

Deep dive into Tomcat Clustering

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About me

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- Apache Tomcat committer since 2010
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Agenda

- Tomcat Clustering Overview
- Session Replication
- Cluster Channel Component (a.k.a. Apache Tribes)
- Monitoring Cluster components
- Questions



Tomcat Clustering Overview

What is Clustering?

- Performance improvement
- High availability

Tomcat Clustering

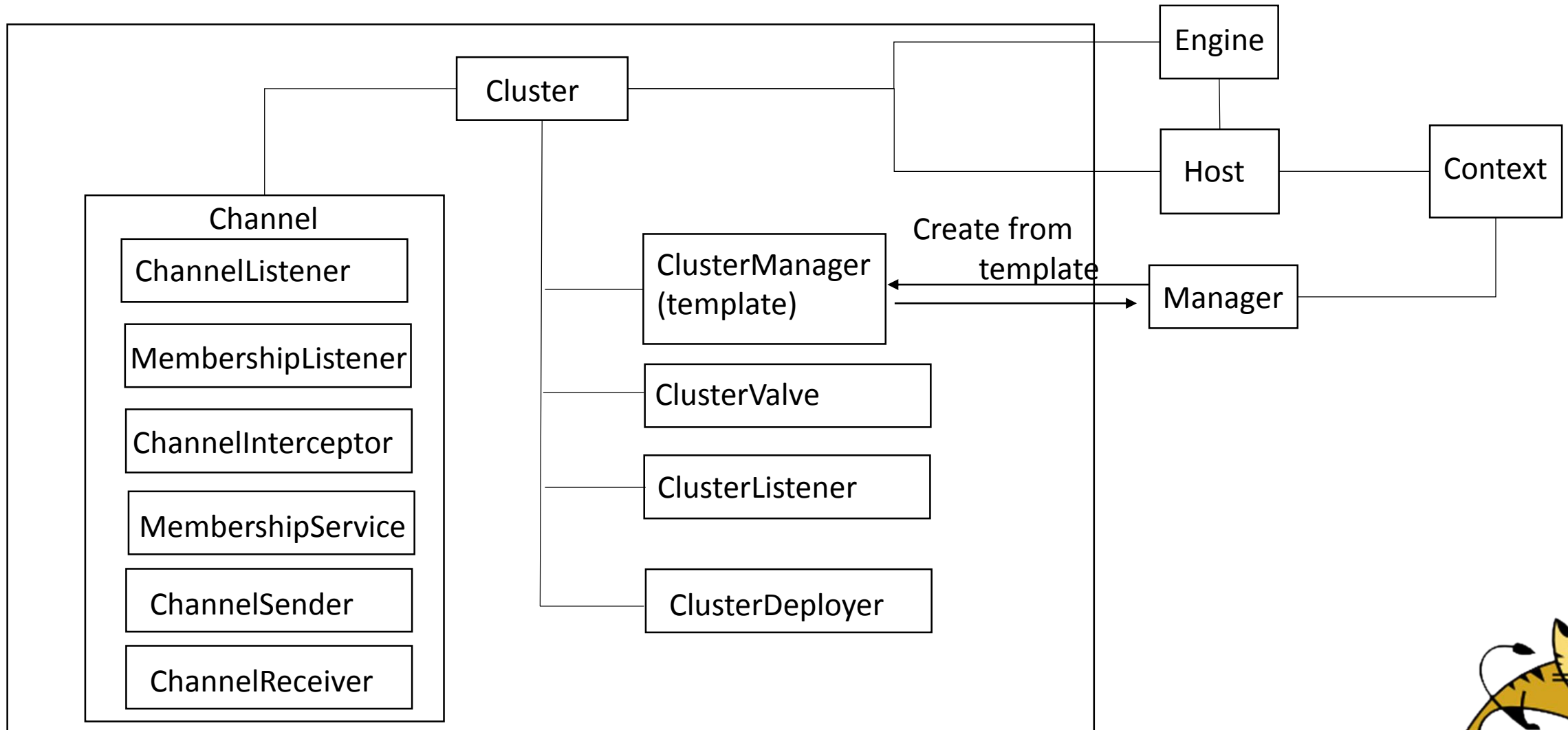
- Cluster membership/Grouping
- Session Replication

Load balancing is not a Tomcat features

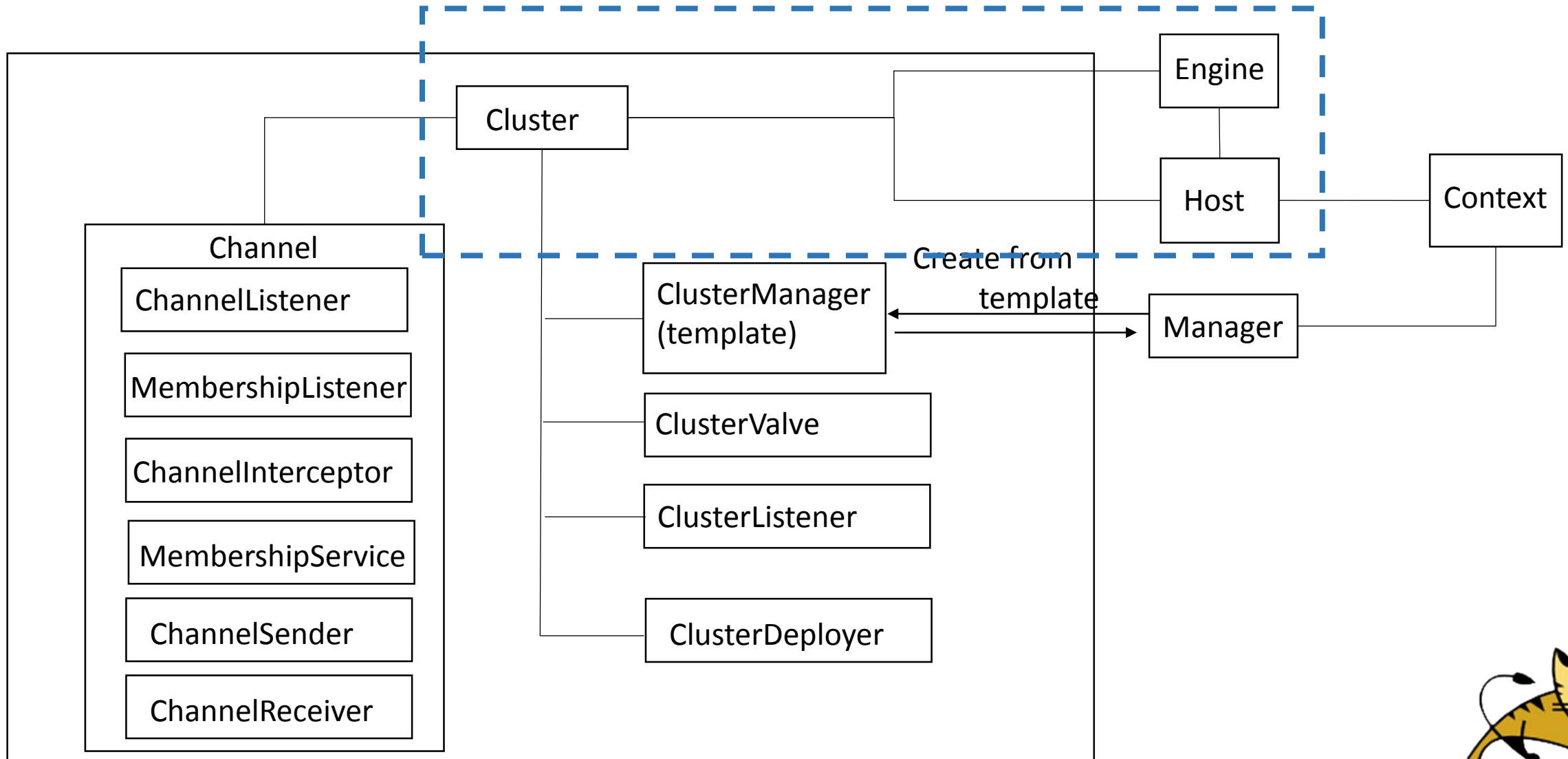
- Use mod_jk / mod_proxy_balancer



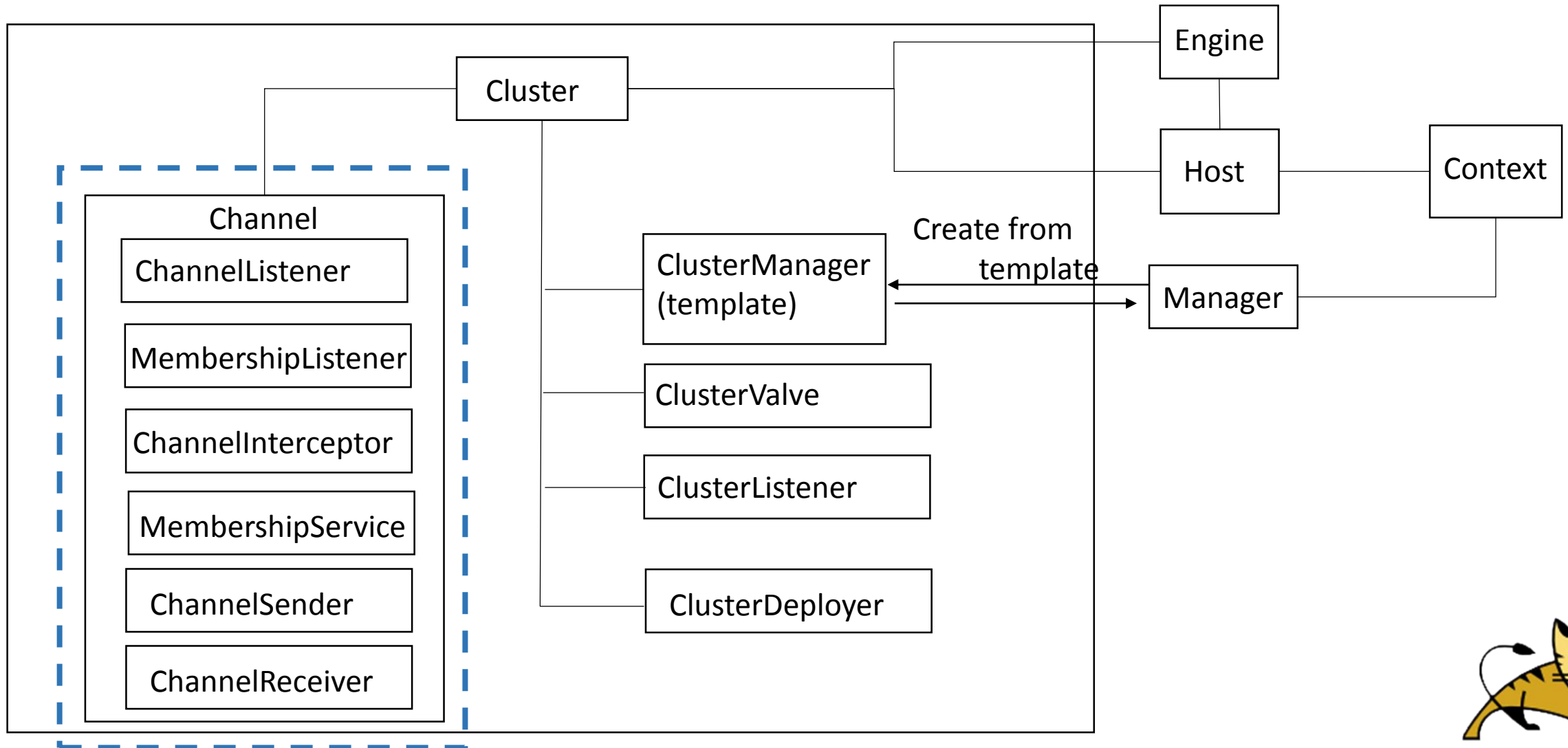
Cluster Architecture



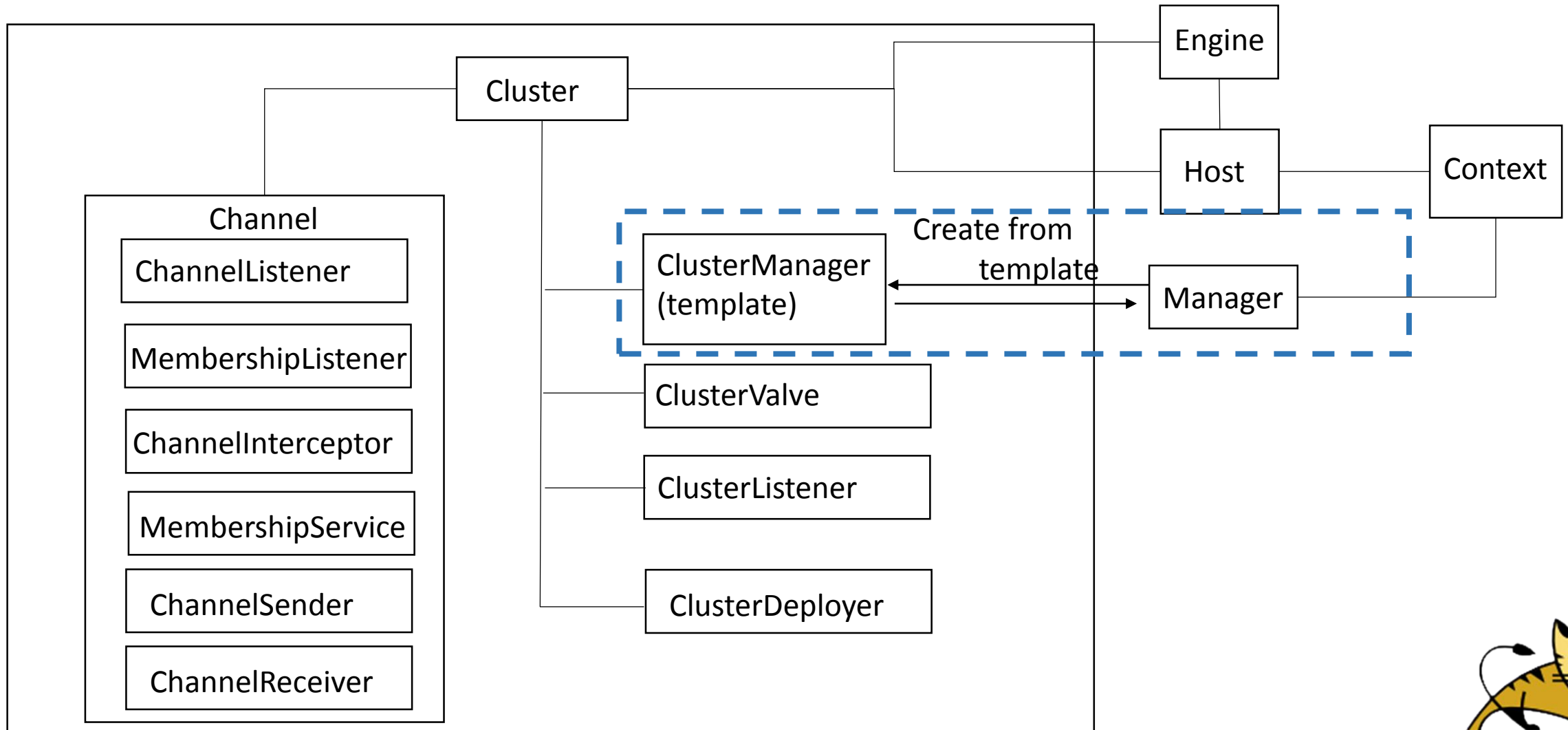
Cluster Architecture



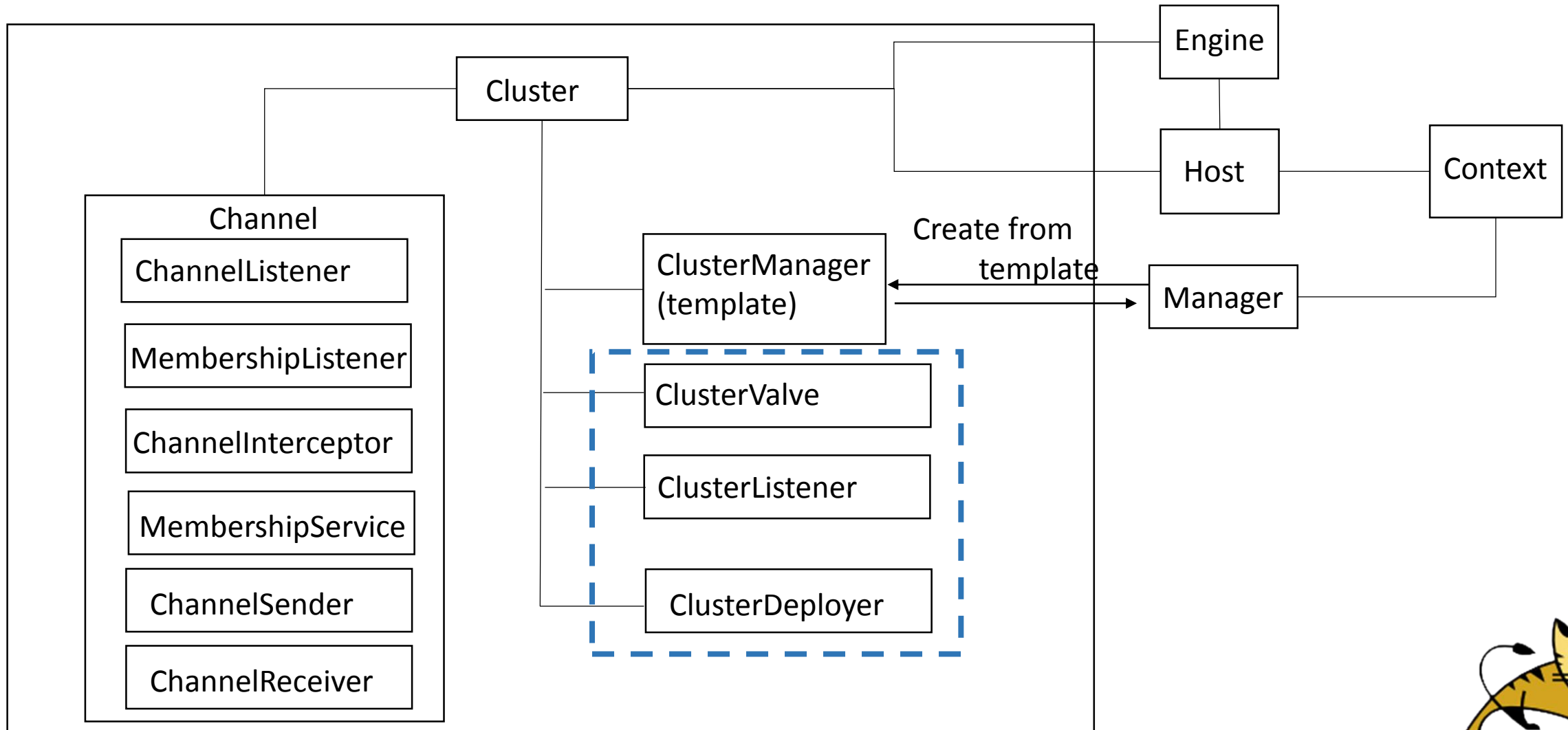
Cluster Architecture



Cluster Architecture



Cluster Architecture



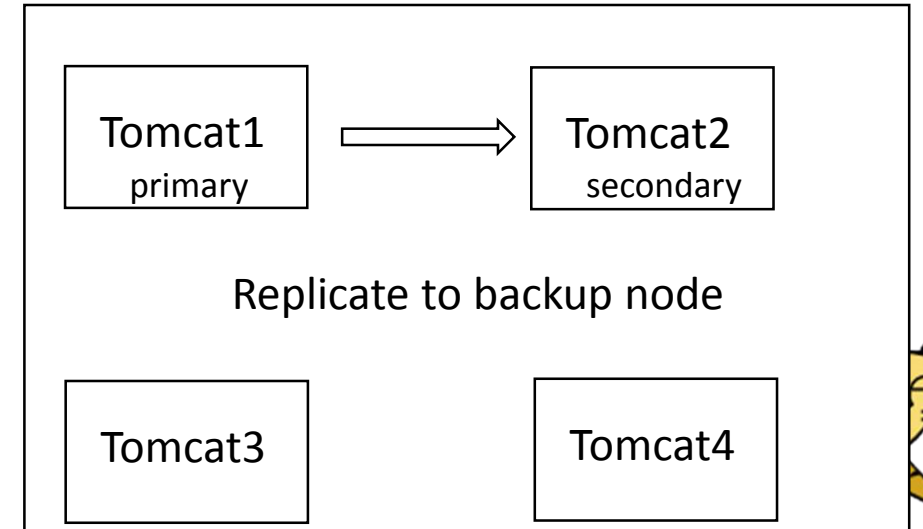
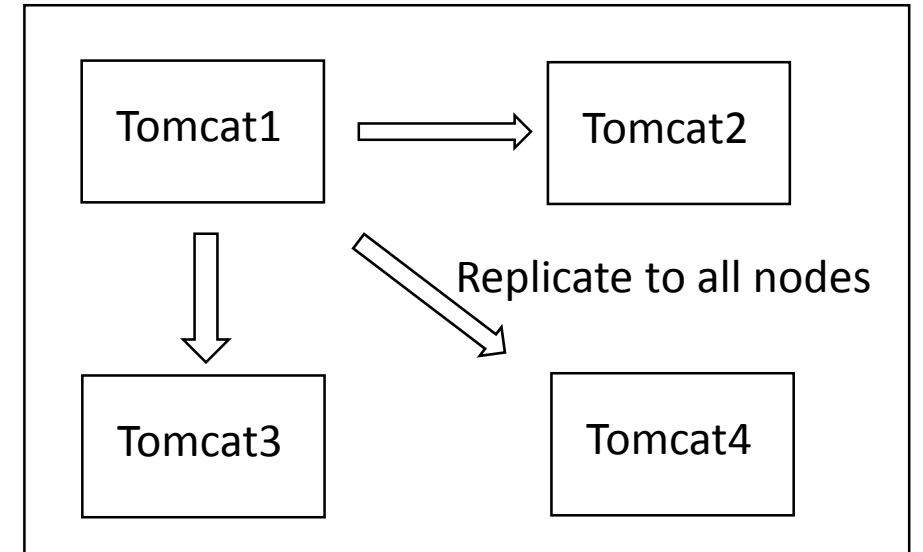
Session Replication



Session Replication

Two ways Implementations

- All-to-All session replication
 - DeltaManager (Default)
 - For small cluster
- Primary-Secondary replication
 - BackupManager
 - For large cluster



Session Replication

Delta Replication for session attributes

- Replicate only the changes of session
 - Not all session data
- Replicate all changes of session at the time of end of request
 - Not replication per change of session



How to configure

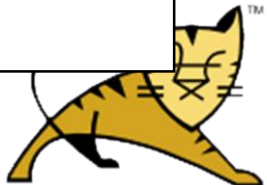
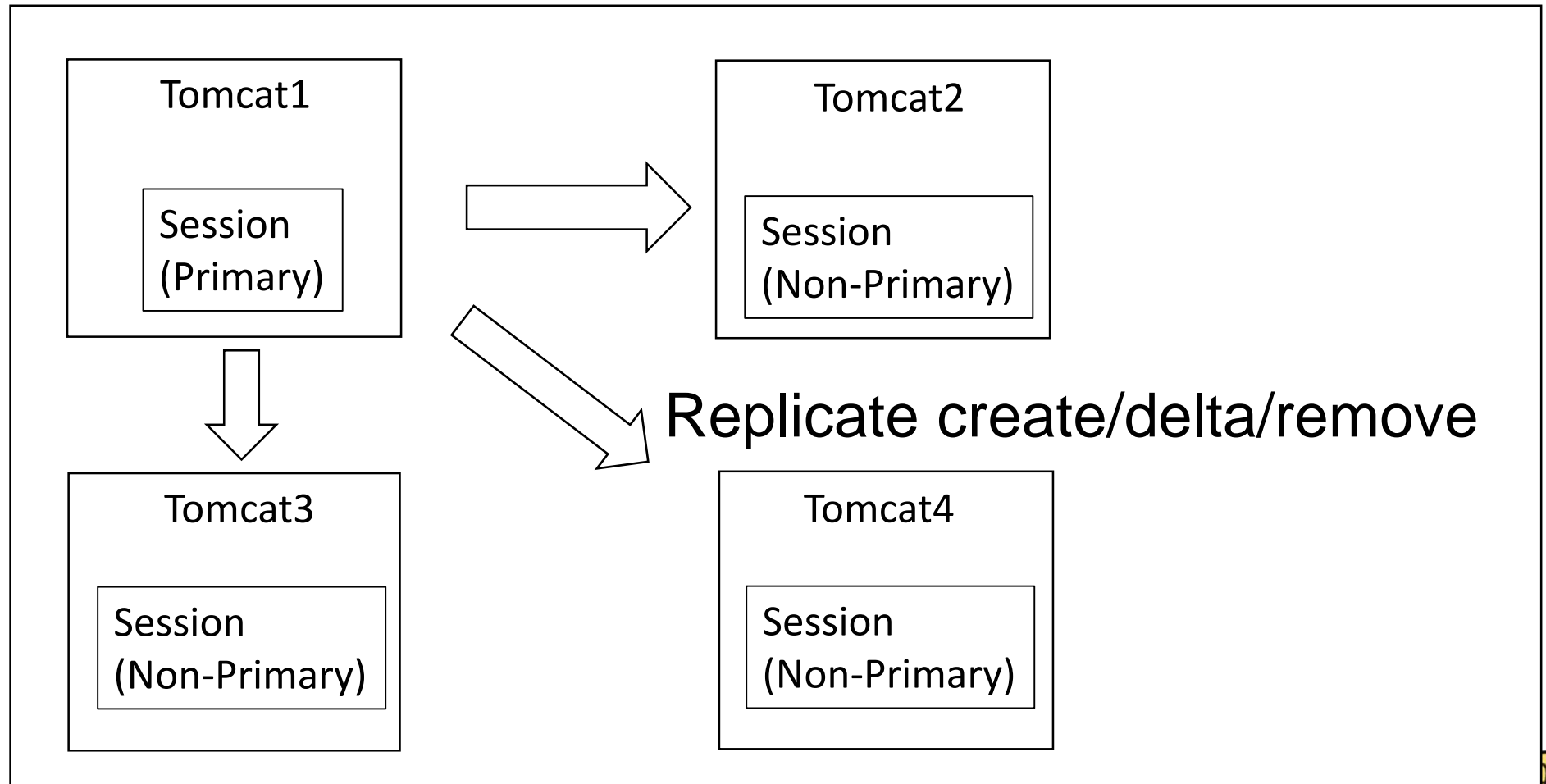
- Define <Cluster> element inside The Engine or Host element.
- Configure Cluster Manager
 - DeltaManager or BackupManager
- Configure Channel components
- Enable `org.apache.catalina.ha.tcp.ReplicationValve`
- Enable `org.apache.catalina.ha.session.ClusterSessionListener`
 - If DeltaManager use



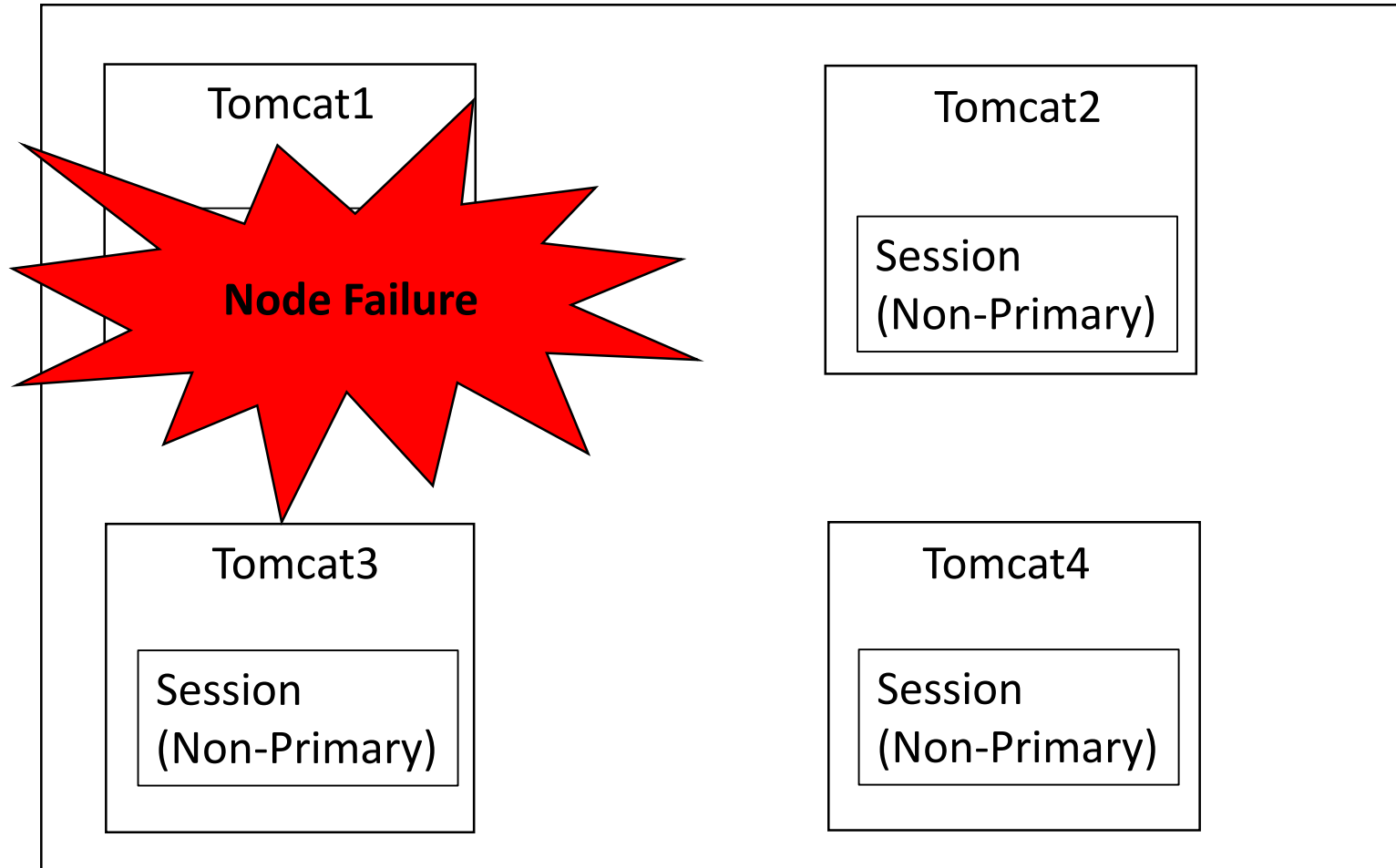
Behavior of Session Replication



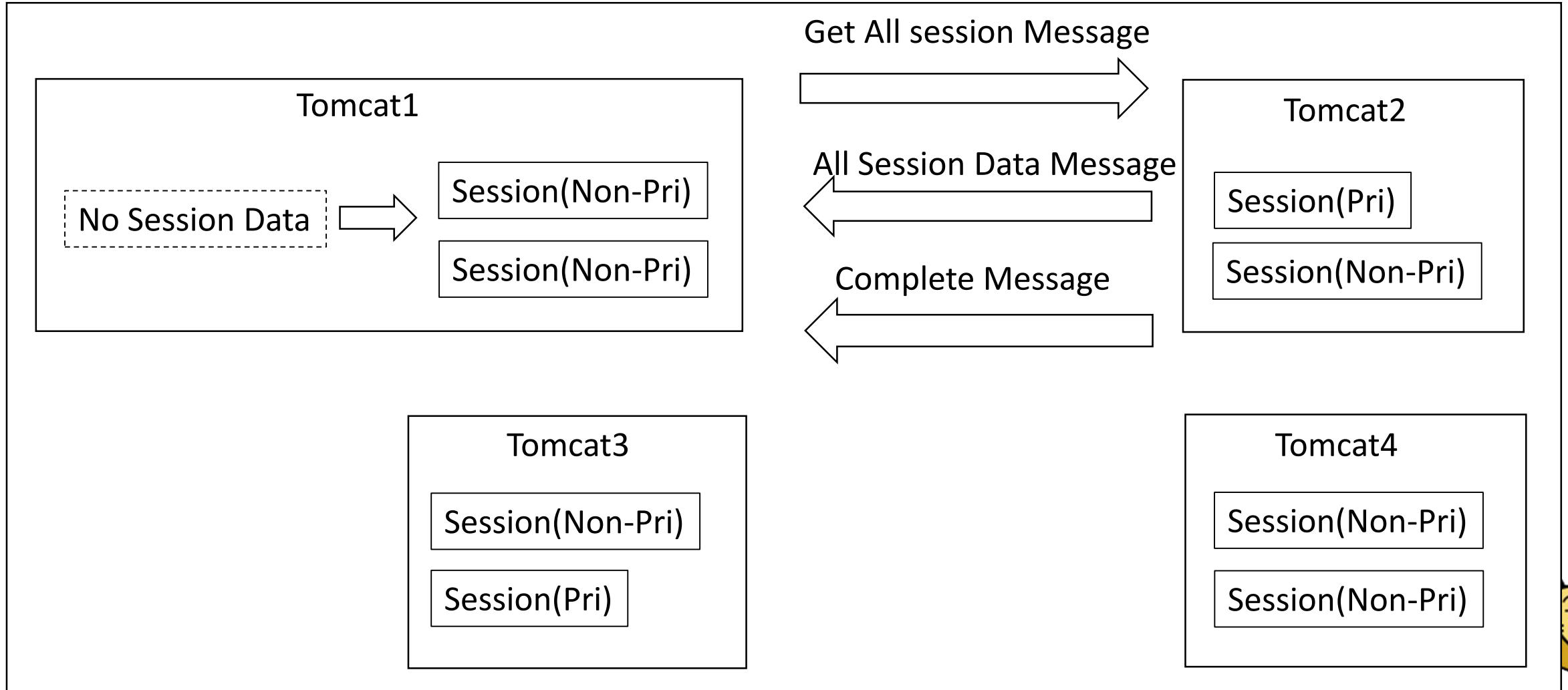
DeltaManager



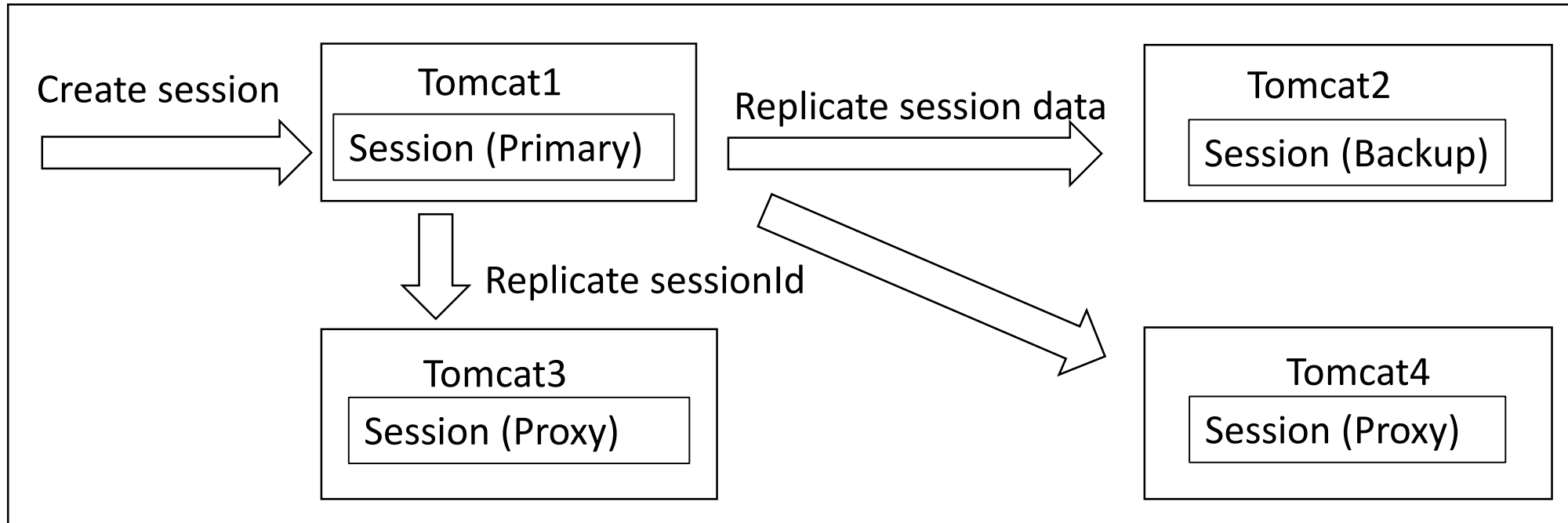
DeltaManager : Node Failure



DeltaManager : Node Recovery



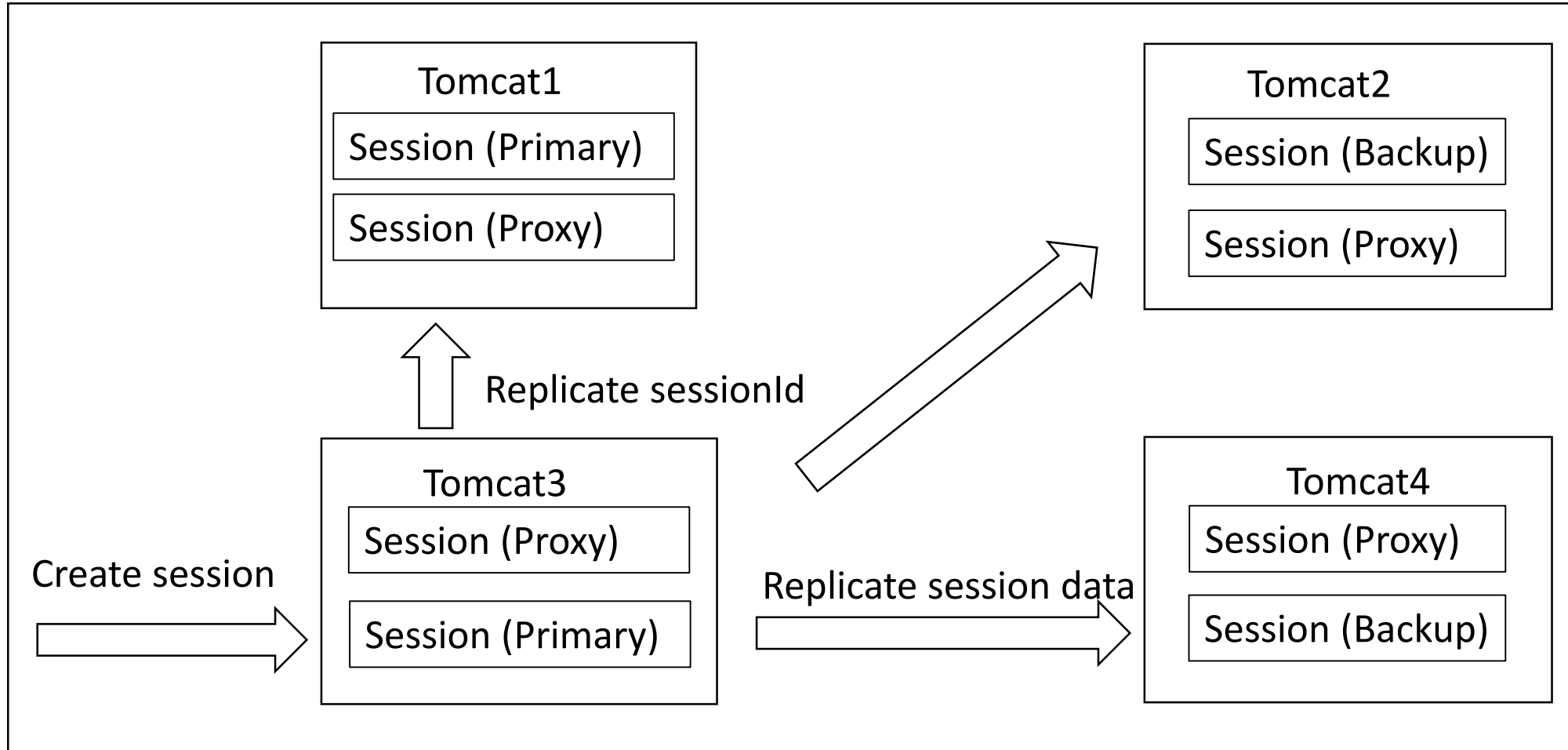
BackupManager : session create



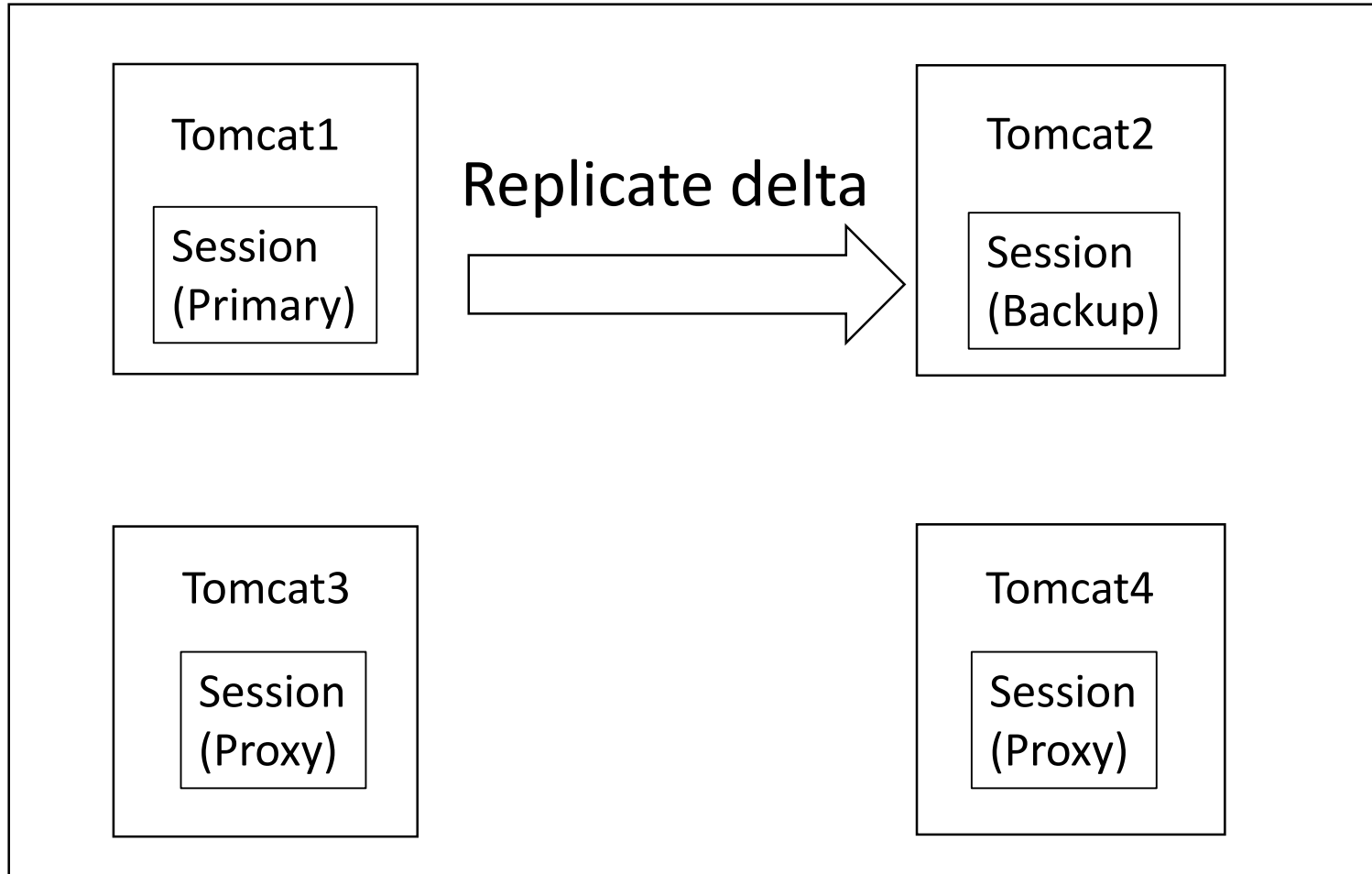
- Primary Session : Master Session that currently used
- Backup Session : Backup session for the primary. it has same session data as primary
- Proxy Session : Sessions that have only session ID but no session data



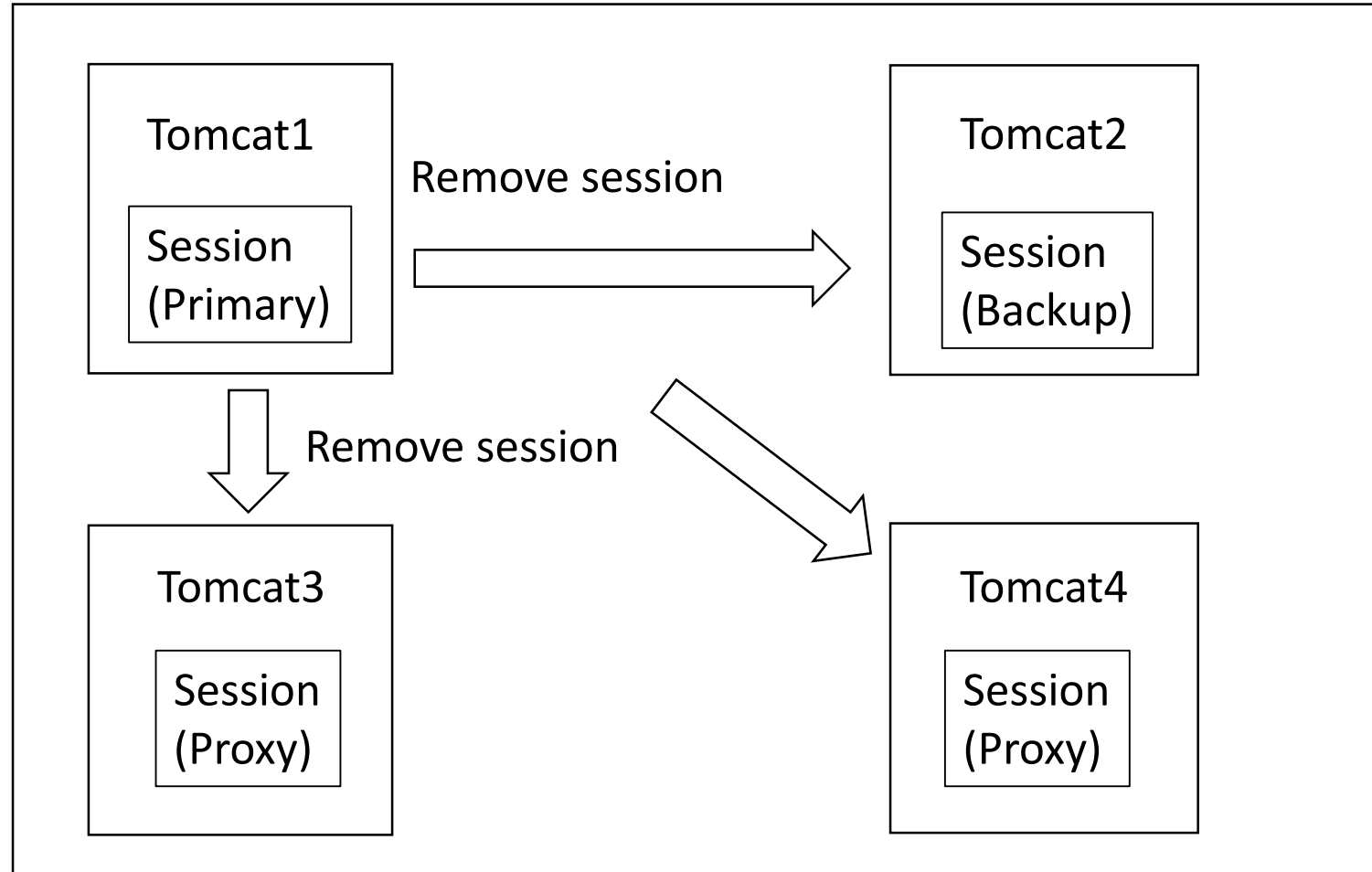
BackupManager : session create



BackupManager : replicate delta



BackupManager : session remove



BackupManager : Node Failure

Tomcat1

SessionA(Primary)

SessionB(Backup)

SessionC(Proxy)

Node Failure

Tomcat2

Promote&Select new backup&publish

SessionA(Backup)

SessionA(Primary)

SessionB(Primary)

Select new backup&publish

SessionC(Proxy)

NOP

Tomcat3

SessionA(Proxy) newly backup SessionA(Backup)

SessionB(Proxy) newly proxy SessionB(Proxy)

SessionC(Primary) NOP

Tomcat4

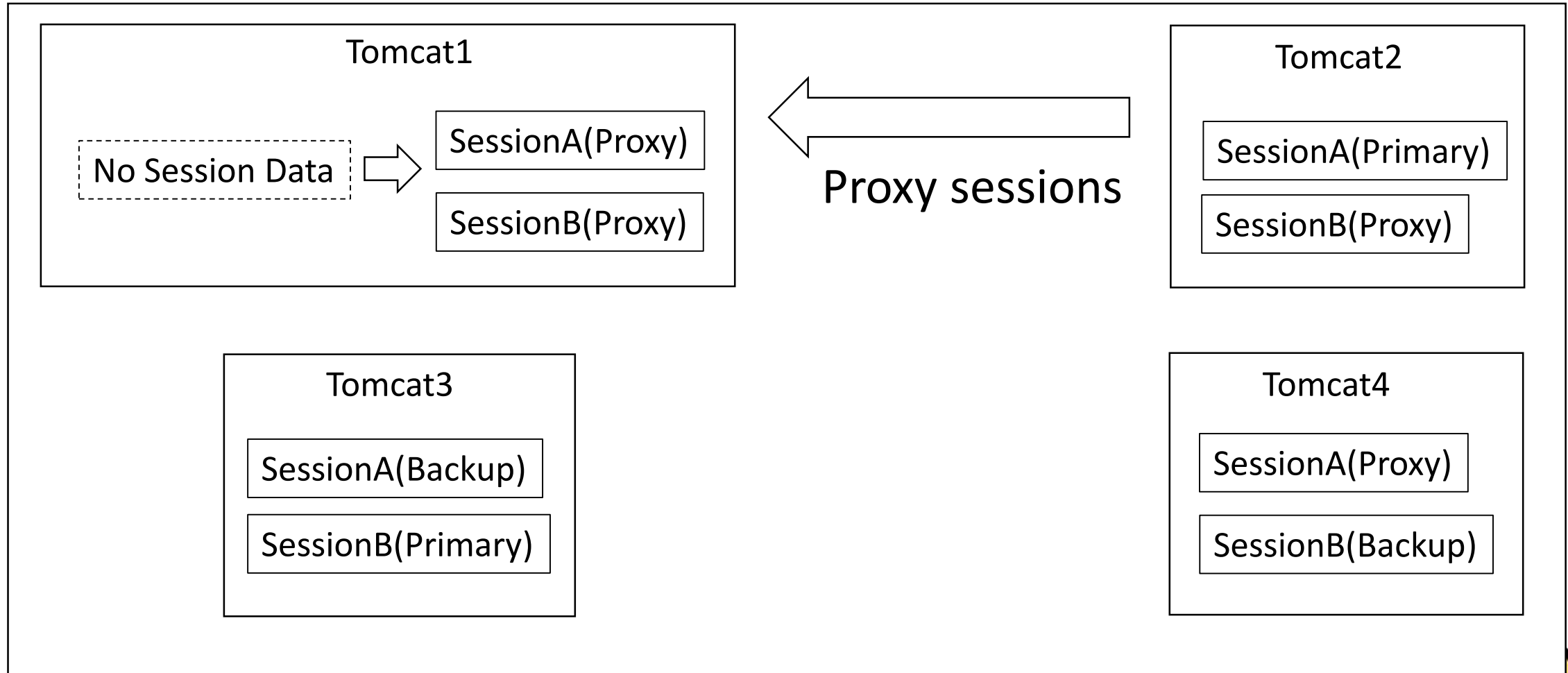
SessionA(Proxy) newly proxy SessionA(Proxy)

SessionB(Proxy) newly backup SessionB(Backup)

SessionC(Backup) NOP



BackupManager : Node Recovery



Cluster Channel



Channel

What is Channel ?

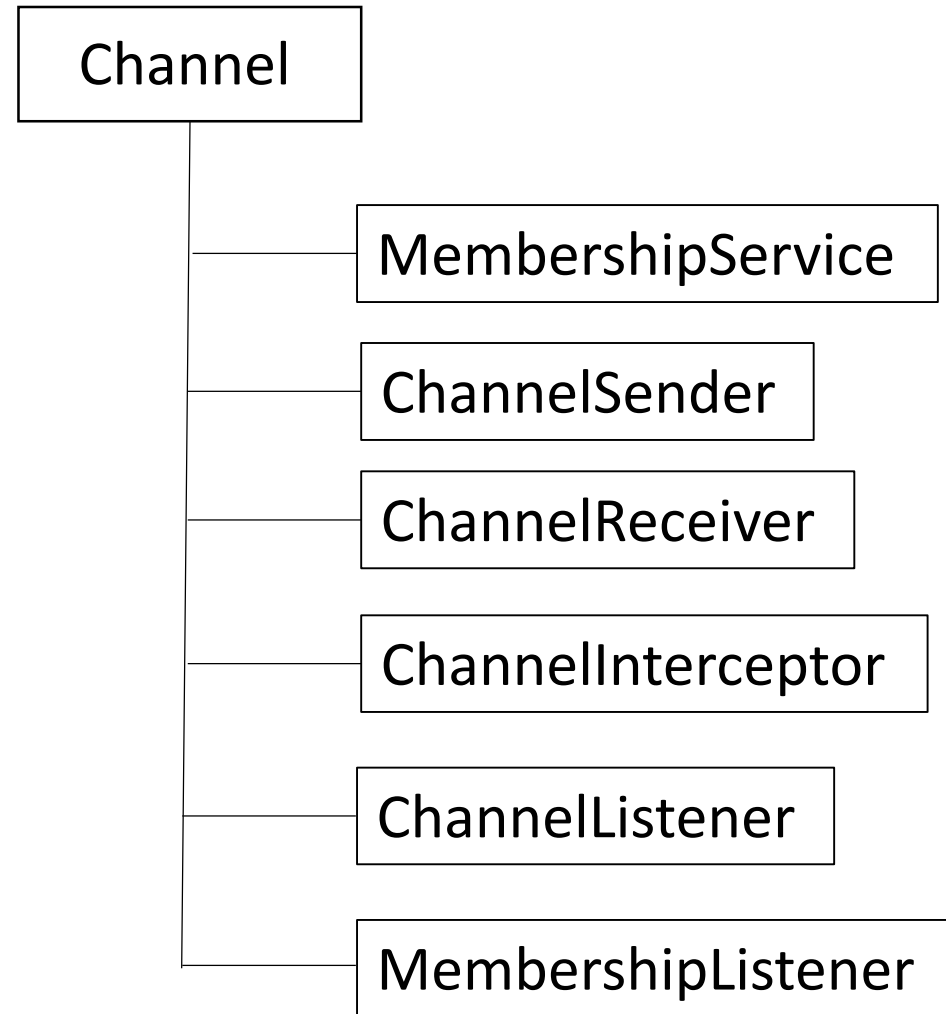
- Messaging & Grouping component

Responsibility

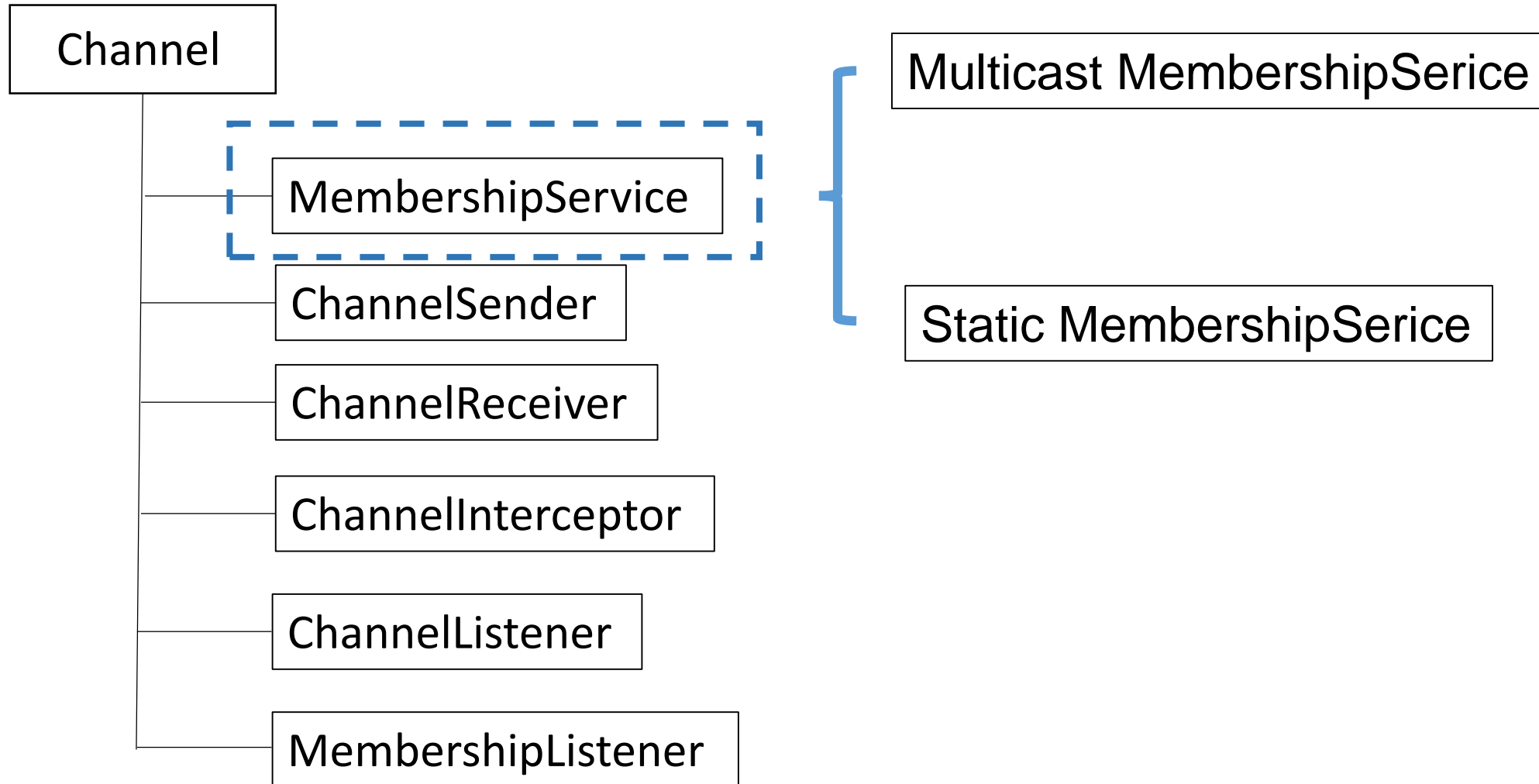
- Build Membership in cluster nodes
- Send channel messages to cluster nodes
- Receive channel messages from cluster nodes



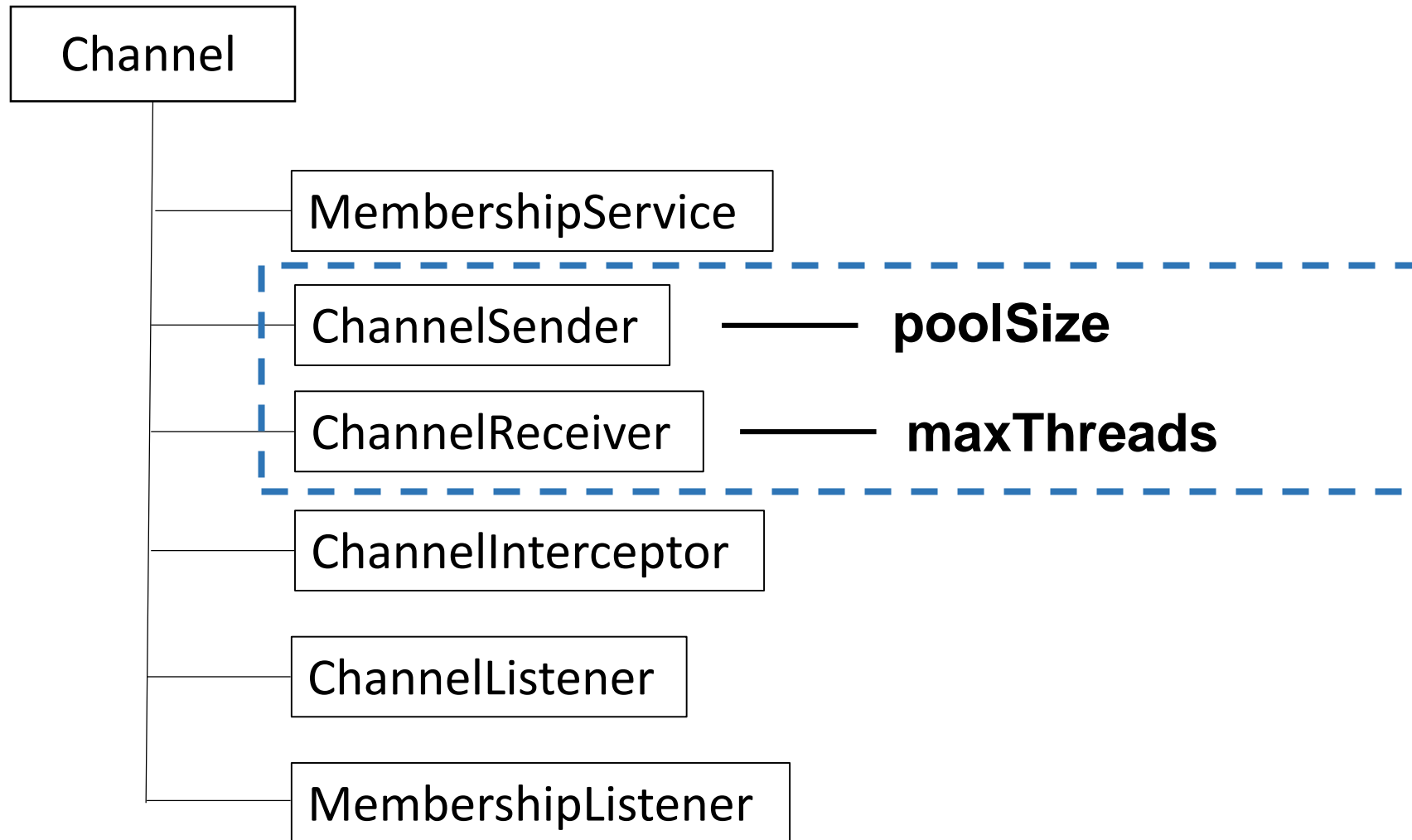
Channel Components



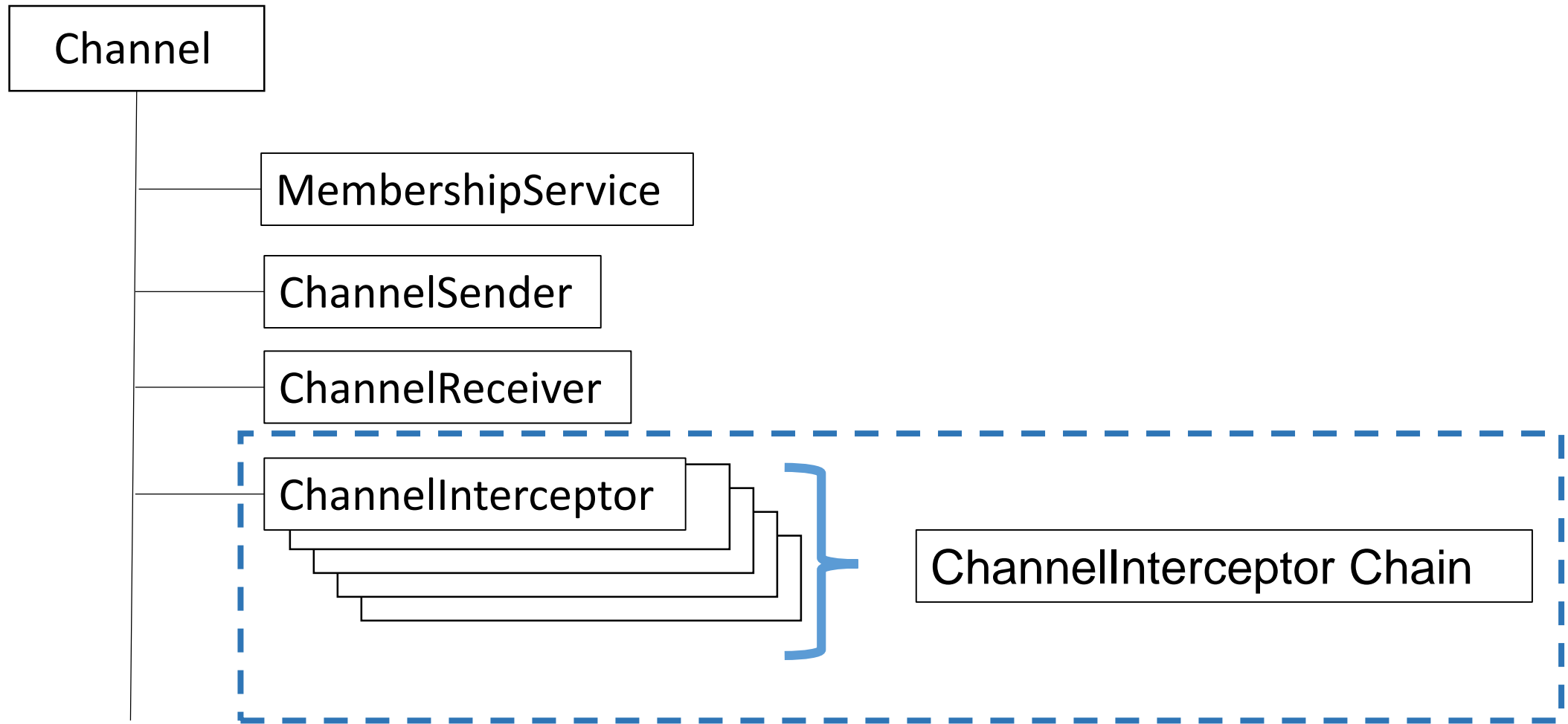
Channel Components



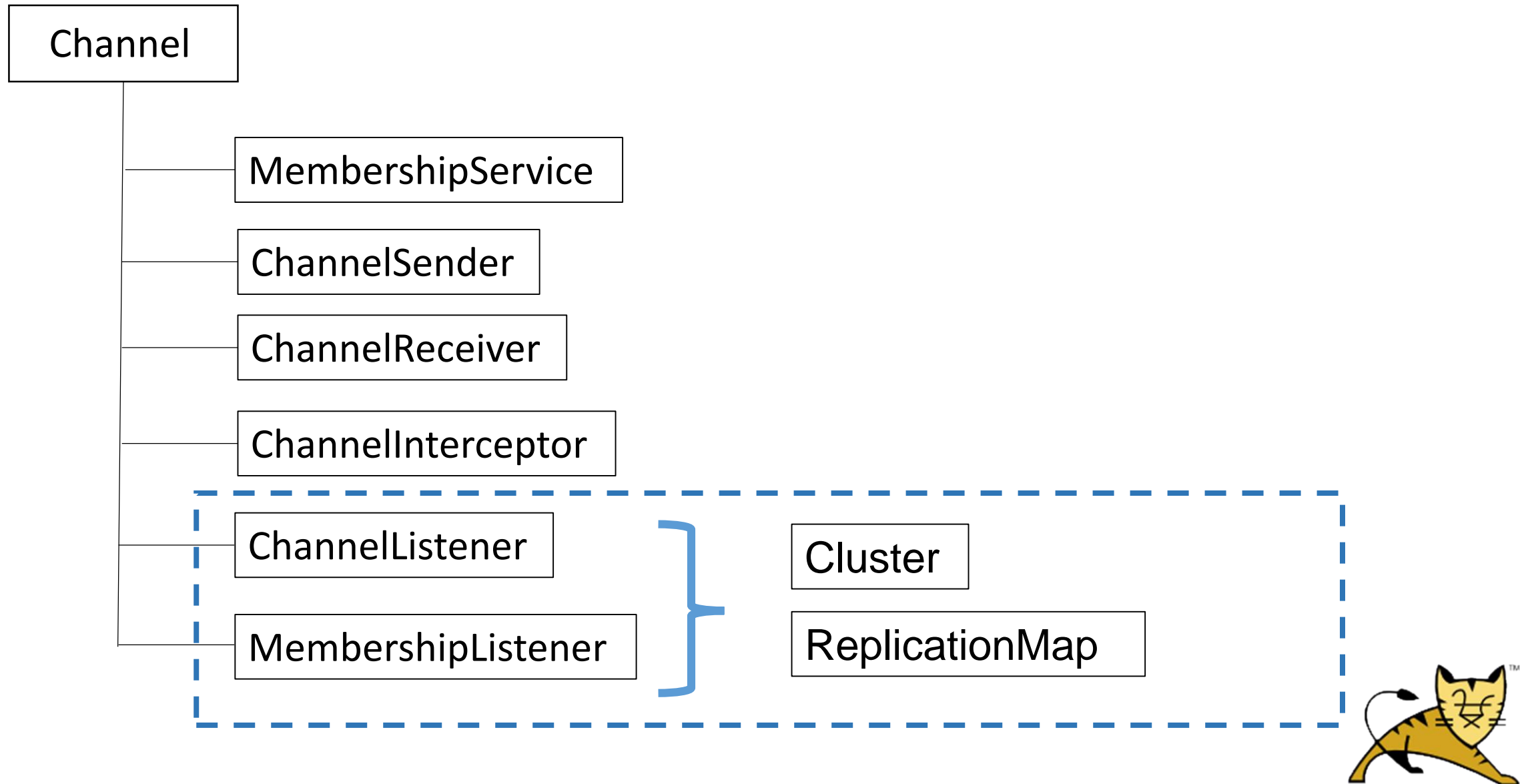
Channel Components



Channel Components

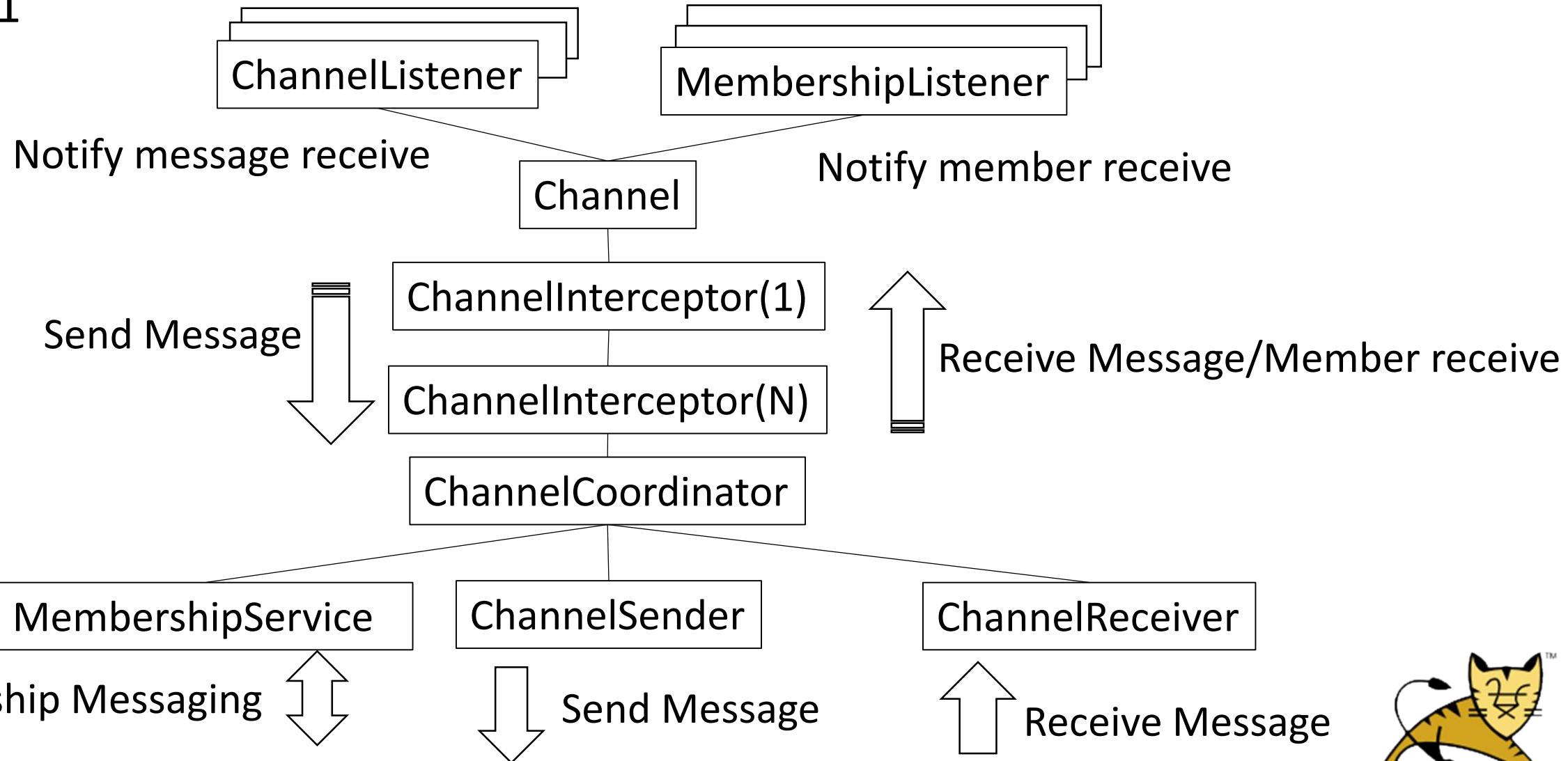


Channel Components

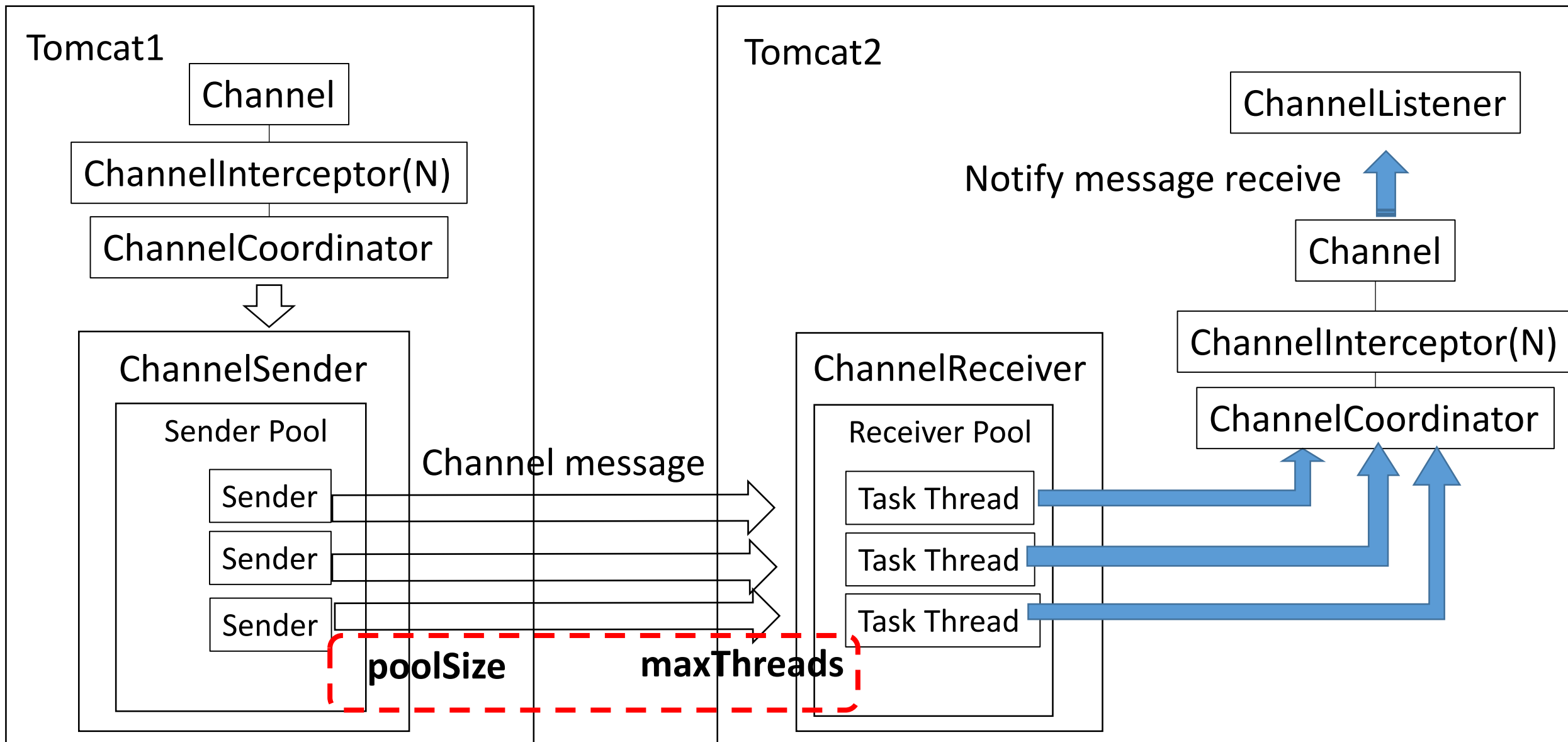


Channel Architecture

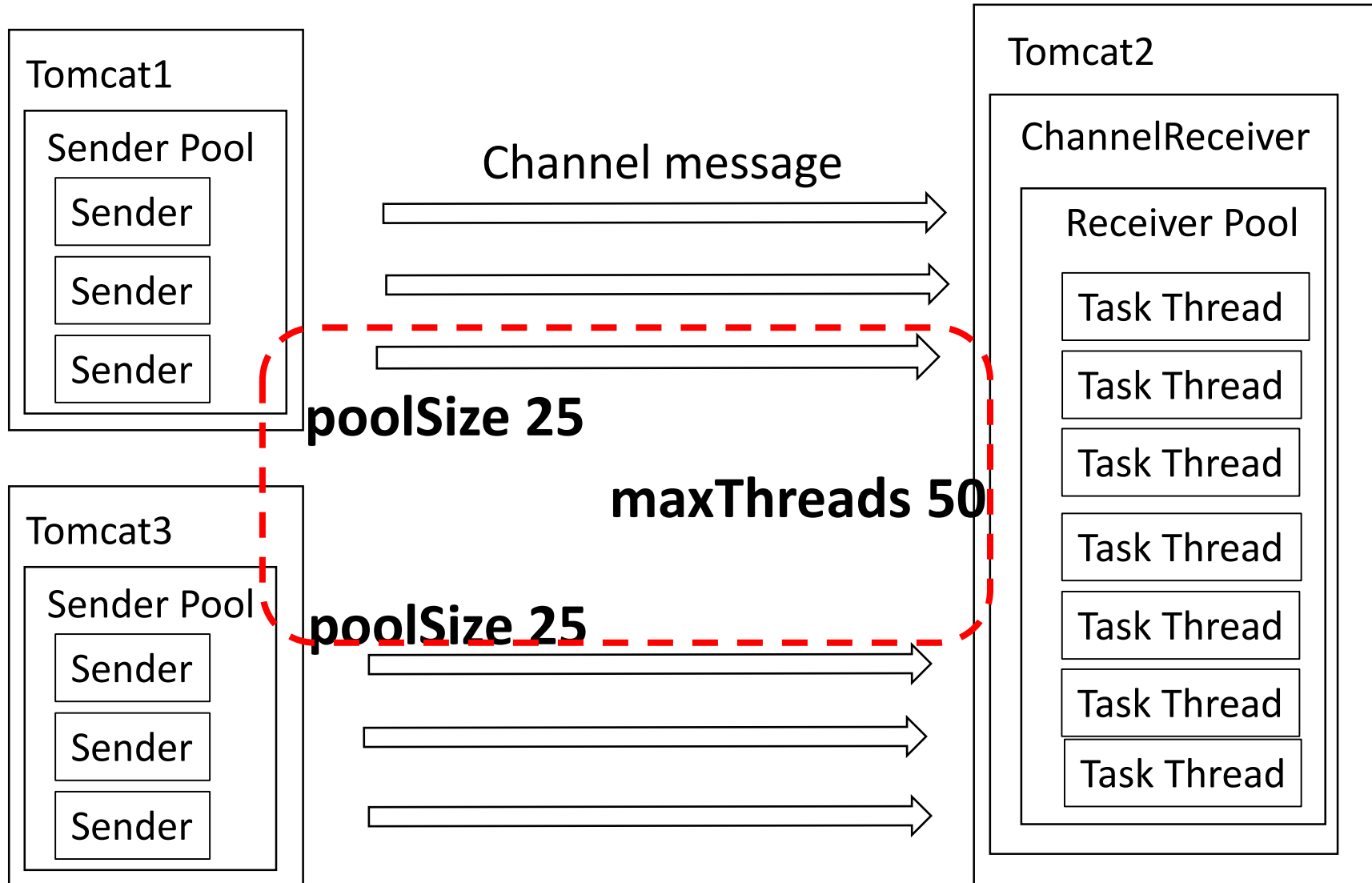
Tomcat1



Sender/Receiver Tuning



Sender/Receiver Tuning



Sample config

```
<Cluster className="org.apache.catalina.ha.tcp.SimpleTcpCluster">
  <Channel className="org.apache.catalina.tribes.group.GroupChannel">
    <Membership className="org.apache.catalina.tribes.membership.McastService"
      address="229.0.0.61" port="45564" frequency="500" dropTime="4000" />

    <Receiver className="org.apache.catalina.tribes.transport.nio.NioReceiver"
      address="auto" port="4004" autoBind="100" maxThreads="25"/>

    <Sender className="org.apache.catalina.tribes.transport.ReplicationTransmitter">
      <Transport className="org.apache.catalina.tribes.transport.nio.PooledParallelSender"
        timeout="5000" poolSize="25"/>
    </Sender>

    <Interceptor className="org.apache.catalina.tribes.group.interceptors.MessageDispatchInterceptor" />
    <Interceptor className="org.apache.catalina.tribes.group.interceptors.TcpFailureDetector"/>
  </Channel>
  . . . . .
</Cluster>
```

Add-ons features for Channel



Verifying members using TCP Packet

TCPFailureDetector

- It works in two ways.
 - Intercept memberDisappeared events
 - a heartbeat timeout has occurred in membership service
 - Catches send errors.

Setting

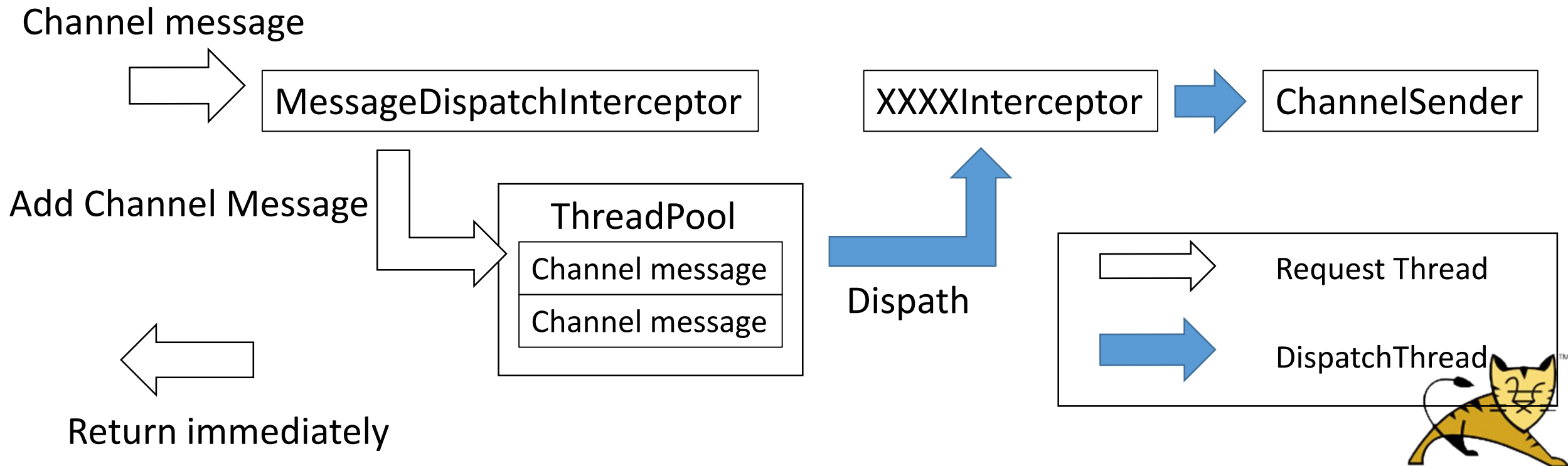
- `<Interceptor`
 `className="org.apache.catalina.tribes.group.interceptors.TCPFailureDetector"`
 `/>`



Asynchronous message dispatcher

MessageDispatchInterceptor

- Enable complete asynchronous messaging
- Queuing the message for delivery and immediately return to the sender



Asynchronous message dispatcher

Setting

- <Interceptor
 className="org.apache.catalina.tribes.group.interceptors.MessageDispatchInterceptor"
 maxThreads="25"
 maxSpareThreads="10"
/>
- You must set the send options asynchronous.
 - Cluster's channelSendOptions to async(8) or async + use_ack(10)
 - BackupManager's mapSendOptions to async(8) or async + use_ack(10)



Asynchronous message dispatcher

Notes : If using with TCPFailureDetector

- MessageDispatchInterceptor does not propagate send errors to upper channel interceptor chains
- The setting order is important

Channel message



- Intercepts memberDisappeared event
- Catches send errors

Channel message



- Intercepts memberDisappeared event
- ~~• Catches send errors~~



Measuring channel messages

ThroughputInterceptor

- Report the throughput statistics.
- Default interval is to report every 10000 messages.

Setting

- `<Interceptor`
 `className="org.apache.catalina.tribes.group.interceptors.ThroughputInterceptor"`
 `/>`
- Logging setting
 - Key: `org.apache.catalina.tribes.group.interceptors.ThroughputInterceptor`
 - Level: INFO



Measuring channel message

- e.g.

```
org.apache.catalina.tribes.group.interceptors.ThroughputInterceptor.report ThroughputInterceptor  
Report[
```

```
  Tx Msg:60,024 messages
```

```
  Sent:53.30 MB (total)
```

```
  Sent:53.31 MB (application)
```

```
  Time:16.84 seconds
```

```
  Tx Speed:3.16 MB/sec (total)
```

```
  TxSpeed:3.16 MB/sec (application)
```

```
  Error Msg:0
```

```
  Rx Msg:60,048 messages
```

```
  Rx Speed:0.23 MB/sec (since 1st msg)
```

```
  Received:53.28 MB]
```



Domain Filtering

DomainFilterInterceptor

- Filtering members that join cluster group by the domain

Setting

- `<Membership className="org.apache.catalina.tribes.membership.McastService"
address="229.0.0.61"
port="45564"
....
domain="{1,2,3,4}"
>`
- `<Interceptor
className="org.apache.catalina.tribes.group.interceptors.DomainFilterInterceptor"
domain="{1,2,3,4}"
>`



Static Membership Service

Static Membership

- unicast based membership service
- sends TCP packets to predefined member address instead of multicast
- build a cluster group by describing the cluster members in server.xml

Two ways for static membership

- StaticMembershipInterceptor
- StaticMembershipService (Tomcat 9.0.11 or later)



Static Membership Service

StaticMembershipInterceptor

- Setting
 - Disable multicast membership
 - Cluster's channelStartOptions attribute = 3
 - Enable TcpPingInterceptor for nodes failure detection
 - Enable TcpFailureDetector for membership management
 - Define members under StaticMembershipInterceptor
 - The order is
 - TcpPingInterceptor
 - TcpFailureDetector
 - StaticMembershipInterceptor



Static Membership Service

Setting:

```
<Interceptor className="org.apache.catalina.tribes.group.interceptors.TcpPingInterceptor"/>
<Interceptor className="org.apache.catalina.tribes.group.interceptors.TcpFailureDetector"/>
<Interceptor className=
    "org.apache.catalina.tribes.group.interceptors.StaticMembershipInterceptor">
  <LocalMember className="org.apache.catalina.tribes.membership.StaticMember"
    uniqueId="{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,1}"/>
  <Member className="org.apache.catalina.tribes.membership.StaticMember"
    port="4010" host="hostA"
    uniqueId="{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,2}" />
  <Member className="org.apache.catalina.tribes.membership.StaticMember"
    port="4010" host="hostB"
    uniqueId="{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,3}" />
</Interceptor>
```



Static Membership Service

StaticMembershipService

- Pros
 - Use membership service instead of Interceptor
 - It does not depend on any other interceptors
 - Easy to extend
 - Several enhancement
- Cons
 - Very new
 - Not been tested than StaticMembershipInterceptor



Static Membership Service

Setting

```
<Membership
  className="org.apache.catalina.tribes.membership.StaticMembershipService"
  useThread="false" pingInterval="1000">
  <LocalMember className="org.apache.catalina.tribes.membership.StaticMember"
    uniqueId="{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,1}"/>
  <Member className="org.apache.catalina.tribes.membership.StaticMember"
    port="4010" host="hostA"
    uniqueId="{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,2}" />
  <Member className="org.apache.catalina.tribes.membership.StaticMember"
    port="4010" host="hostB"
    uniqueId="{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,3}" />
</Membership>
```



Customize Channel components

Channel components are pluggable modules

- Channel is built using interfaces.
- Any of the components that are part of channels can be customized



Customize Channel components

Customize ChannelInterceptor

- Two ways for customizing ChannelInterceptor
 - Implements `org.apache.catalina.tribes.ChannelInterceptor`
 - Required interface, needs to implement lots of methods
 - The base class is usually used.
 - Extends `org.apache.catalina.tribes.group.ChannelInterceptorBase`
 - Easy to use
 - Propagate channel messages and member events
 - JMX Support



Customize ChannelInterceptor

- How to Extend ?
 - How to Intercept channel messages?
 - Overrides sendMessage and messageReceived methods
 - How to intercept member events?
 - Overrides memberAdded and memberDisappeared methods
 - Periodical events
 - Overrides heartbeat method
 - Starts up/shuts down Interceptor
 - Overrides start and stop methods
- ✂ Make sure to call super.XXXX in above All methods



Customize ChannelInterceptor

- Setting
 - Add interceptor class to classpath
 - Set FQCN to className attribute in <Interceptor>
 - <Interceptor
 className="FQCN" attr="xxxxx"
/>



Customize Channel components

Customize MembershipService

- Two ways for customizing MembershipService
 - Implements `org.apache.catalina.tribes.MembershipService`
 - It's a little complicated, it's hard to know which method to use
 - Extends
 - `org.apache.catalina.tribes.membership.MembershipServiceBase`
 - `org.apache.catalina.tribes.membership.MembershipProviderBase`
 - More simple
 - Basic membership operations already have implemented



Customize MembershipService

- How to implement MembershipServiceBase ?
 - Create concrete MembershipProvider in start method
- How to implement MembershipProviderBase ?
 - It depends heavily on what membership is based on.
 - Basically detect members, add them to membership, and notify membership service.
- ✕ For reference, you can see StaticMembershipService.



Customize MembershipService

- Setting
 - Add membershipService and provider class to classpath
 - Set FQCN to className attribute in <Membership>
 - < Membership
 className="FQCN" attr="xxxxx"
/>



Customize Channel components

Customize Listeners

- Two customizable listeners
 - `org.apache.catalina.tribes.ChannelListener`
 - listens to incoming messages from a channel
 - `org.apache.catalina.tribes.MembershipListener`
 - Listens to when a member has joined the group and when a member has disappeared



Customize Listeners

- How to customize ChannelListener ?
 - Implements accept method
 - verify incoming message and member
 - determine whether the listener will process this message or not.
 - Implements messageReceived method
 - Process a incoming message
- Setting
 - Add ChannelListener class to classpath
 - Set FQCN to className Attribute in <ChannelListener>
 - <ChannelListener
 className="FQCN" attr="xxxxx"
/>



Customize Listeners

- How to customize MembershipListener ?
 - Implements memberAdded method
 - Handles event that a member has joined the cluster group
 - Implements memberDisappeared method
 - Handles event that a member has disappeared from cluster group
- Setting
 - Add MembershipListener class to classpath
 - Set FQCN to className Attribute in <MembershipListener>
 - <MembershipListener
className="FQCN" attr="xxxxx"
/>



Customize Channel components

Customize Channel

- No need to customize channel
 - It is enough to existing implementation(GroupChannel)
 - It is hard to.
 - There are so many interfaces what have to implement .



Channel APIs

Implements channel components programmatically in embedded environment

- Using channel APIs
- Along the channel architecture



Channel APIs

Build Channel

```
// create a Channel
GroupChannel channel = new GroupChannel();

// Membership Service
MembershipService membershipService = new MyMembershipService();
channel.setMembershipService(membershipService);

// Receiver
NioReceiver receiver = new NioReceiver();
receiver.setAddress("host");
receiver.setPort(4000);
channel.setChannelReceiver(receiver);

// Sender
ReplicationTransmitter sender = new ReplicationTransmitter();
PooledParallelSender transport = new PooledParallelSender();
sender.setTransport(transport);
channel.setChannelSender(sender);
```



Channel APIs

Build Channel

```
// Interceptors
MessageDispatchInterceptor dispatcher = new MessageDispatchInterceptor();
channel.addInterceptor(dispatcher);
TcpFailureDetector tcpdetector = new TcpFailureDetector();
channel.addInterceptor(tcpdetector);
ChannelInterceptor myInterceptor = new MyChannelInterceptor();
channel.addInterceptor(myInterceptor );

//listeners
ChannelListener msgListener = new MyMessageListener();
MembershipListener mbrListener = new MyMemberListener();
channel.addMembershipListener(mbrListener);
channel.addChannelListener(msgListener);
```



Channel APIs

How to use

- Tomcat Cluster Env

```
// set channel to cluster  
cluster.setChannel(channel);  
// start cluster via container startup  
...
```

- Embedded Env

```
//start the channel  
myChannel.start(Channel.DEFAULT);  
  
//send the message  
Member[] members= channel.getMembers();  
Serializable myMsg = new MyMessage();  
channel.send(members, myMsg, Channel.SEND_OPTIONS_DEFAULT);
```



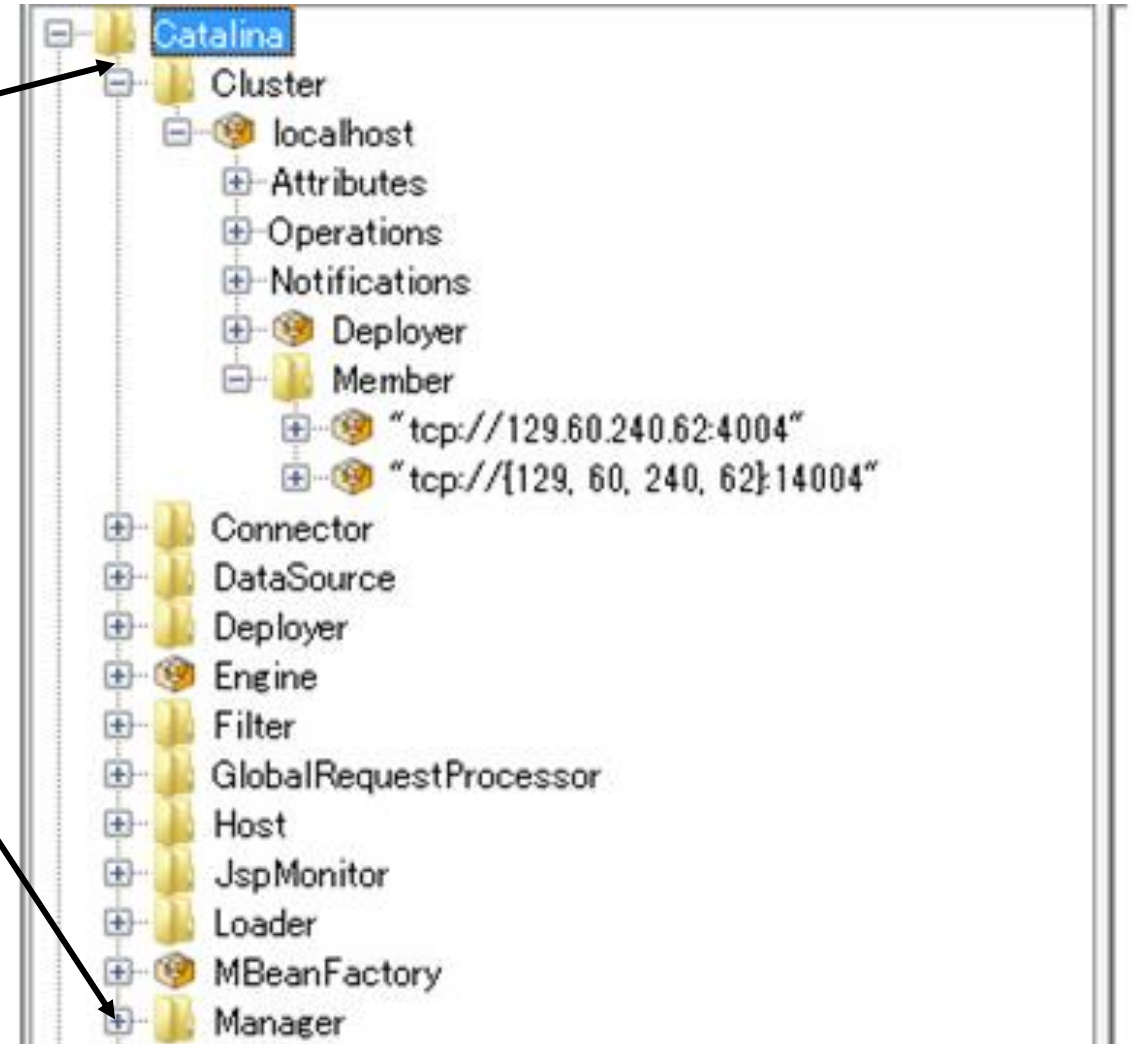
Monitoring Cluster



Monitoring Cluster

Monitoring your Cluster with JMX

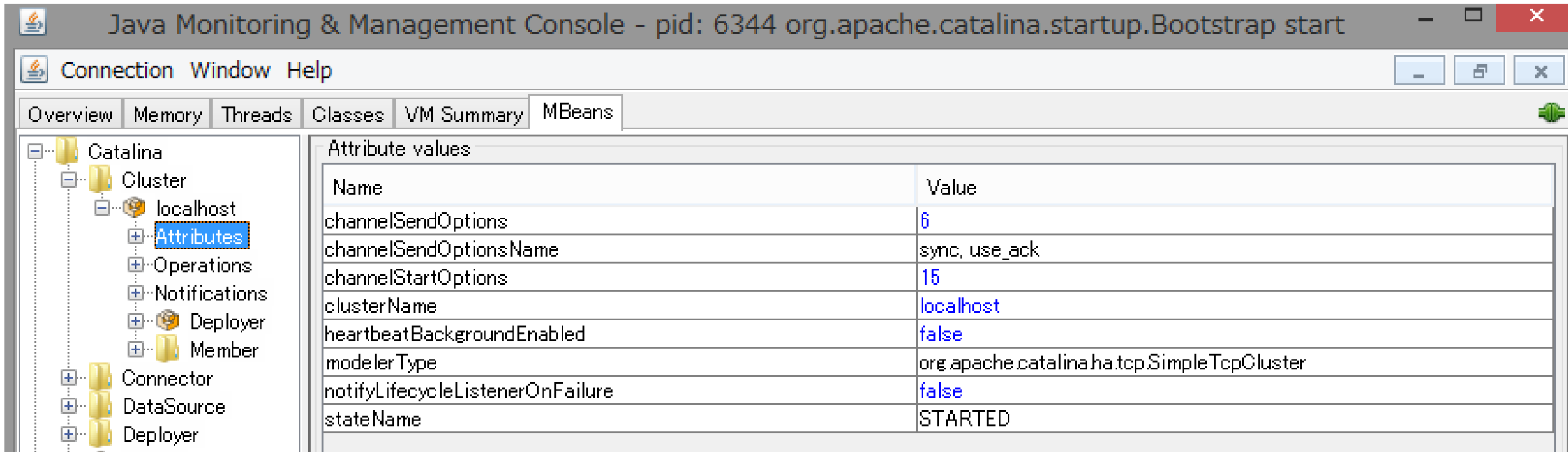
- Catalina Domain
 - Cluster Mbeans
 - Cluster Mbean
 - Deployer Mbean
 - Member MBeans
 - (Cluster)Manager Mbean



Monitoring Cluster

Cluster Mbean

- Cluster settings



The screenshot displays the Java Monitoring & Management Console window. The title bar reads "Java Monitoring & Management Console - pid: 6344 org.apache.catalina.startup.Bootstrap start". The window has a menu bar with "Connection", "Window", and "Help". Below the menu bar is a tabbed interface with tabs for "Overview", "Memory", "Threads", "Classes", "VM Summary", and "MBeans". The "MBeans" tab is selected. On the left side, there is a tree view showing the hierarchy: "Catalina" > "Cluster" > "localhost" > "Attributes". The "Attributes" node is selected and highlighted. The main area on the right displays the "Attribute values" table.

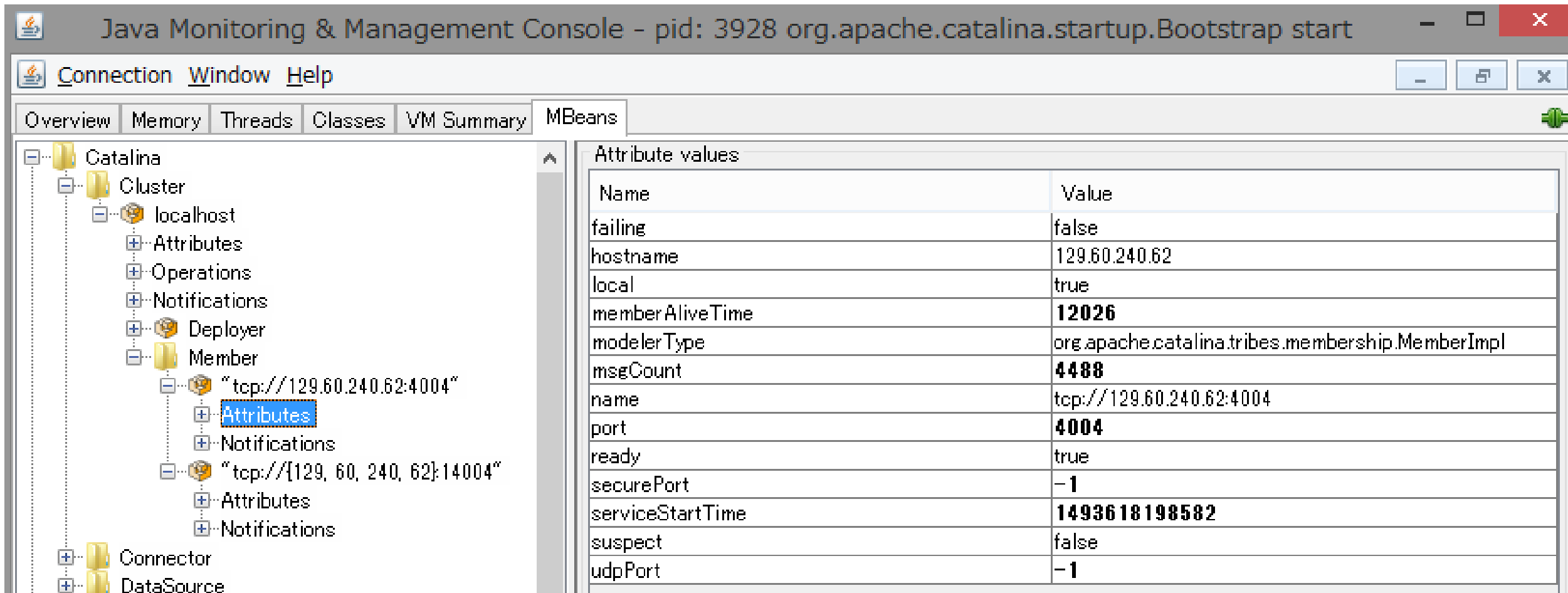
Name	Value
channelSendOptions	6
channelSendOptionsName	sync, use_ack
channelStartOptions	15
clusterName	localhost
heartbeatBackgroundEnabled	false
modelerType	org.apache.catalina.ha.tcp.SimpleTcpCluster
notifyLifecycleListenerOnFailure	false
stateName	STARTED



Monitoring Cluster

Member Mbeans

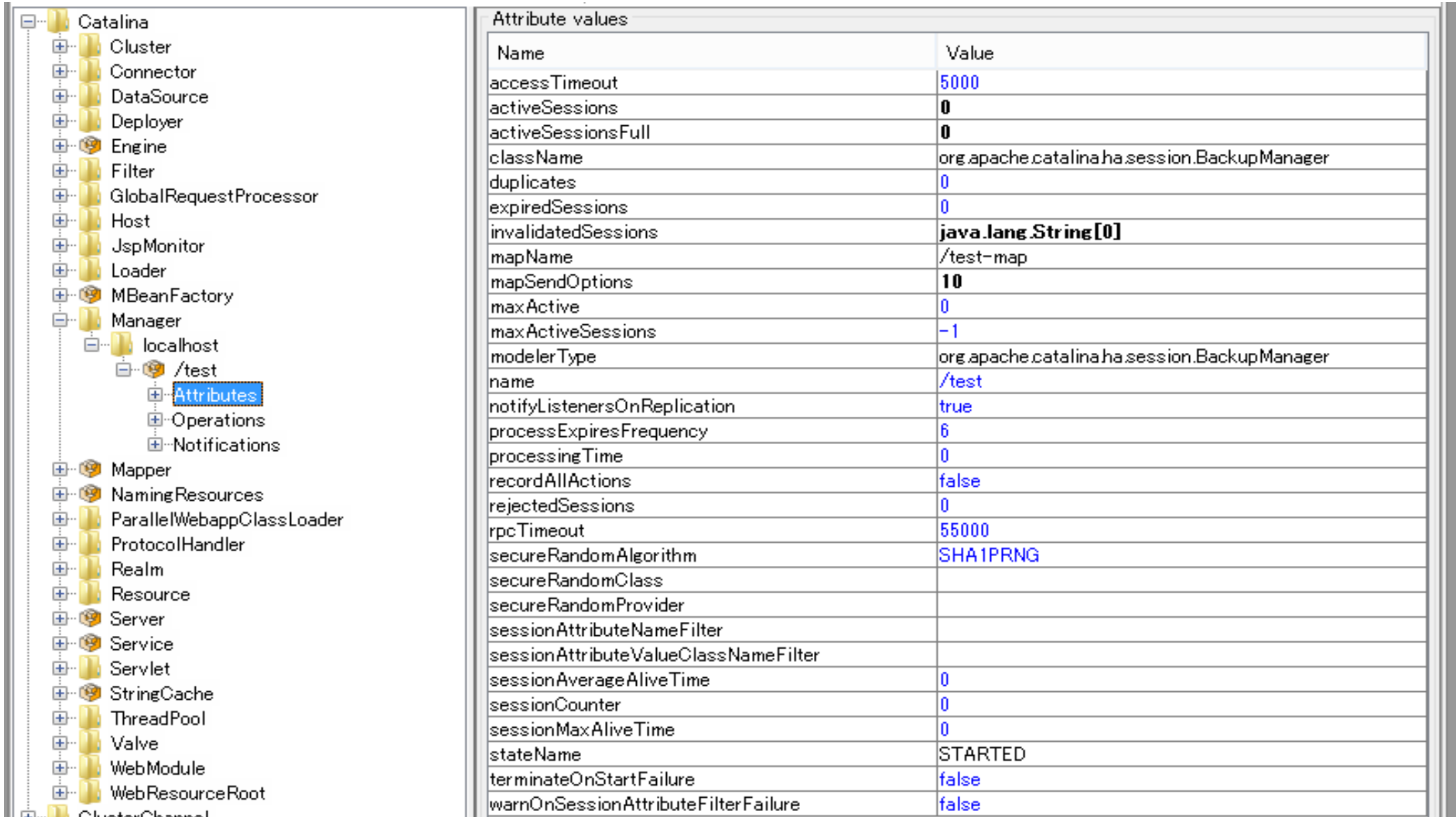
- All Cluster members that have been joining cluster group



The screenshot displays the Java Monitoring & Management Console window. The title bar reads "Java Monitoring & Management Console - pid: 3928 org.apache.catalina.startup.Bootstrap start". The menu bar includes "Connection", "Window", and "Help". The tab bar shows "Overview", "Memory", "Threads", "Classes", "VM Summary", and "MBeans", with "MBeans" being the active tab. The left-hand tree view shows a hierarchy: Catalina > Cluster > localhost > Attributes > Operations > Notifications > Deployer > Member > "tcp://129.60.240.62:4004" > Attributes (highlighted). The right-hand pane, titled "Attribute values", contains a table with the following data:

Name	Value
failing	false
hostname	129.60.240.62
local	true
memberAliveTime	12026
modelerType	org.apache.catalina.tribes.membership.MemberImpl
msgCount	4488
name	tcp://129.60.240.62:4004
port	4004
ready	true
securePort	-1
serviceStartTime	1493618198582
suspect	false
udpPort	-1

Manager Mbean - Session Information



The screenshot displays the JBoss JMX console interface. On the left, a tree view shows the hierarchy of MBeans, with 'Manager' expanded under 'localhost' and 'Attributes' selected. On the right, a table lists the attribute values for the selected MBean.

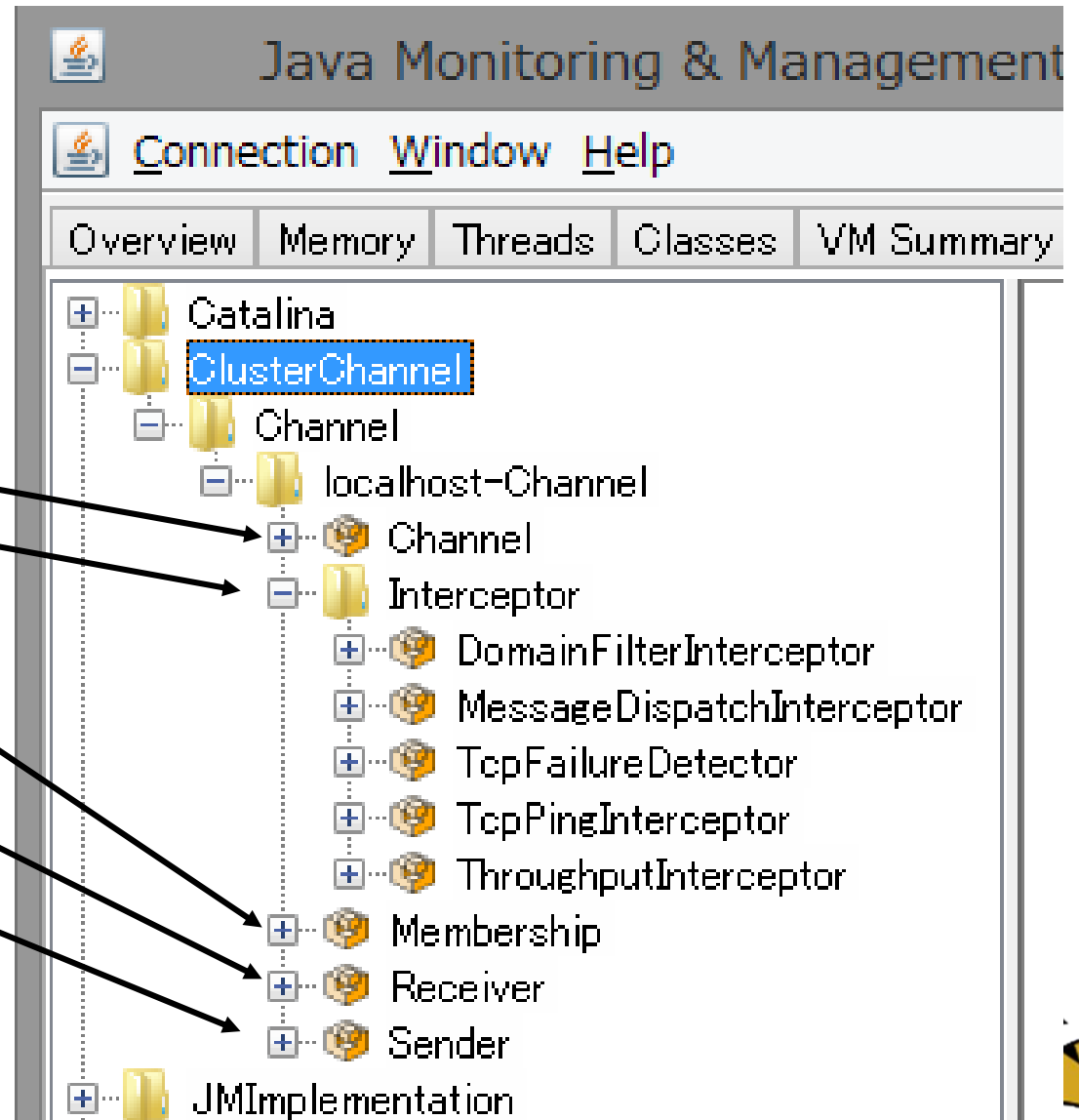
Name	Value
accessTimeout	5000
activeSessions	0
activeSessionsFull	0
className	org.apache.catalina.ha.session.BackupManager
duplicates	0
expiredSessions	0
invalidatedSessions	java.lang.String[0]
mapName	/test-map
mapSendOptions	10
maxActive	0
maxActiveSessions	-1
modelerType	org.apache.catalina.ha.session.BackupManager
name	/test
notifyListenersOnReplication	true
processExpiresFrequency	6
processingTime	0
recordAllActions	false
rejectedSessions	0
rpcTimeout	55000
secureRandomAlgorithm	SHA1PRNG
secureRandomClass	
secureRandomProvider	
sessionAttributeNameFilter	
sessionAttributeValueClassNameFilter	
sessionAverageAliveTime	0
sessionCounter	0
sessionMaxAliveTime	0
stateName	STARTED
terminateOnStartFailure	false
warnOnSessionAttributeFilterFailure	false



Monitoring Cluster Channel

Monitoring Cluster Channel

- ClusterChannel Domain
 - Channel Mbeans
 - Channel Mbean
 - Interceptor Mbeans
 - Membership Mbean
 - Receiver Mbean
 - Sender MBean



Monitoring Cluster Channel

Channel Mbean

Java Monitoring & Management Console - pid: 3928 org.apache.catalina.startup.Bootstrap start

Connection Window Help

Overview Memory Threads Classes VM Summary MBeans

Catalina

- ClusterChannel
 - Channel
 - localhost-Channel
 - Channel
 - Attributes
 - Operations
 - Interceptor
 - Membership
 - Receiver
 - Sender

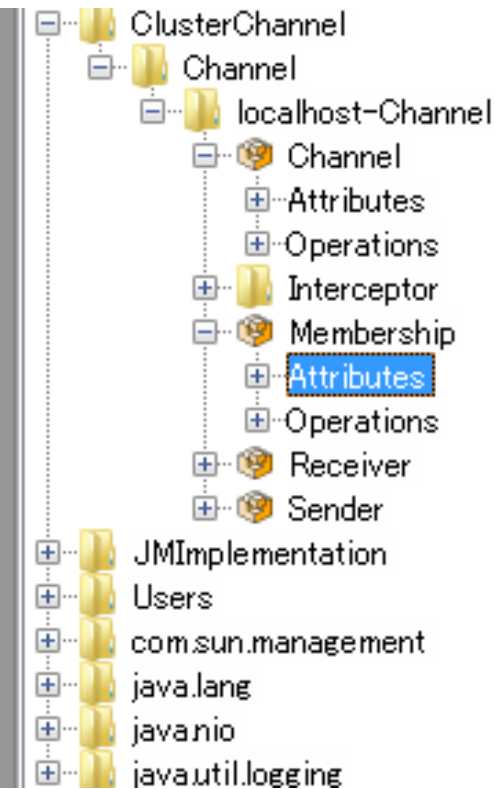
Attribute values

Name	Value
Heartbeat	true
HeartbeatSleeptime	60000
Members	Unavailable
OptionCheck	true



Monitoring Cluster Channel

Membership Mbean



Name	Value
Address	229.0.0.61
Bind	
Domain	byte[4]
DomainName	{1,2,3,4}
DropTime	4000
Frequency	500
LocalLoopbackDisabled	false
LocalMemberName	org.apache.catalina.tribes.membership.MemberImpl[tcp://129...
MembersByName	java.lang.String[1]
Port	45564
Properties	{tcpListenHost=129.60.240.62, udpListenPort=-1, ...
RecoveryCounter	-1
RecoveryEnabled	false
RecoverySleepTime	-1
SoTimeout	0
Ttl	0



Monitoring Cluster Channel

Membership Mbean

- Membership Operations

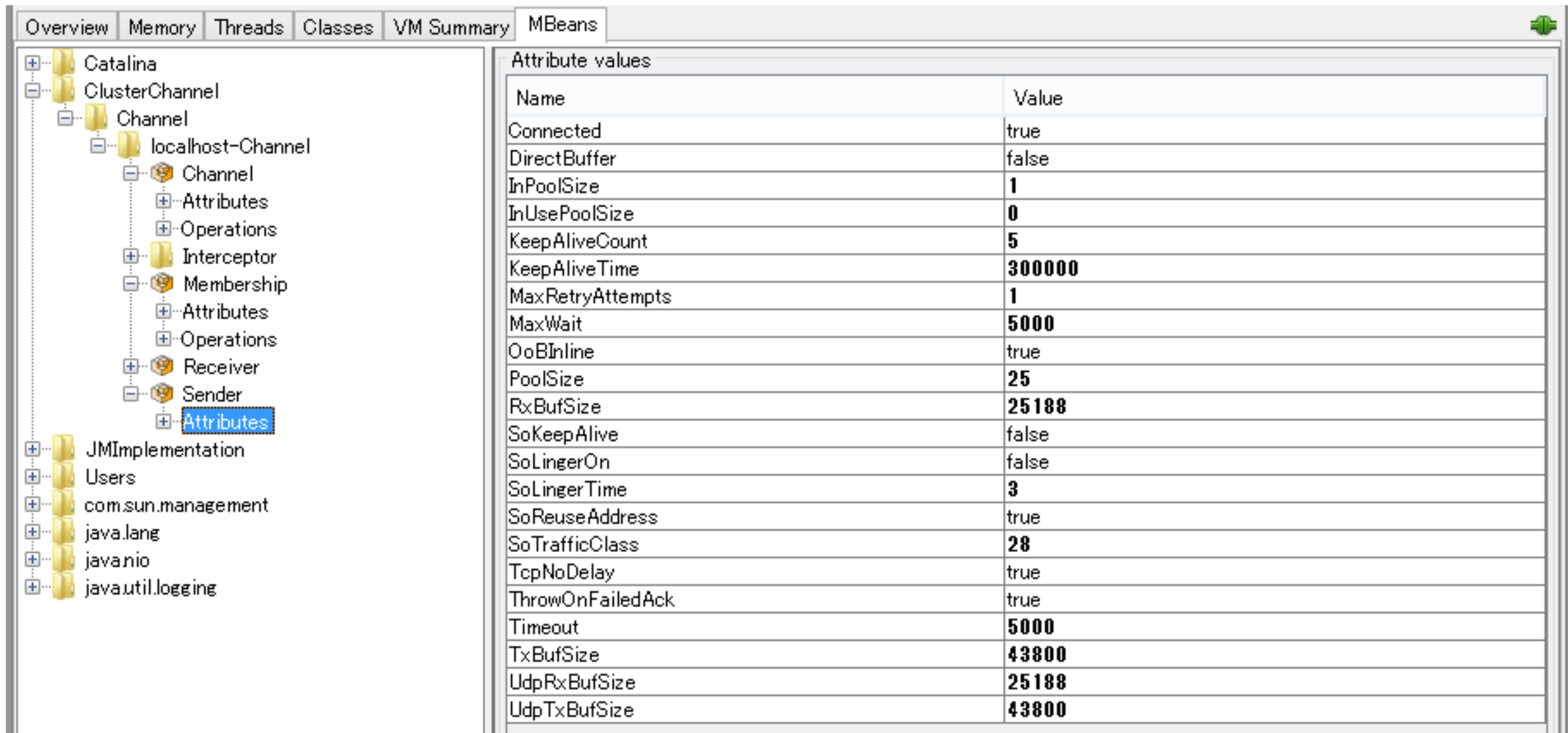
The screenshot displays the JMX console interface. On the left, a tree view shows the hierarchy of MBeans. The 'ClusterChannel' MBean is expanded, revealing its sub-MBeans: 'Channel', 'localhost-Channel', 'Channel', 'Attributes', 'Operations', 'Interceptor', 'Membership', 'Attributes', 'Operations' (highlighted with a blue dashed border), 'Receiver', and 'Sender'. Below this, other MBeans like 'JMImplementation', 'Users', 'com.sun.management', 'java.lang', 'java.nio', and 'java.util.logging' are listed.

On the right, the 'hasMembers' operation is selected, showing its signature: `boolean hasMembers ()`. Below this, the 'findMemberByName' operation is shown with its signature: `Member findMemberByName (p1 String)`.



Monitoring Cluster Channel

Sender Mbean : Settings and Stats info



The screenshot displays the JMX console interface. The left sidebar shows a tree view of the MBean hierarchy. The 'Sender' Mbean under the 'Channel' is selected, and its 'Attributes' sub-node is expanded. The right pane shows the 'Attribute values' table for the selected Mbean.

MBean Hierarchy:

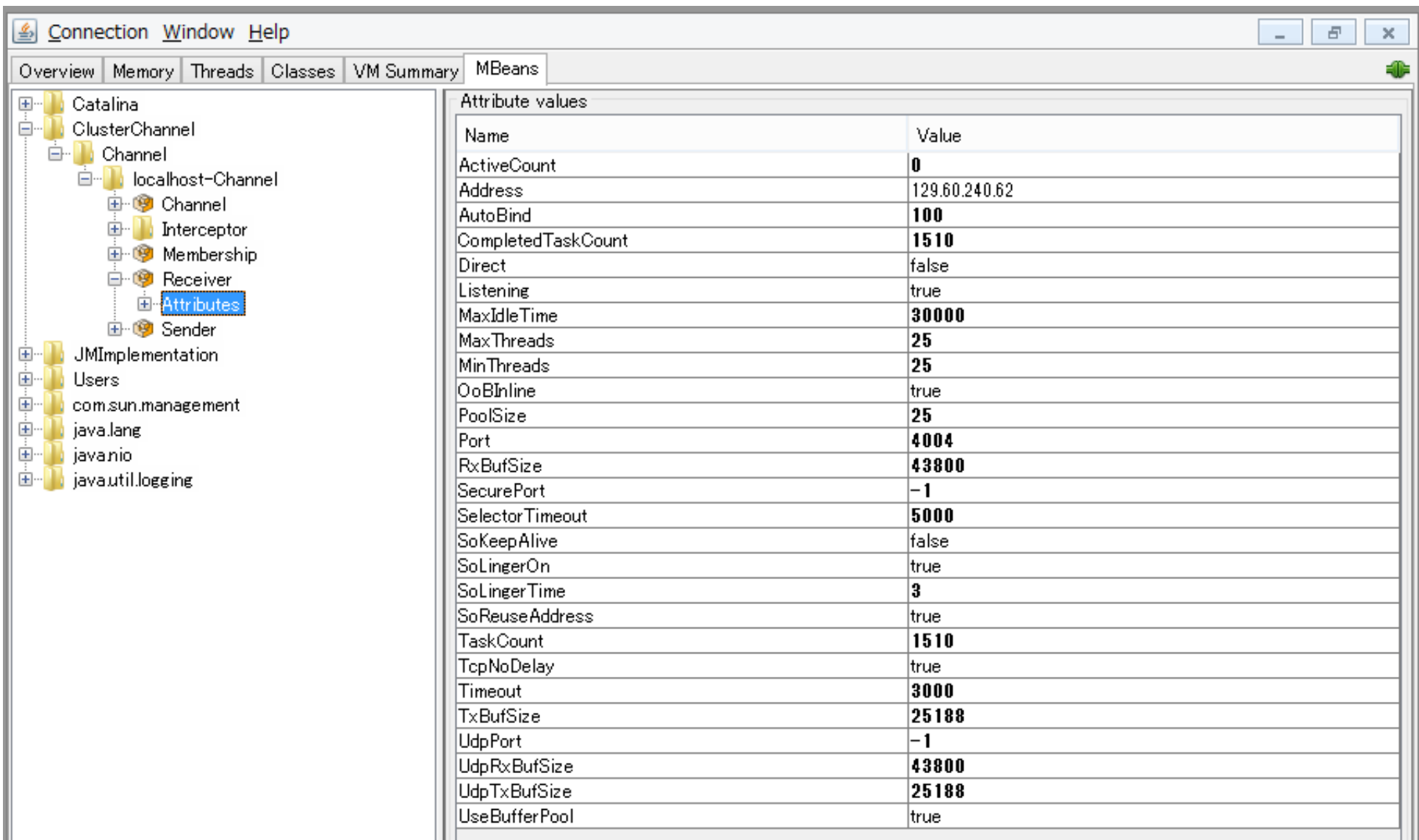
- Catalina
 - ClusterChannel
 - Channel
 - localhost-Channel
 - Channel
 - Attributes
 - Operations
 - Interceptor
 - Membership
 - Attributes
 - Operations
 - Receiver
 - Sender
 - Attributes (Selected)

Attribute values:

Name	Value
Connected	true
DirectBuffer	false
InPoolSize	1
InUsePoolSize	0
KeepAliveCount	5
KeepAliveTime	300000
MaxRetryAttempts	1
MaxWait	5000
OoBInline	true
PoolSize	25
RxBufSize	25188
SoKeepAlive	false
SoLingerOn	false
SoLingerTime	3
SoReuseAddress	true
SoTrafficClass	28
TcpNoDelay	true
ThrowOnFailedAck	true
Timeout	5000
TxBufSize	43800
UdpRxBufSize	25188
UdpTxBufSize	43800

Monitoring Cluster Channel

Receiver Mbean



The screenshot displays the JMX console interface with the 'MBeans' tab selected. The left-hand tree view shows the hierarchy: Catalina > ClusterChannel > Channel > localhost-Channel > Receiver, with the 'Attributes' sub-tab highlighted. The right-hand pane, titled 'Attribute values', contains a table of the Receiver Mbean's attributes and their current values.

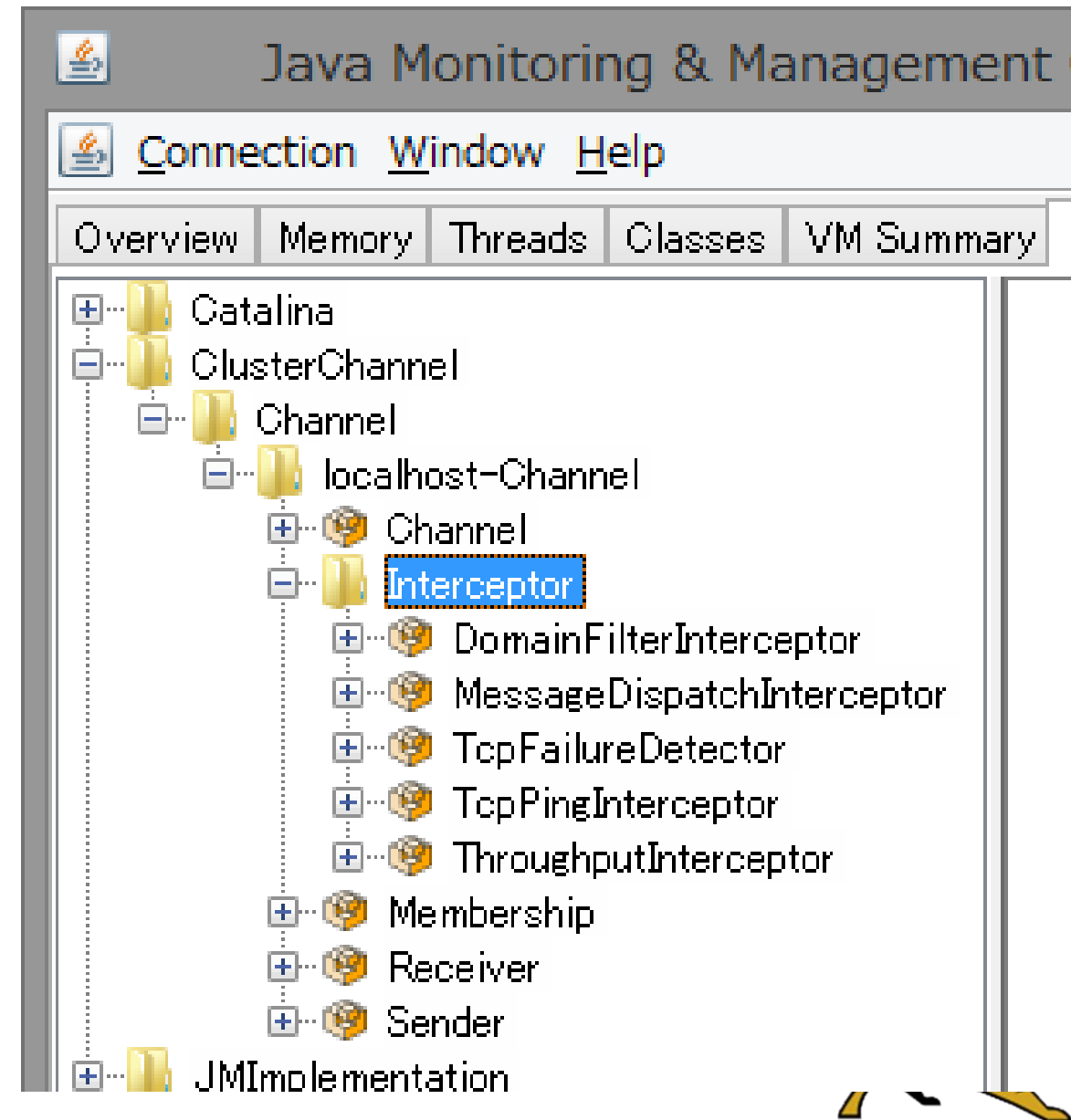
Name	Value
ActiveCount	0
Address	129.60.240.62
AutoBind	100
CompletedTaskCount	1510
Direct	false
Listening	true
MaxIdleTime	30000
MaxThreads	25
MinThreads	25
OoBInline	true
PoolSize	25
Port	4004
RxBufSize	43800
SecurePort	-1
SelectorTimeout	5000
SoKeepAlive	false
SoLingerOn	true
SoLingerTime	3
SoReuseAddress	true
TaskCount	1510
TcpNoDelay	true
Timeout	3000
TxBufSize	25188
UdpPort	-1
UdpRxBufSize	43800
UdpTxBufSize	25188
UseBufferPool	true



Monitoring Cluster Channel

Interceptor Mbeans

- All interceptor that are used in channel



Monitoring Cluster Channel

ThroughputInterceptor

Java Monitoring & Management Console - pid: 3928 org.apache.catalina.startup.Bootstrap start

Connection Window Help

Overview Memory Threads Classes VM Summary MBeans

Catalina

- ClusterChannel
 - Channel
 - localhost-Channel
 - Channel
 - Interceptor
 - DomainFilterInterceptor
 - MessageDispatchInterceptor
 - TcpFailureDetector
 - TcpPingInterceptor
 - ThroughputInterceptor
 - Attributes
 - Operations
 - Membership
 - Receiver

Attribute values

Name	Value
Interval	10000
LastOnt	1.0
MbAppTx	0.3916463851928711
MbRx	0.6031494140625
MbTx	0.3916463851928711
MsgRxOnt	1339
MsgTxOnt	672
MsgTxErr	0
OptionFlag	0
RxStart	1493618700380
TimeTx	0.38000000000000002
TxStart	1493625363908



Monitoring Cluster Channel

TcpFailureDetector

Java Monitoring & Management Console - pid: 3928 org.apache.catalina.startup.Bootstrap start

Connection Window Help

Overview Memory Threads Classes VM Summary MBeans

Catalina

ClusterChannel

Channel

localhost-Channel

Channel

Interceptor

DomainFilterInterceptor

MessageDispatchInterceptor

TcpFailureDetector

Attributes

Operations

TcpPingInterceptor

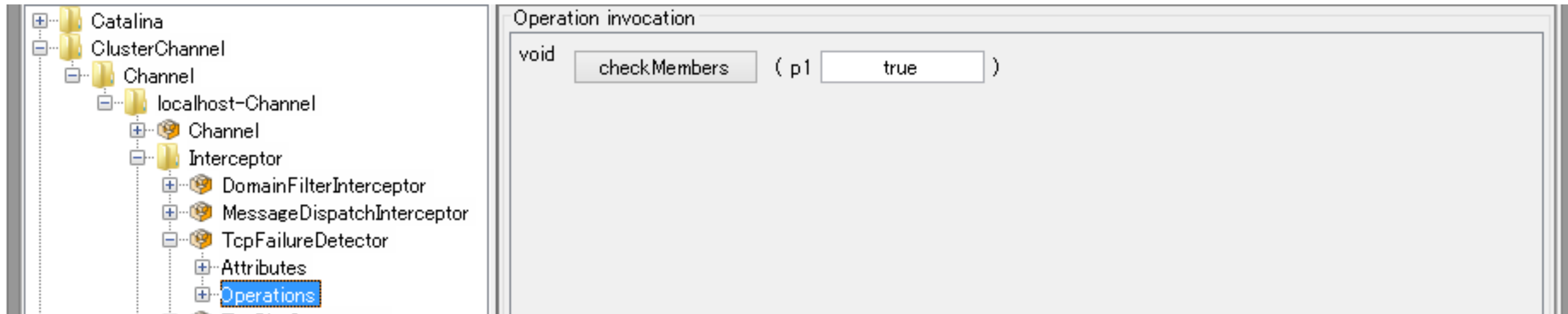
Attribute values

Name	Value
ConnectTimeout	1000
OptionFlag	0
PerformReadTest	false
PerformSendTest	true
ReadTestTimeout	5000
RemoveSuspectsTimeout	300



Monitoring Cluster Channel

TcpFailureDetector



Monitoring Cluster Channel

MessageDispatchInterceptor

Java Monitoring & Management Console - pid: 3928 org.apache.catalina.startup.Bootstrap start

Connection Window Help

Overview Memory Threads Classes VM Summary MBeans

Tree view:

- Catalina
 - ClusterChannel
 - Channel
 - localhost-Channel
 - Channel
 - Interceptor
 - DomainFilterInterceptor
 - MessageDispatchInterceptor
 - Attributes
 - TcpFailureDetector
 - TcpPingInterceptor
 - ThroughputInterceptor
 - Membership
 - Receiver

Attribute values

Name	Value
ActiveCount	0
AlwaysSend	true
CompletedTaskCount	476
CurrentSize	0
KeepAliveTime	5000
MaxQueueSize	67108864
MaxSpareThreads	10
MaxThreads	10
OptionFlag	8
PoolSize	10
TaskCount	476



Questions?



Thank You

