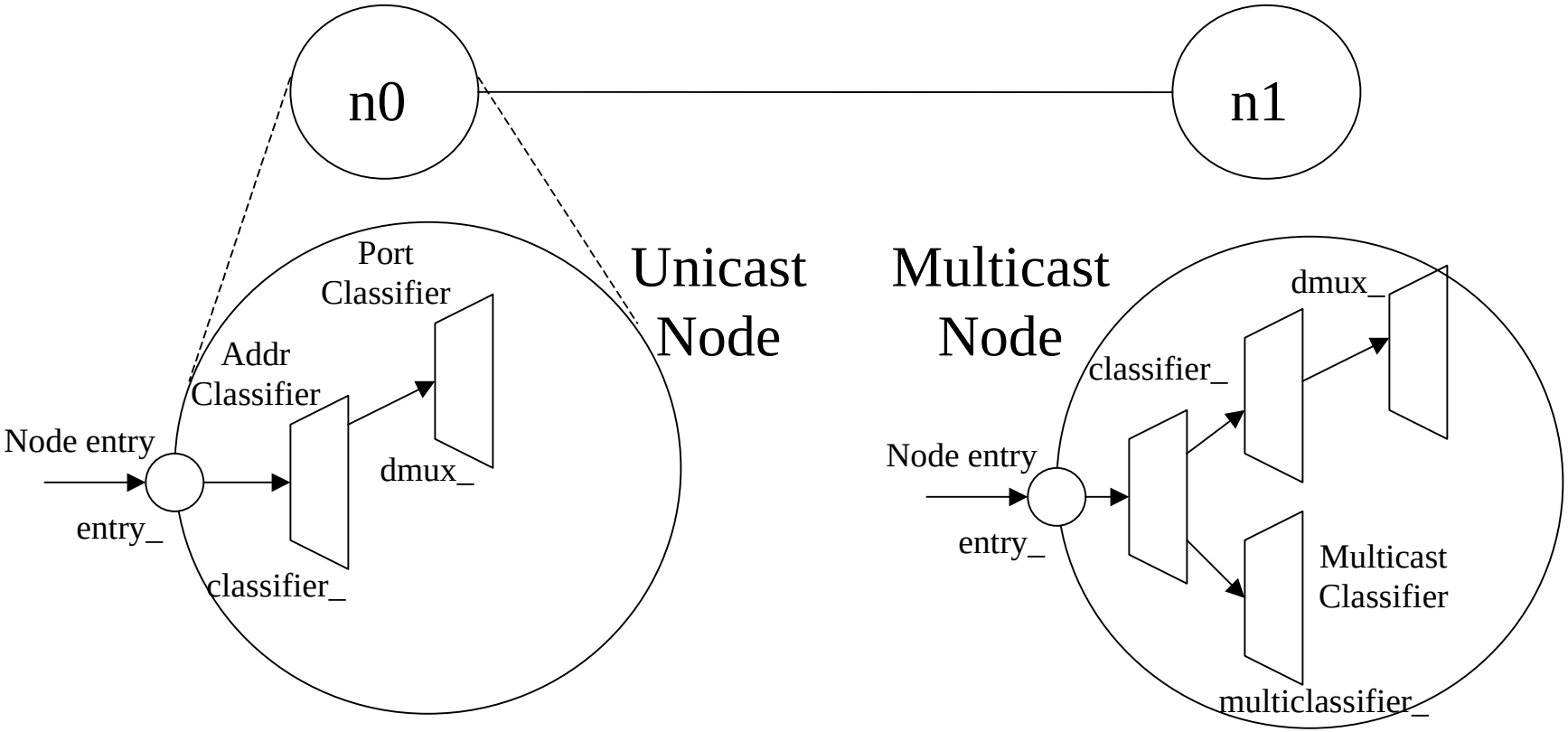
Internals

- Discrete Event Scheduler
- Network Topology
- Routing
- Transport
- Application
- Packet Flow
- Packet Format

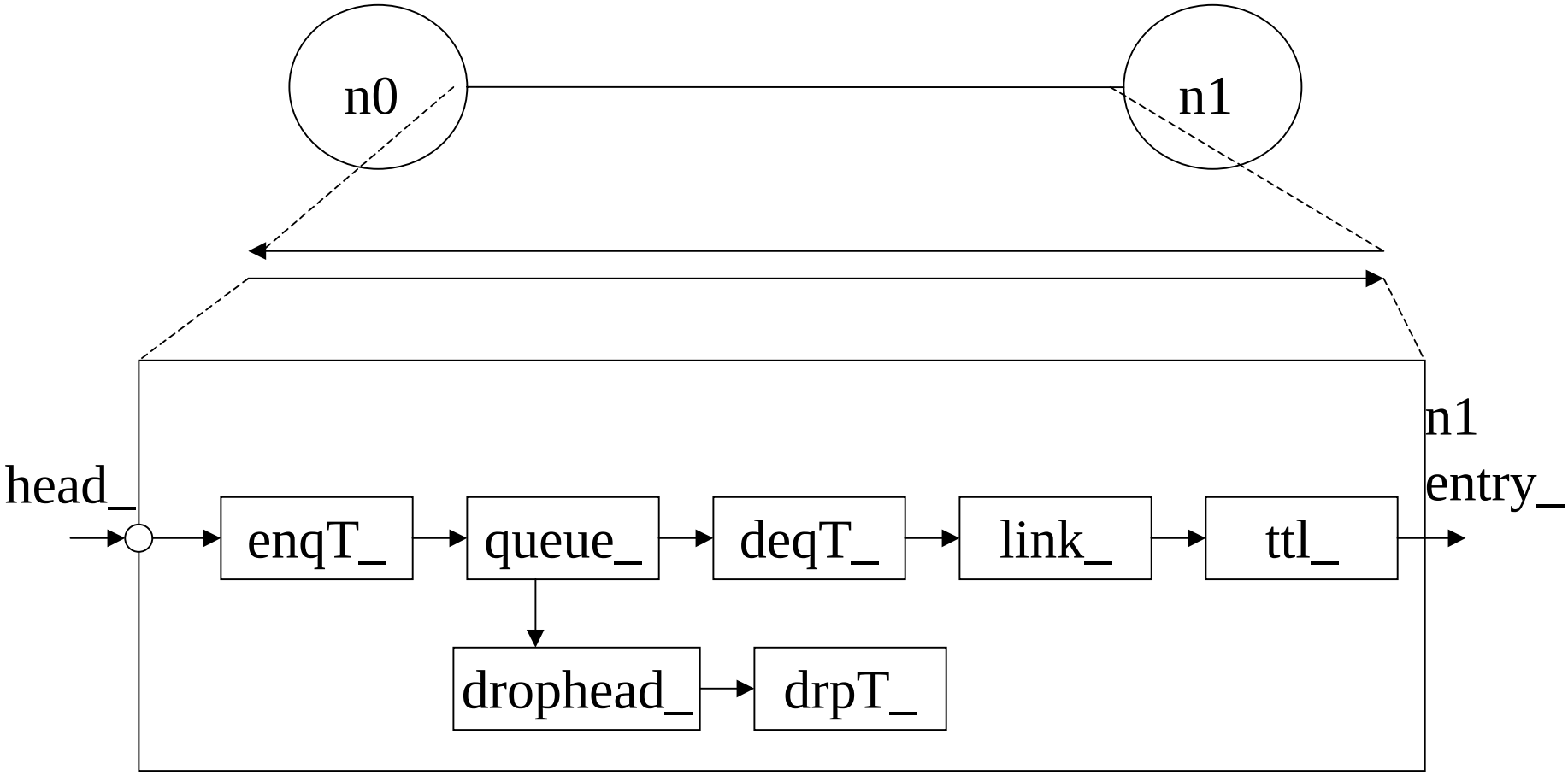
Discrete Event Scheduler



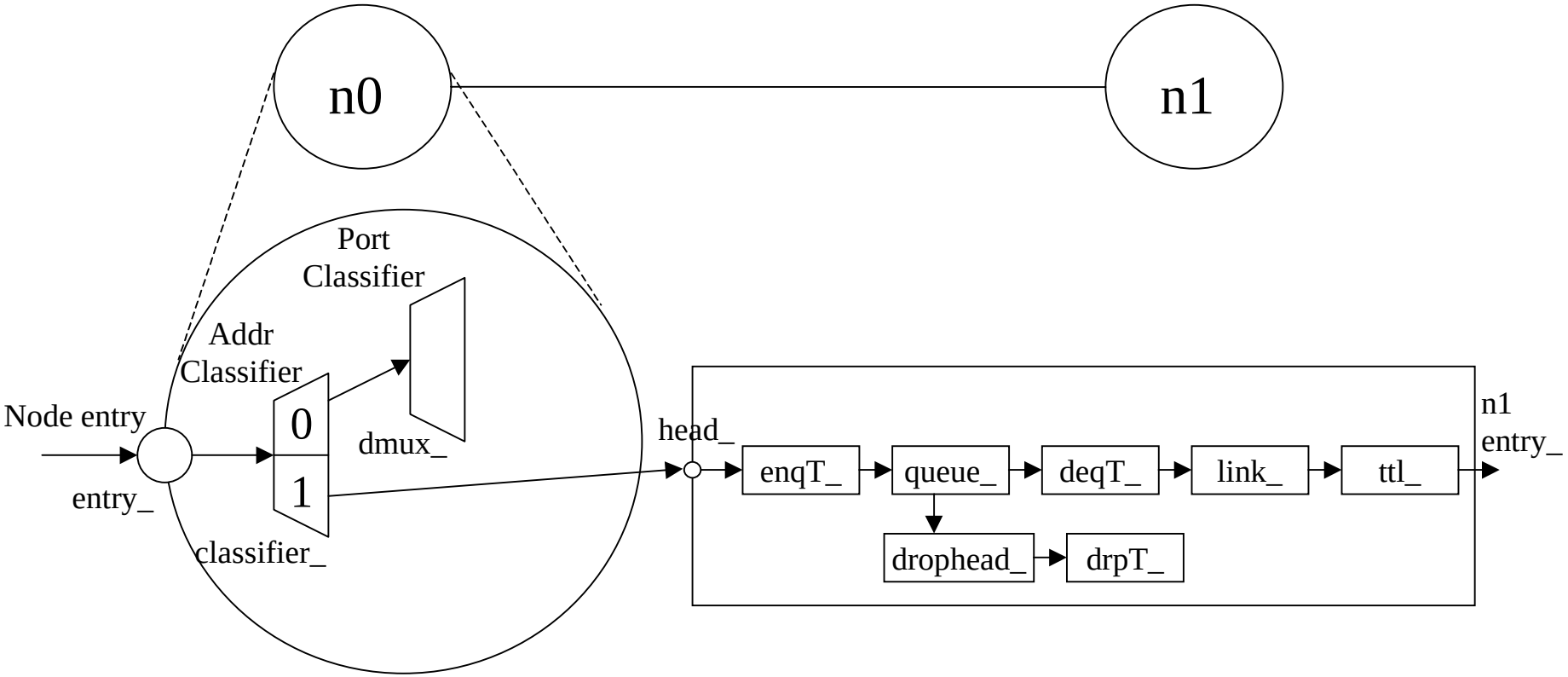
Network Topology - Node



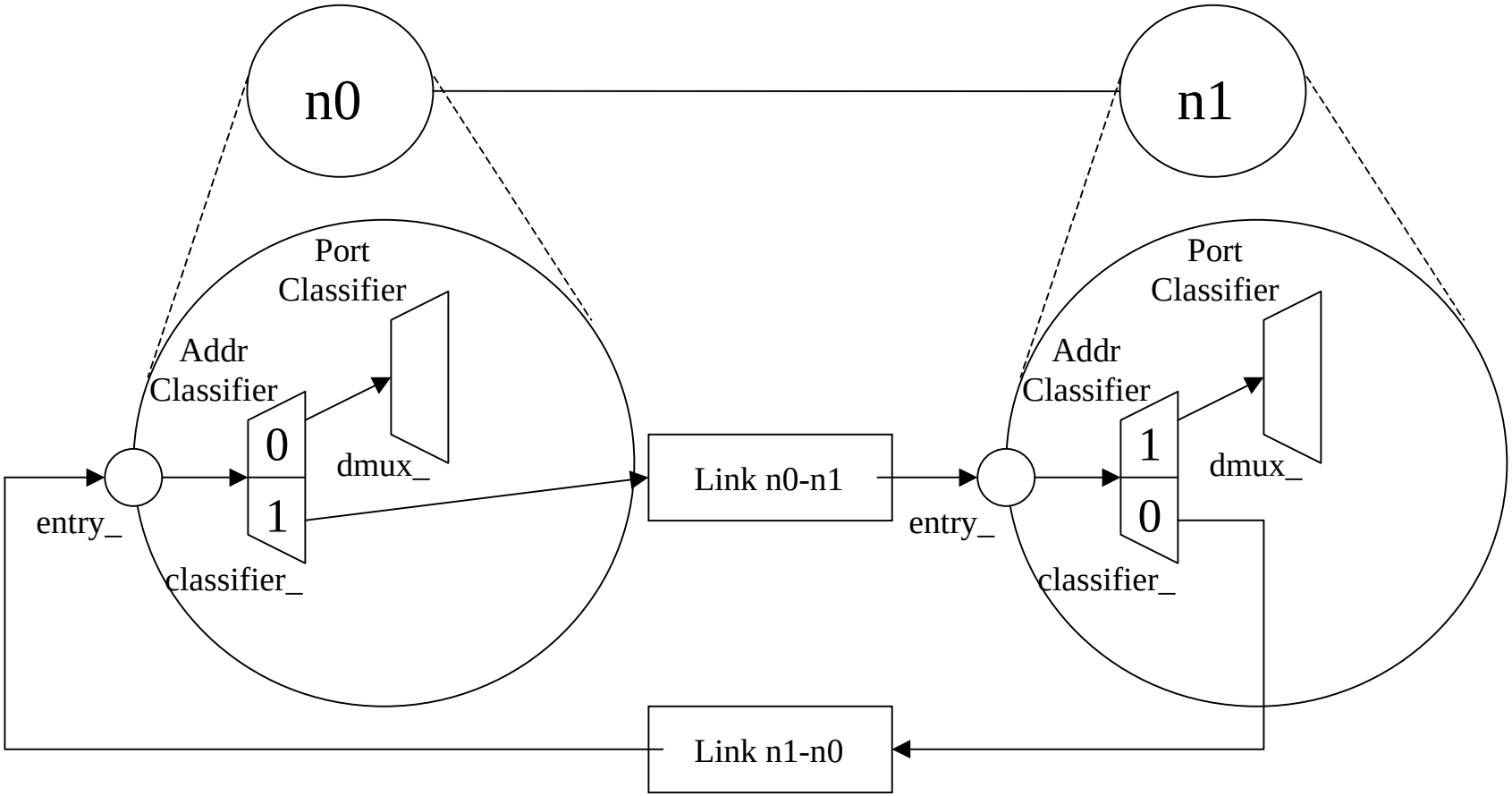
Network Topology - Link



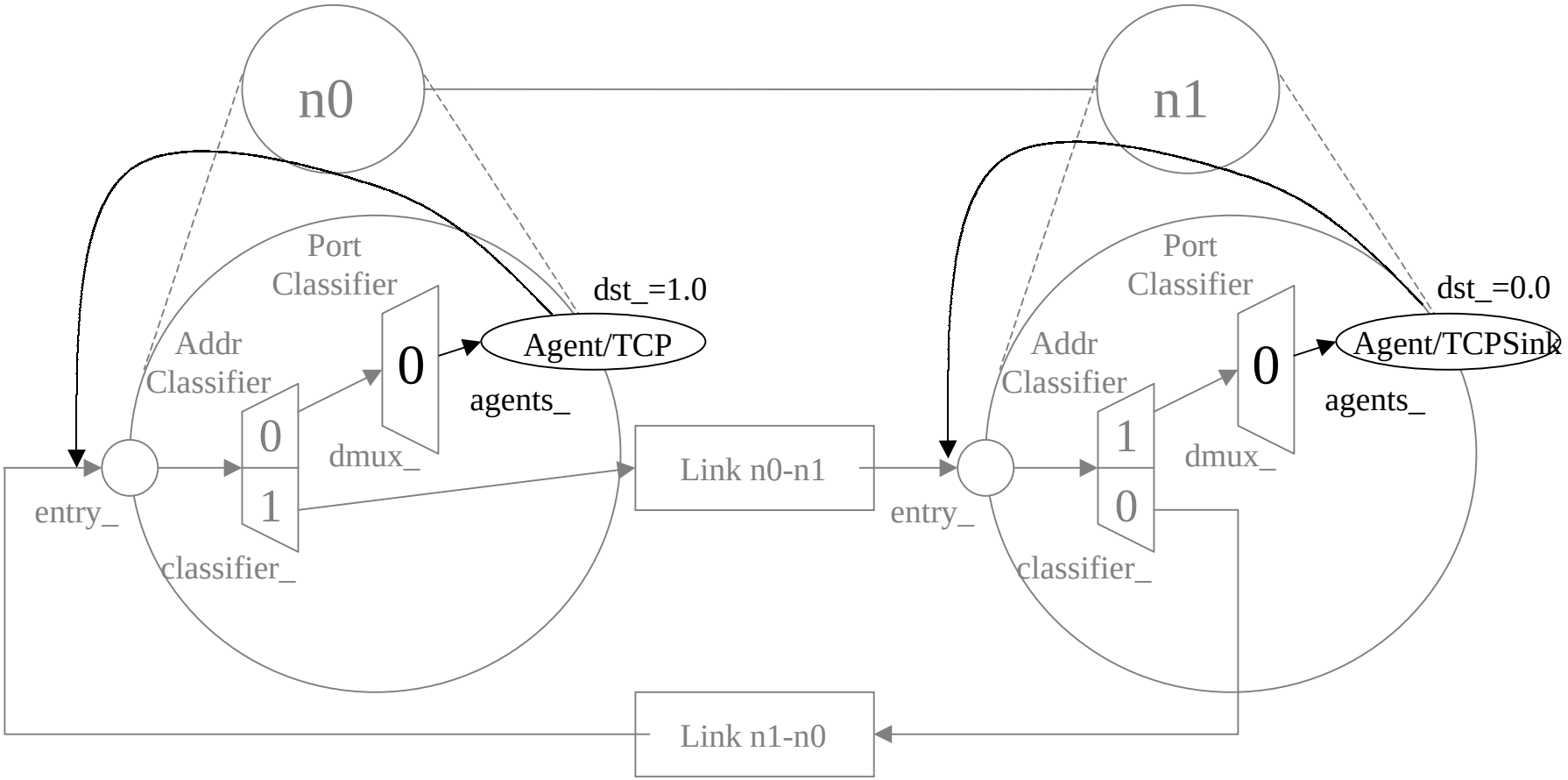
Routing


n0
n1
Port
Classifier
Addr
Classifier
Node entry
0
1
dmux_
entry_
classifier_
head_
enqT_
queue_
deqT_
link_
ttl_
n1
entry_
drophead_
drpT_

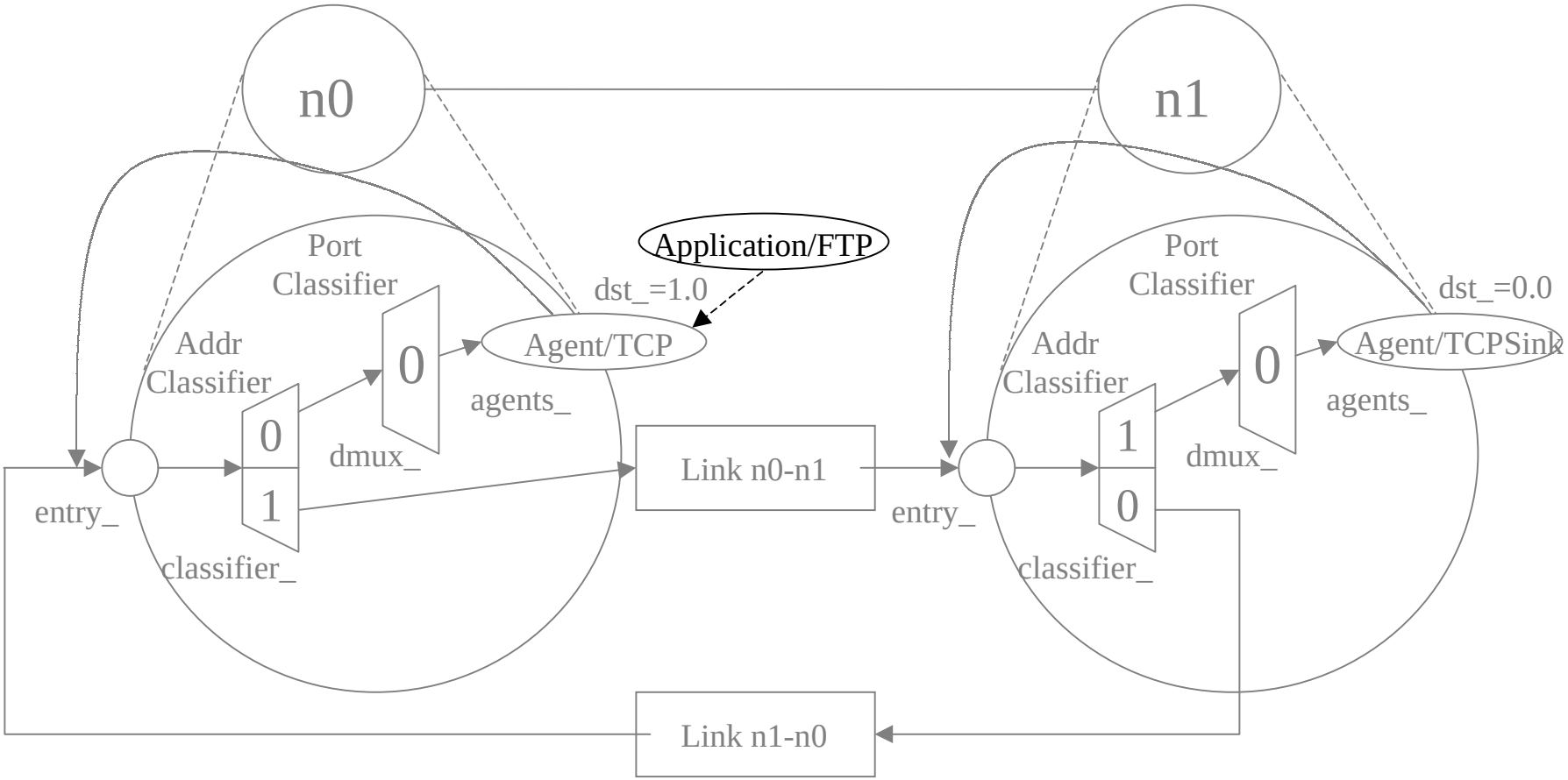
Routing (cont.)



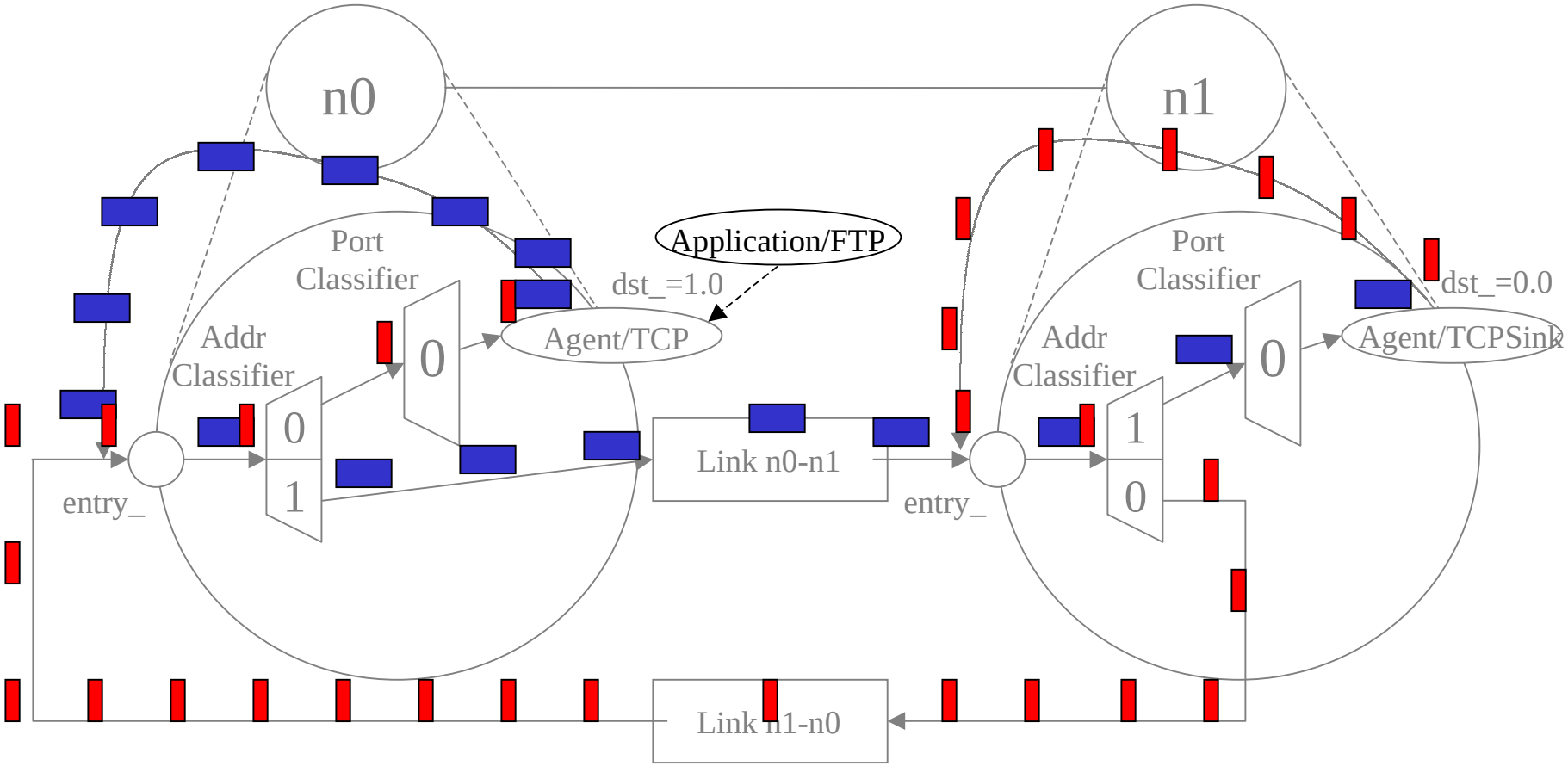
Transport


n0
n1
Port
Classifier
Addr
Classifier
0
1
dmux_
dst_=1.0
Agent/TCP
agents_
entry_
classifier_
Link n0-n1
Link n1-n0
dst_=0.0
Agent/TCPSink

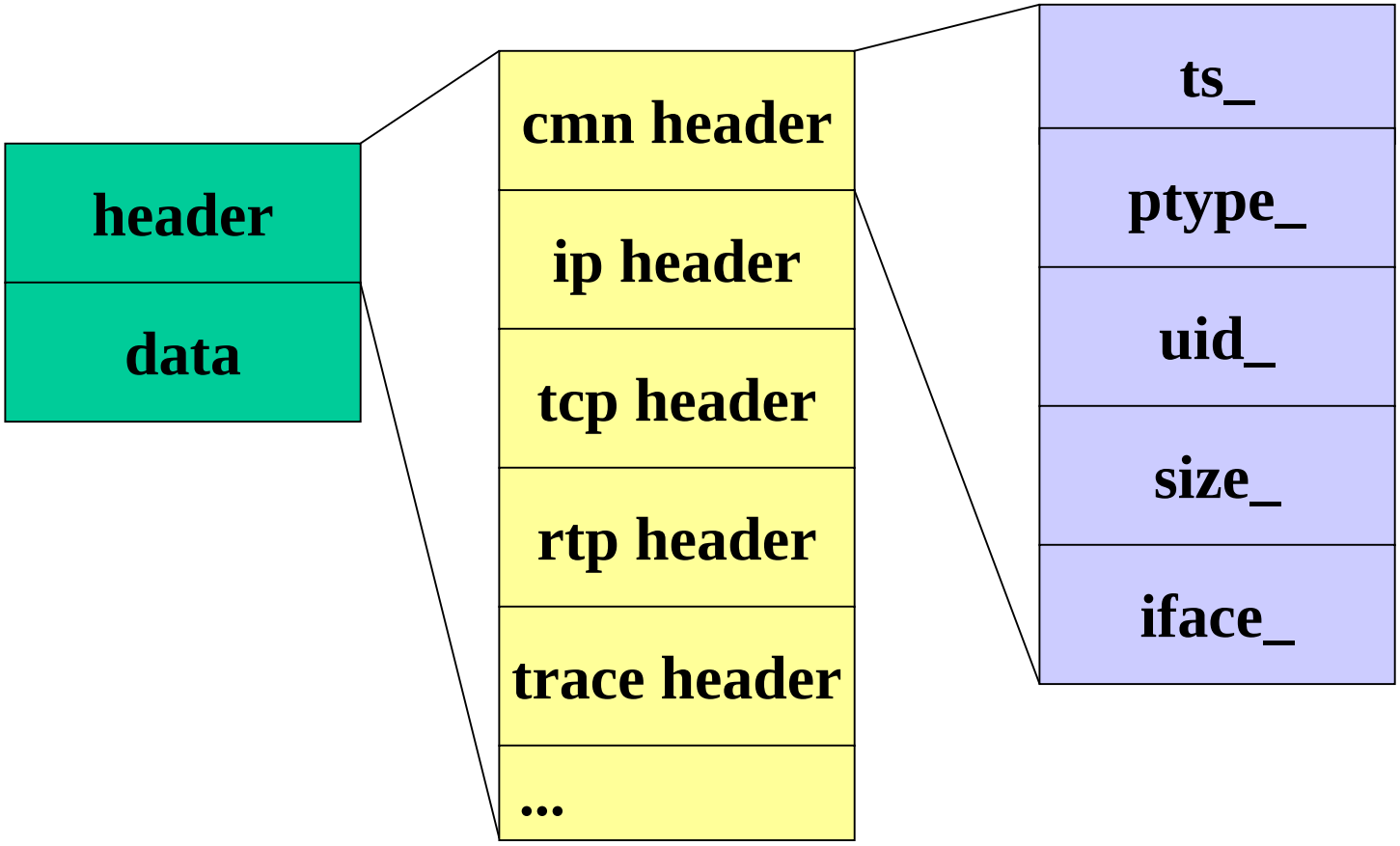
Application



Packet Flow


n0
n1
Application/FTP
Port
Classifier
dst_=1.0
Addr
Classifier
0
1
Agent/TCP
Link n0-n1
entry_
Port
Classifier
dst_=0.0
Addr
Classifier
1
0
Agent/TCPSink
Link n1-n0

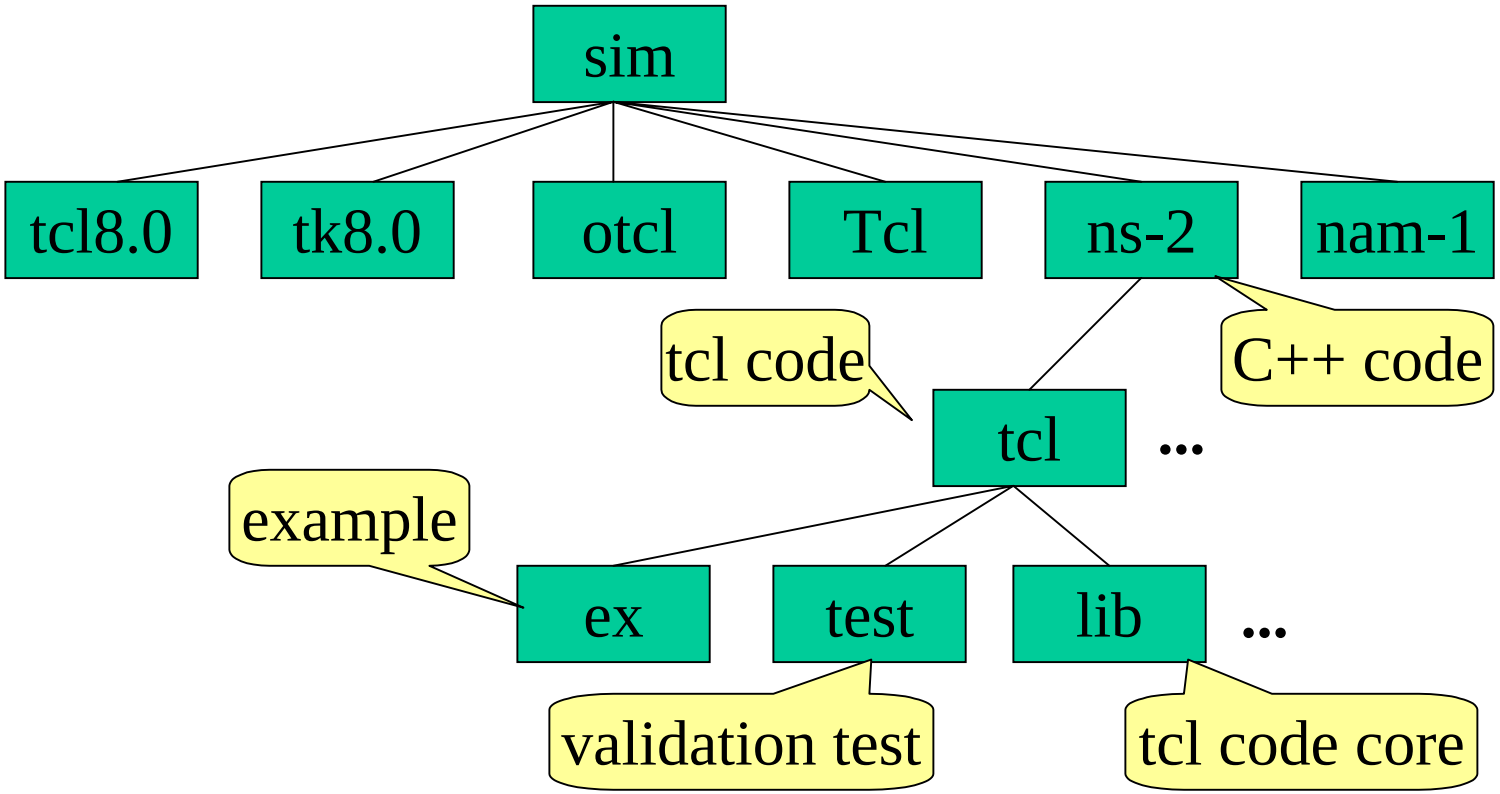
Packet Format



Outline

- Internals
- **Making changes**
- Creating new components

ns-2 Directory Structure



Making Changes in C++ Space

- Existing code
  - recompile
- Addition
  - change Makefile and recompile

Making Changes in otcl Space

- Existing code
  - recompile
  - source
- Addition
  - source
  - change Makefile (NS_TCL_LIB), tcl/ns-lib.tcl (source) and recompile

Outline

- Internals
- Making changes
- **Creating new components**

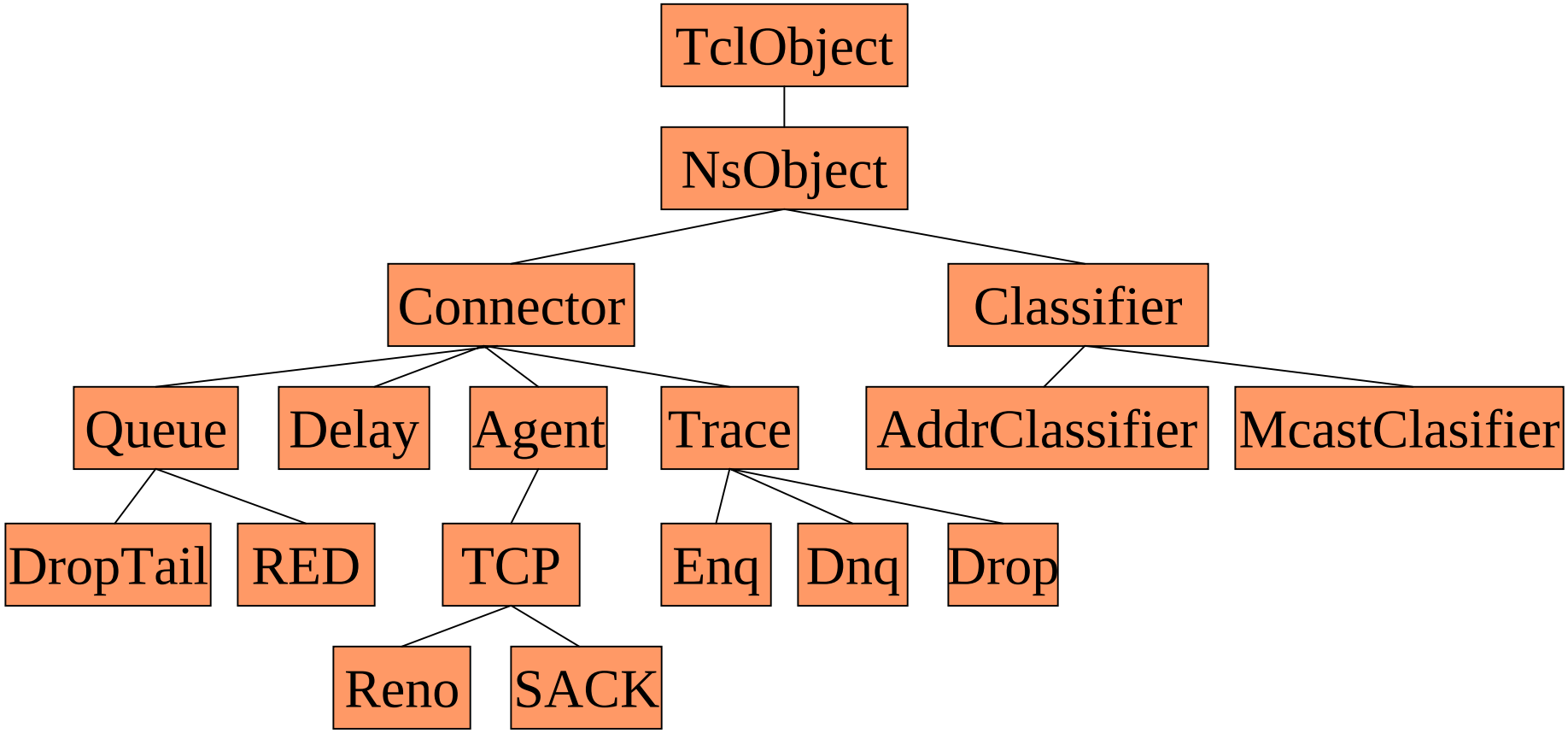
Creating New Components

- Guidelines
- Inheritance Hierarchy
- C++ and otcl Interface
- Examples
  - Network layer
  - Transport layer
  - Application layer

Guidelines

- Decide its inheritance structure
- Create the class and fill in the API virtual functions
- Define otcl linkage functions
- Write the necessary otcl code to access your agent

Class Hierarchy (Partial)

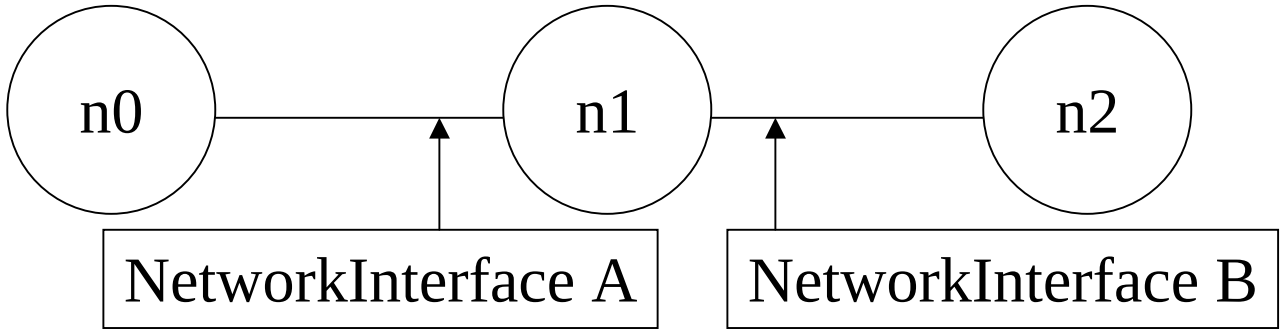


C++ and otcl Interface

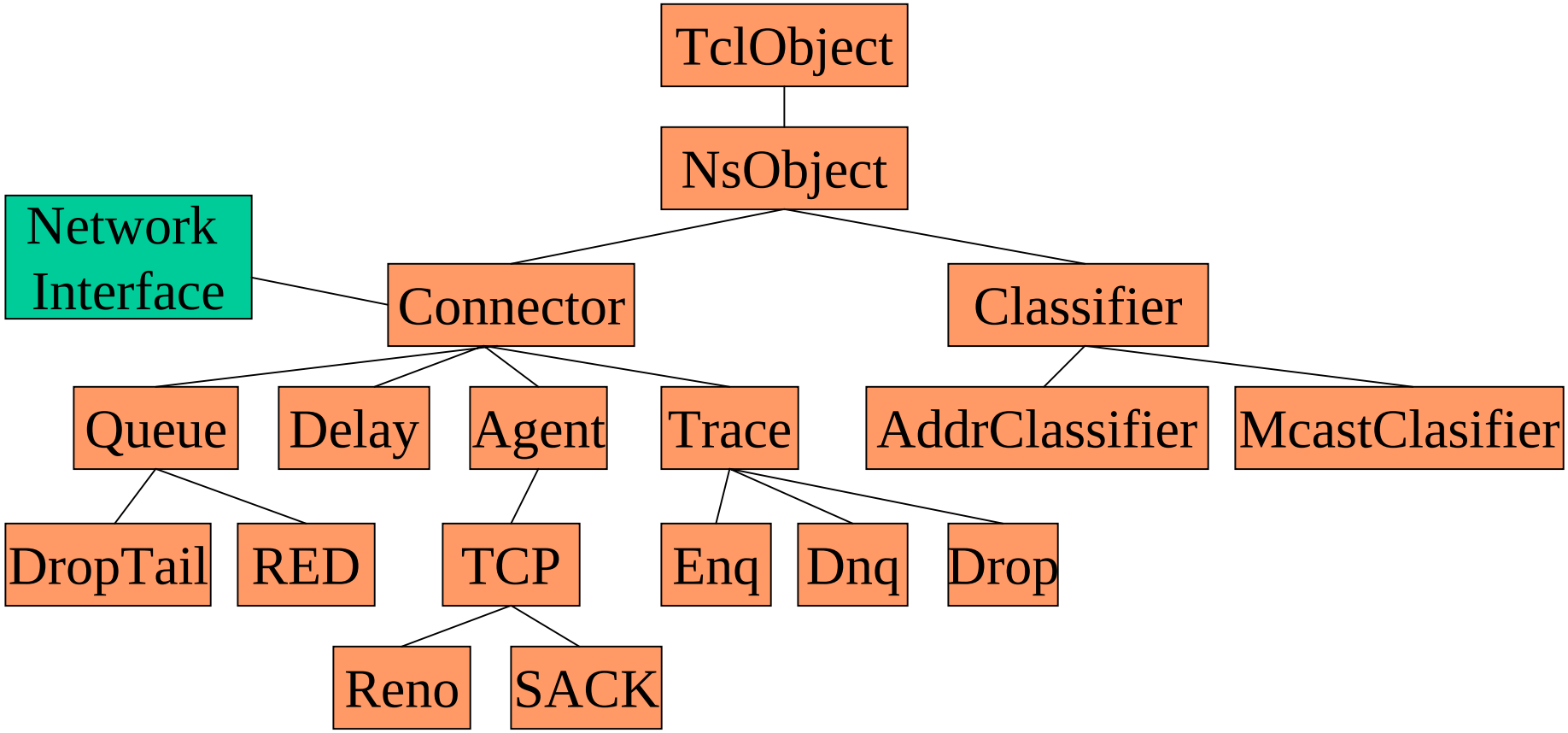
- Supported by tclcl (a.k.a., Tcl)
  - Tcl& tcl = Tcl::instance();
- Implementation is 100% in C++
  - otcl -> C++
    - command(): <otcl command>
    - tcl.result()
  - C++ -> otcl
    - tcl.eval("<otcl action>")
    - bind() or [otcl->C++]

Network Layer

- Network Interface - Packet Labeler

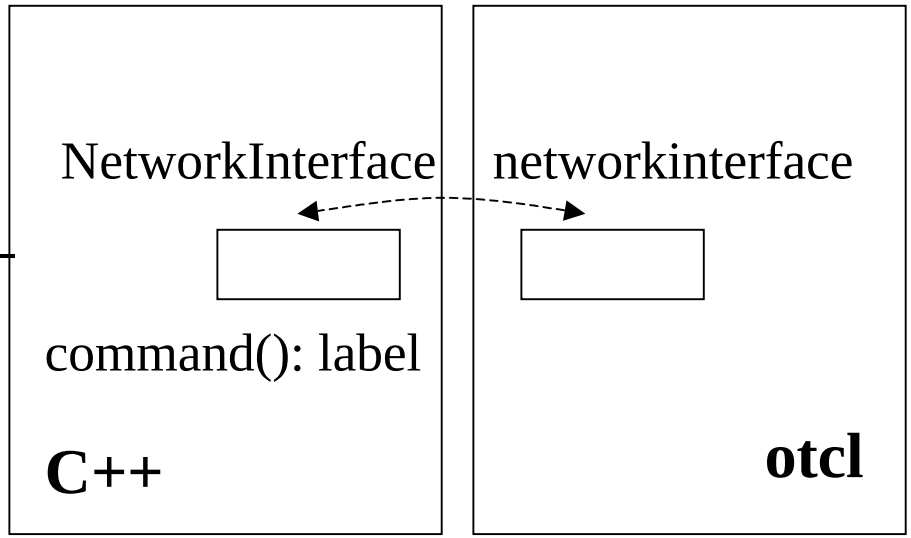


Class Hierarchy



Network Interface Labeler

- class NetworkInterface
  - NetworkInterface()
  - recv(pkt)
    - pkt->iface() = label_
  - send(pkt)
    - target->recv(pkt)
  - command()
    - label argv {label_ = argv}
- TclClass("networkinterface")

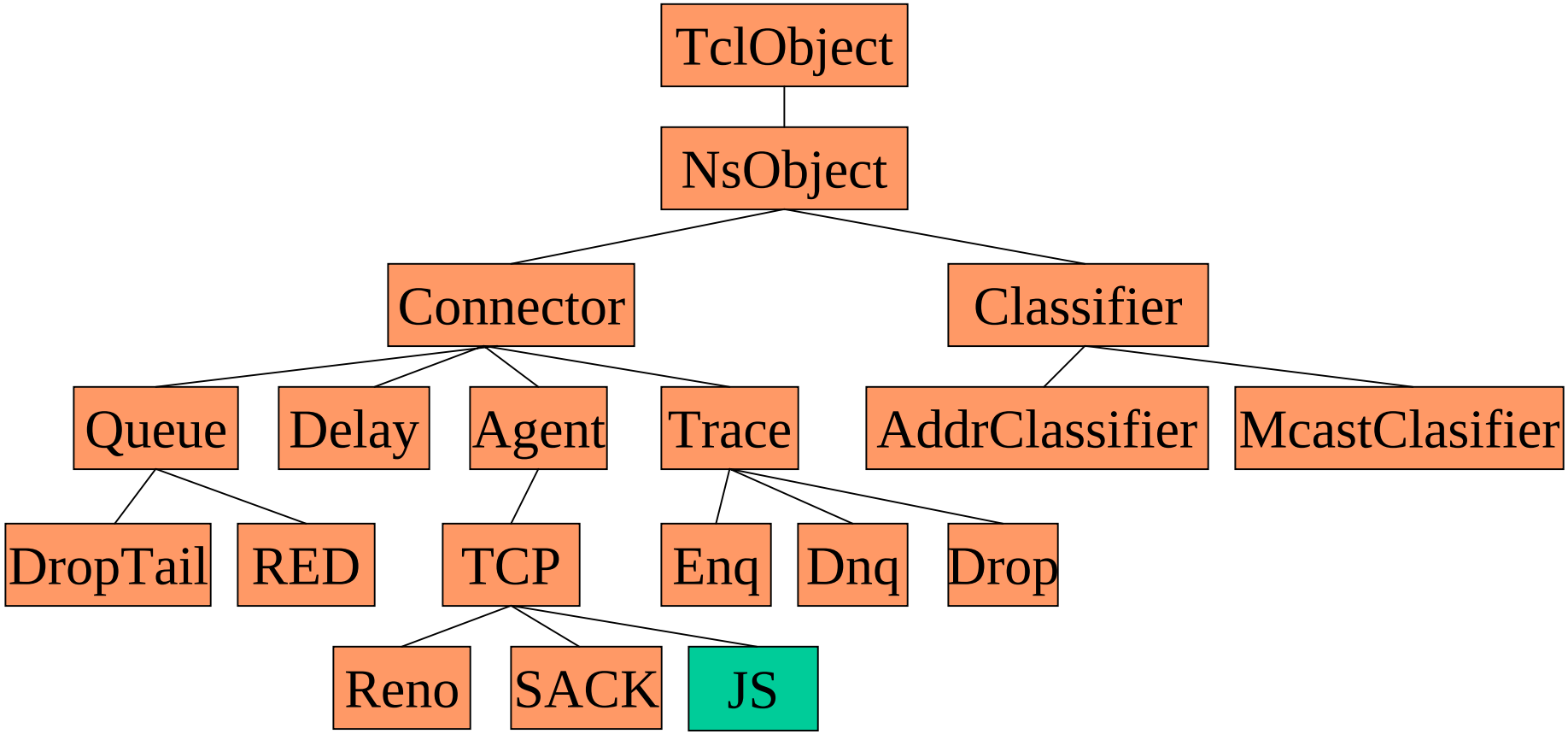



```
set iface [new networkinteface]
$iface label A
```

Transport Layer

- TCP Jump Start
  - from cwnd += 1
  - to cwnd = maxwin

Class Hierarchy

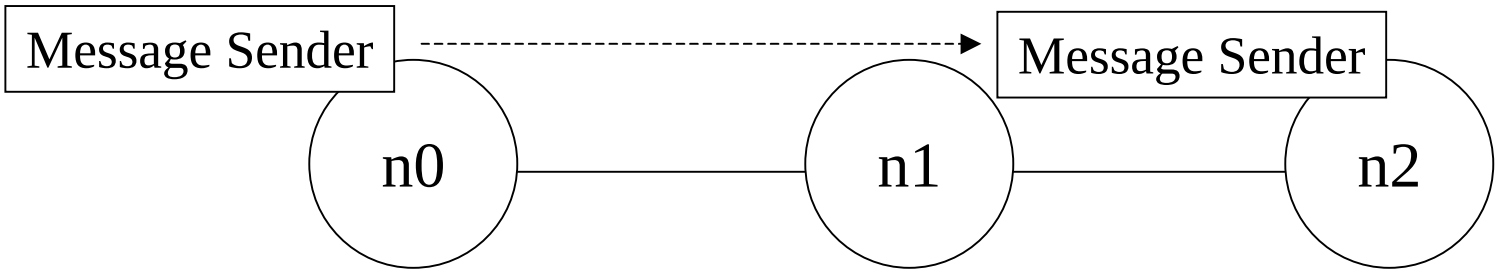


TCP Linear Slow Start

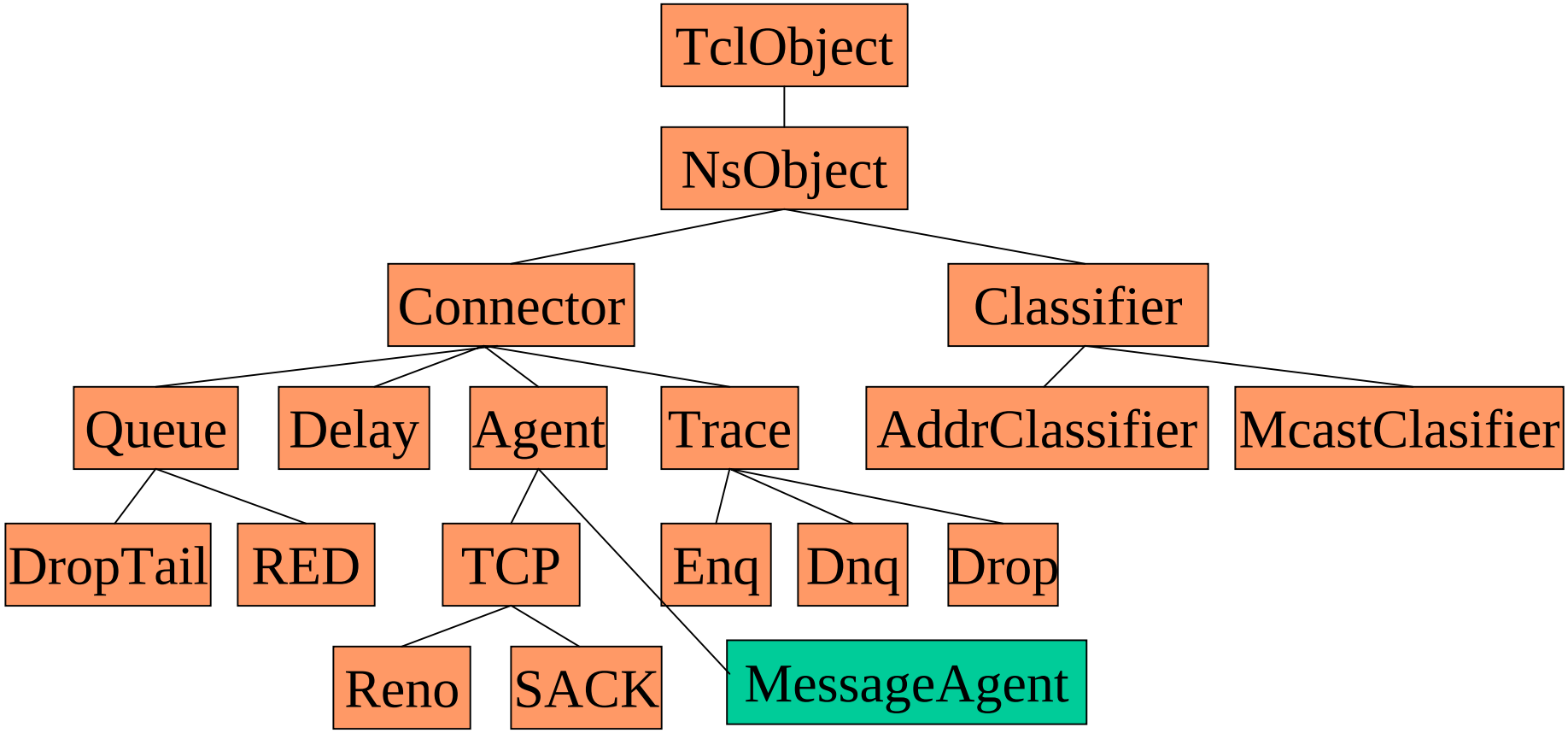
- class JSTcpAgent
  - openwin()
  - slowdown()
- TclClass(“Agent/TCP/JS”)

Application Layer

- Message sender

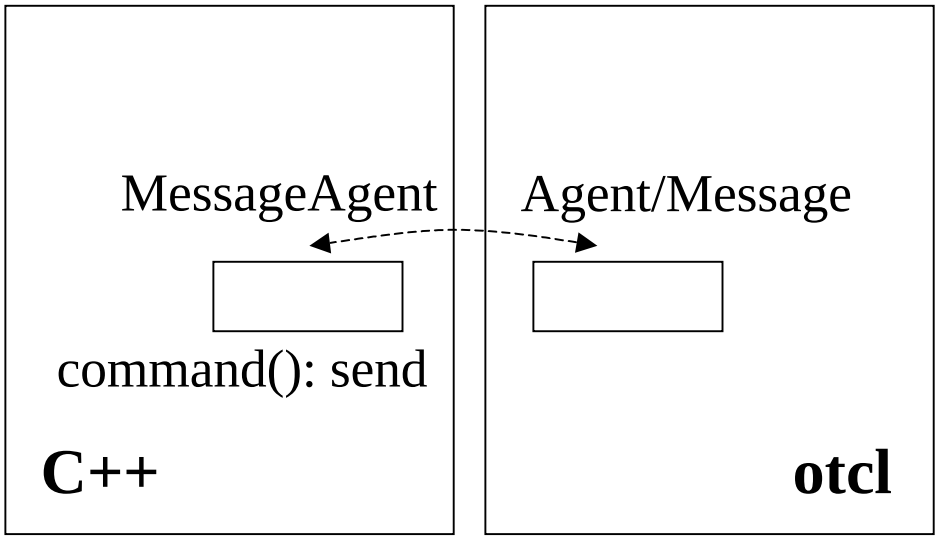


Class Hierarchy



Message Sender

- class MessageAgent
  - MessageAgent()
  - recv()
  - send()
  - command()
    - send {send()}



- TclClass("Agent/Message")

```
set msg [new Agent/Message]
$msg send
```

ns-2 301 Preview

- Generating representative web traffic
  - HttpSession internal - step by step code walk through
- Isolating flow control or error recovery mechanisms from TCP
  - TCP internal - step by step code walk through

Slides

- http://www.research.att.com/~phuang