[CE520] WSN Programming
2nd assignment
Packet propagation to all nodes

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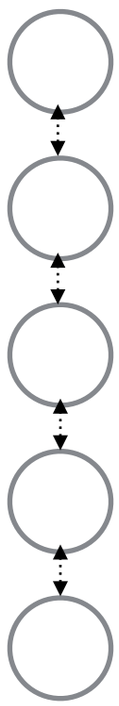
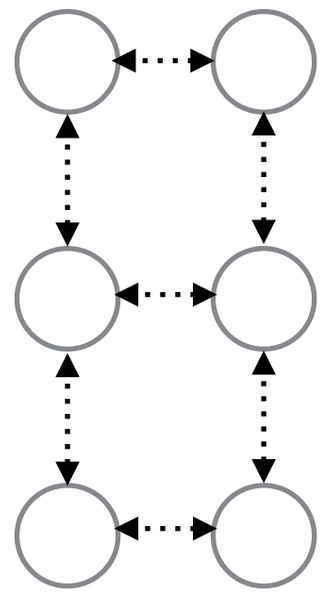
Case study: Best-effort network-wide broadcast

- Given a topology of nodes (chain, tree, or grid)
- Each source node transmits a new packet periodically
- Each node that receives a packet, it propagates the packet to its neighbours
- Target is to distribute a packet through the whole network, to reach a steady silent state and to avoid collisions when transmitting packets

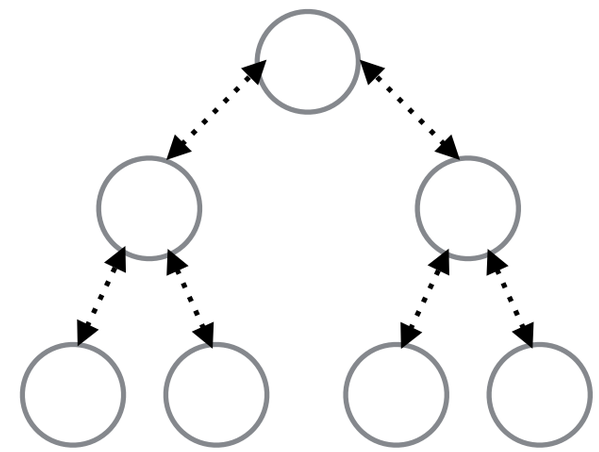
Topologies



Chain



Grid



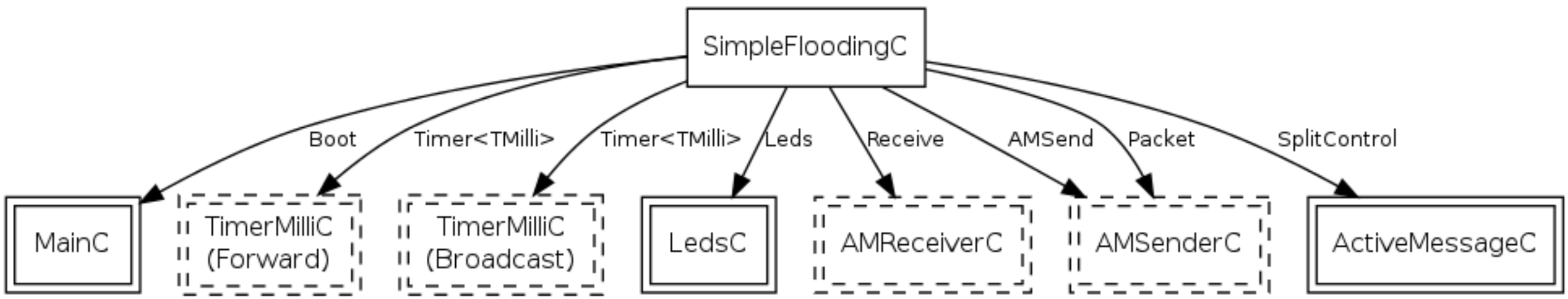
Tree

Pseudocode

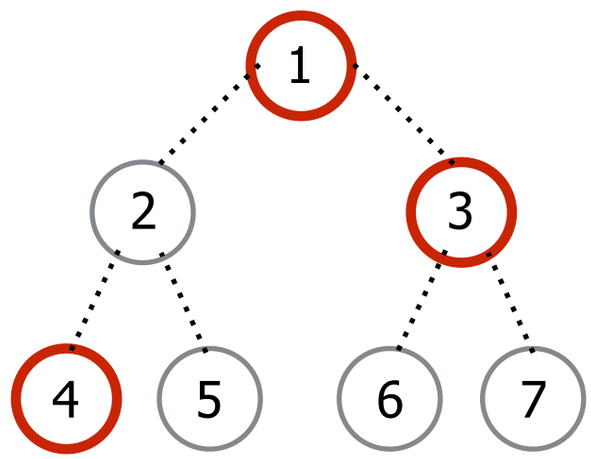
```
onBoot():
   initCache();
   startAMControl();

onAMControlDone():
   nodeID = TOS_NODE_ID;
   bcastPeriodic( PERIOD );

onBcastFired():
   if ( sendIsBusy ), back-off;
   pkt = createPacket();
   if ( bcast( pkt )  == SUCCESS )
       sendIsBusy = TRUE;
   if ( maxBcastsReached )
       stopBcastPeriodic();
```

```
onPktReceived():
   if ( pkt.getSourceID == nodeID ), return;
   if ( pkt.version < cache.version ), return;

   addCache( pkt );
   schedForward( PERIOD );

onForwardFired():
   if ( sendIsBusy ), schedForward( PERIOD );
   else
       pkt = getPktFromCache();
       if ( bcast( pkt )  == SUCCESS )
           sendIsBusy = TRUE;
```

Structure (Wiring) of the Algorithm



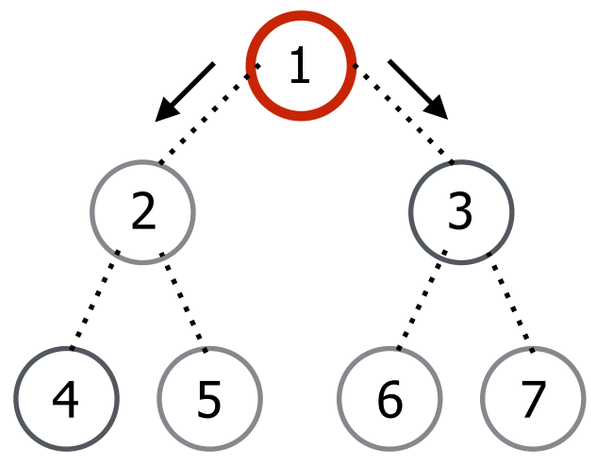
Demo



(*) The sources are indicated with red border

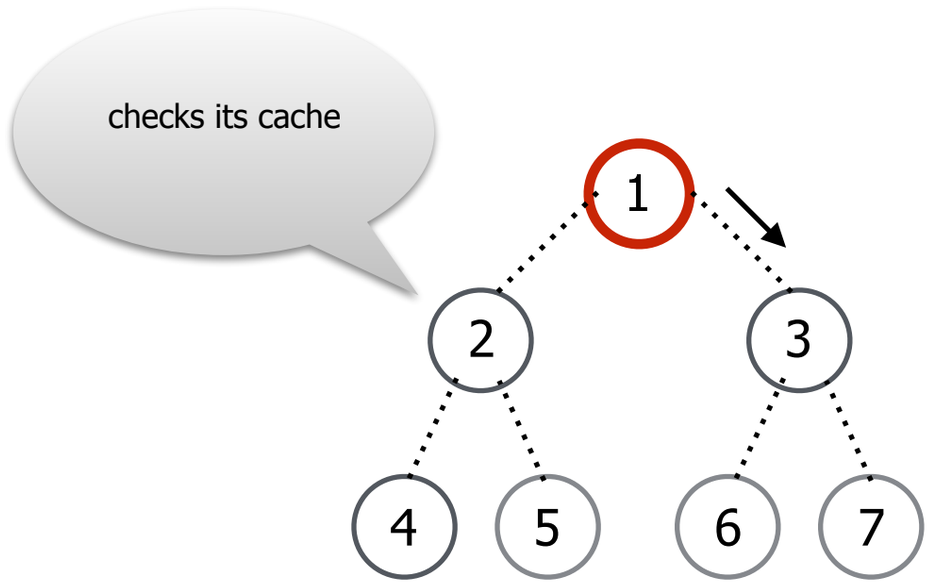
(**) The dotted lines indicate which nodes are in range

Flooding



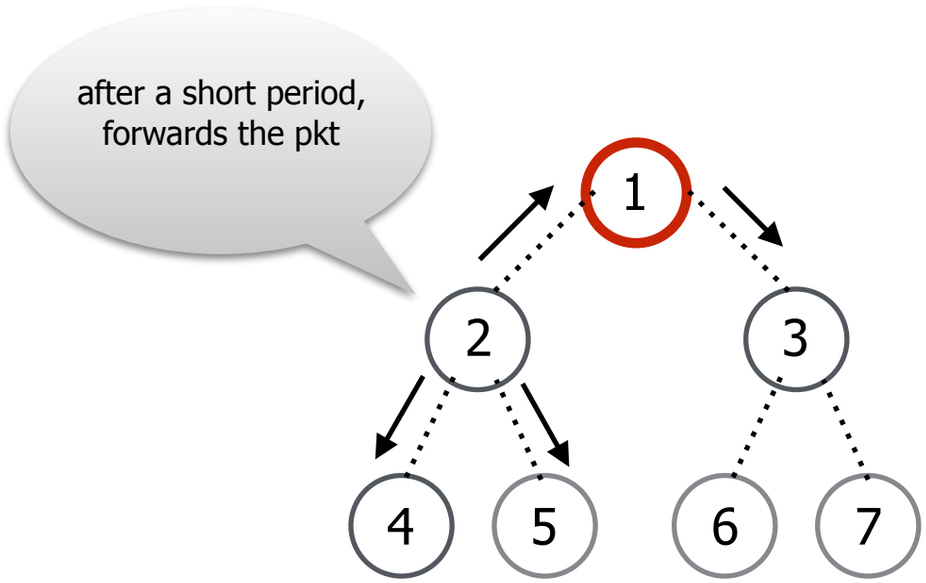
Node 1 broadcasts a packet

Flooding



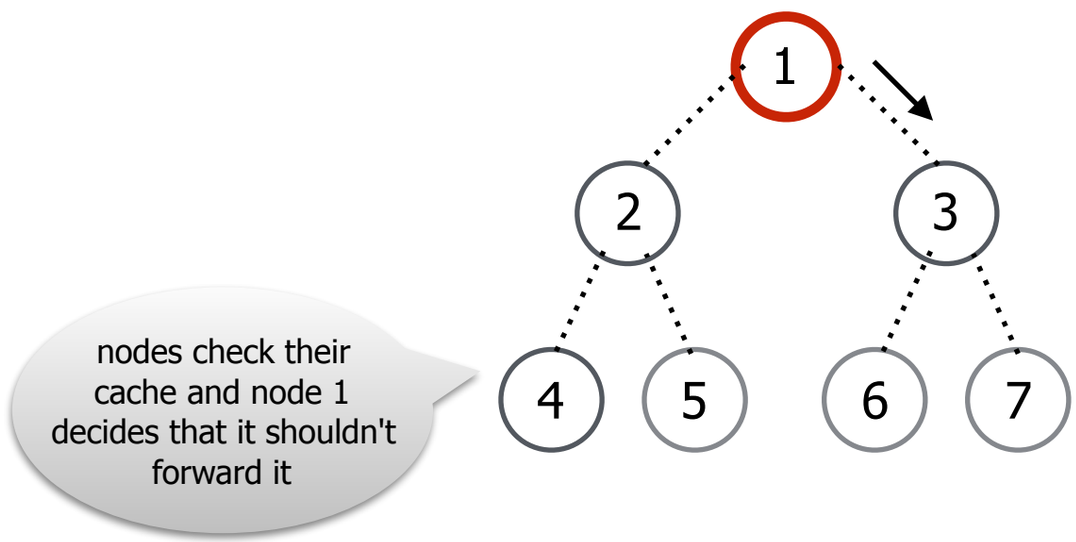
Node 2 receives the packet

Flooding



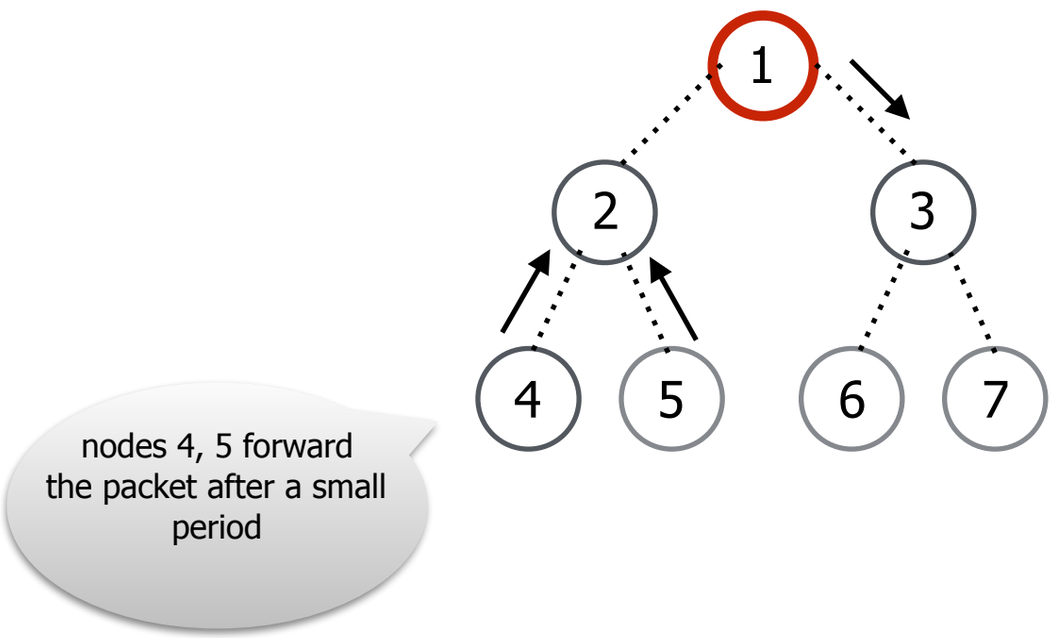
Node 2 forwards the packet

Flooding



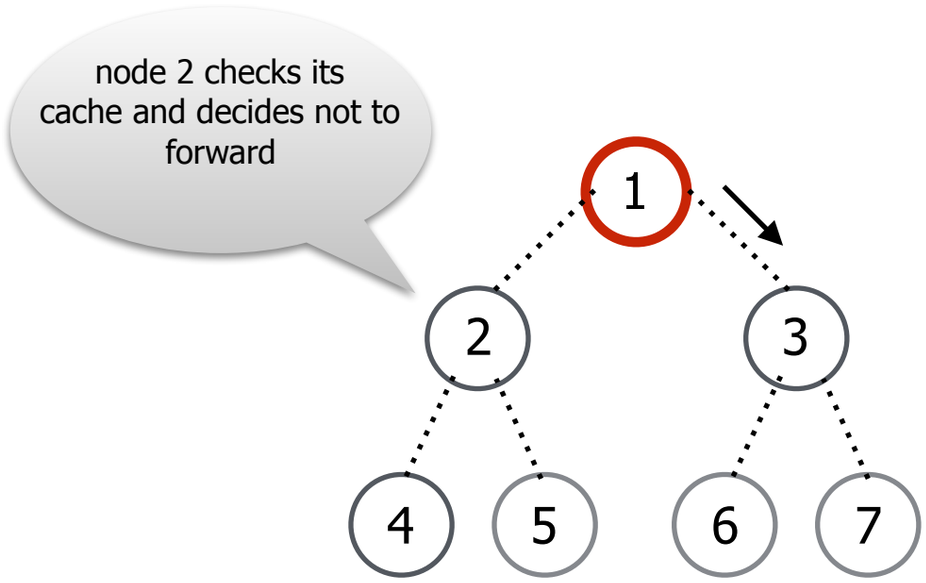
Nodes 1,4,5 receive the packet

Flooding



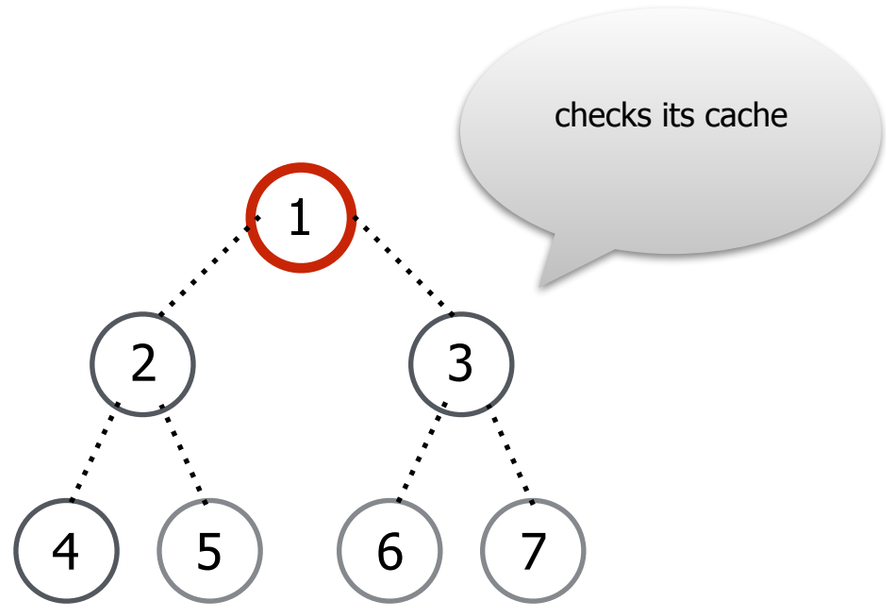
Node 4,5 forward the packet

Flooding



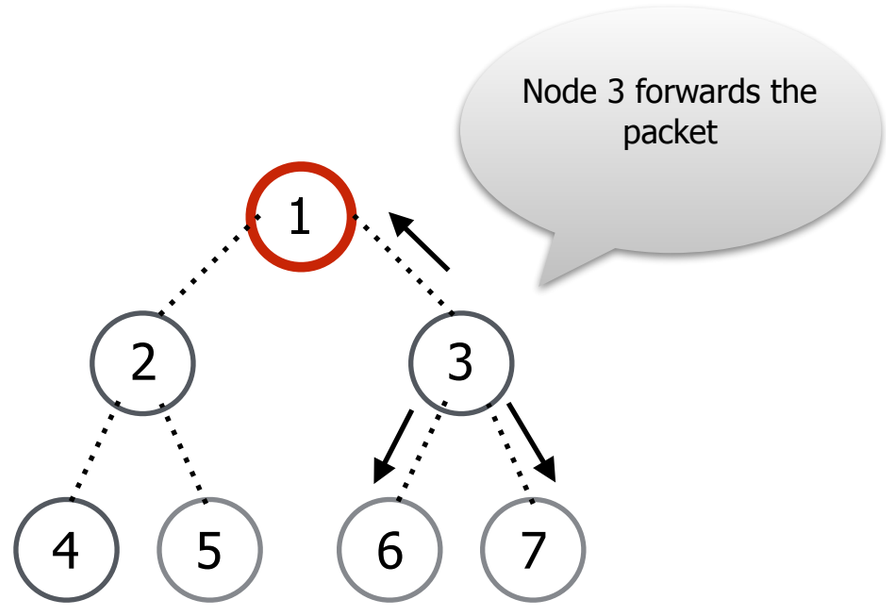
Node 2 receives the packet

Flooding



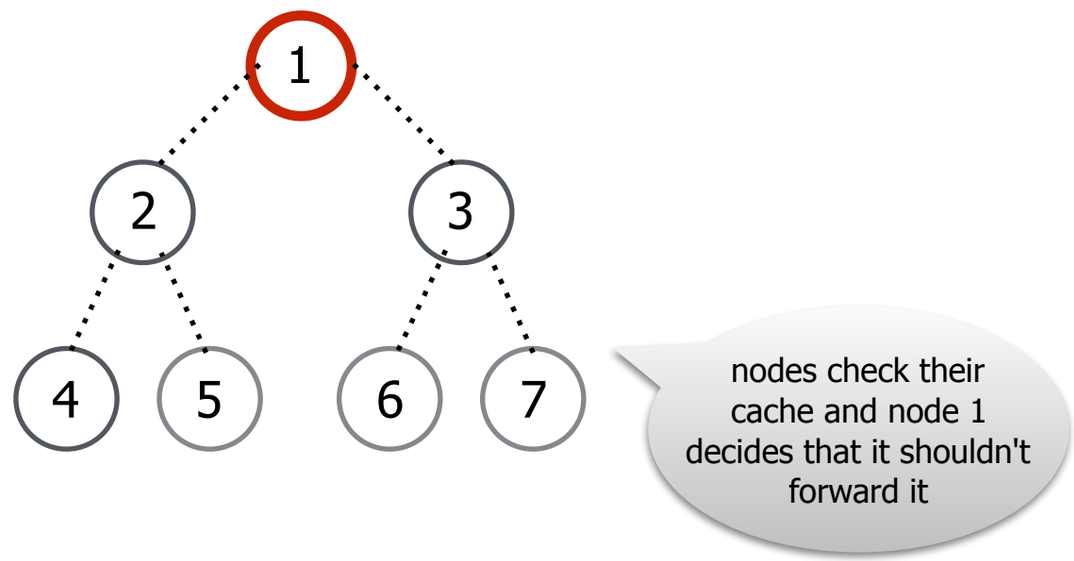
Nodes 3 receives the packet

Flooding



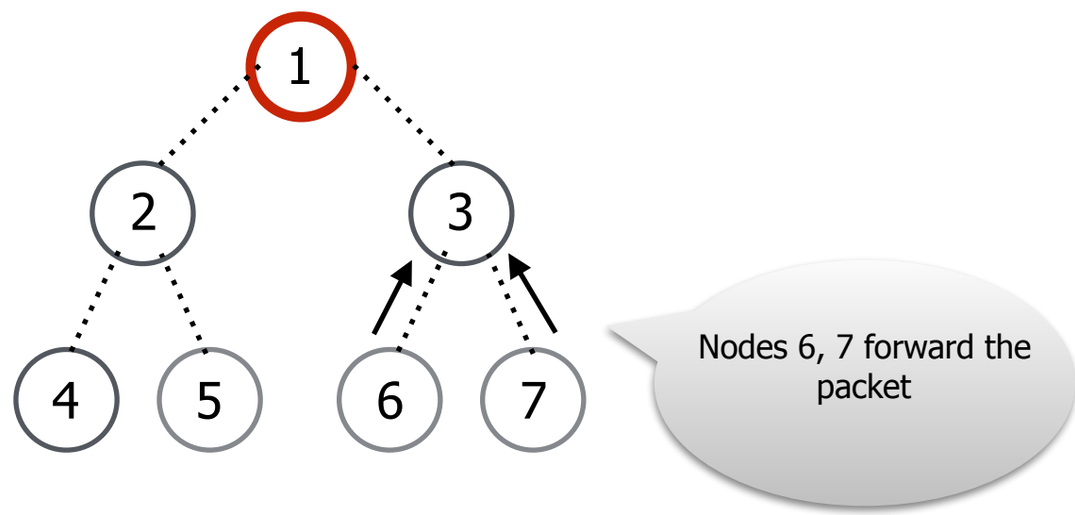
Nodes 3 forwards the packet

Flooding



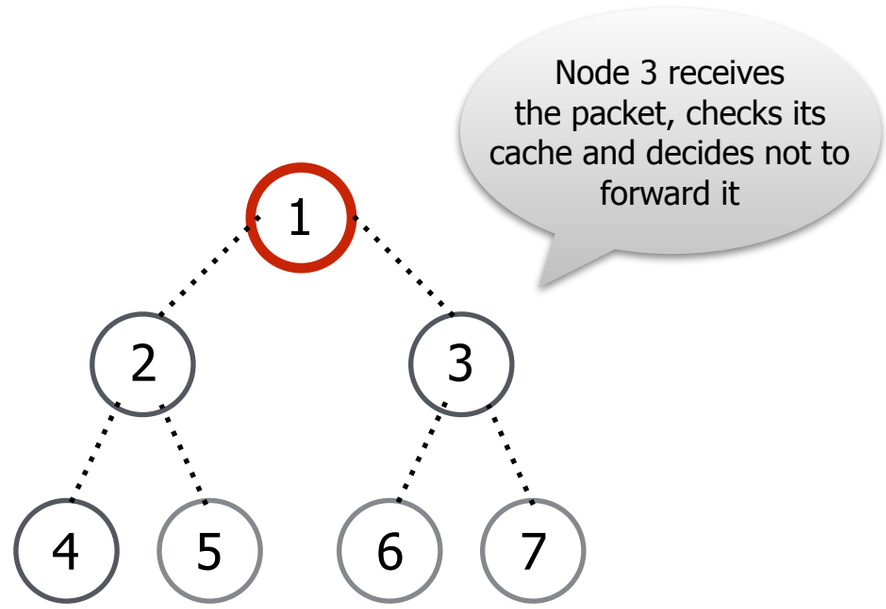
Nodes 1,6,7 receive the packet

Flooding



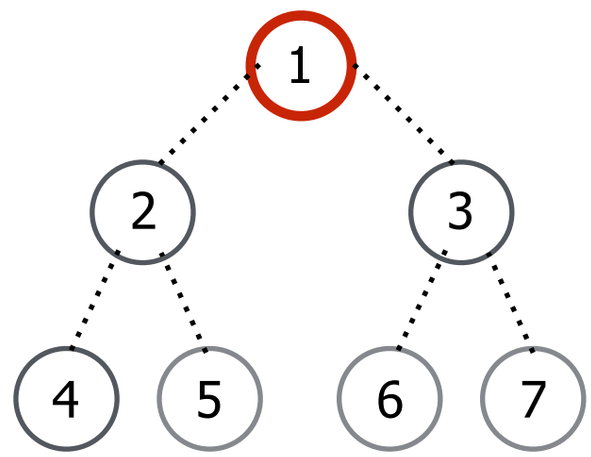
Nodes **6,7** forward the packet

Flooding



Nodes 3 receives the packet

Flooding



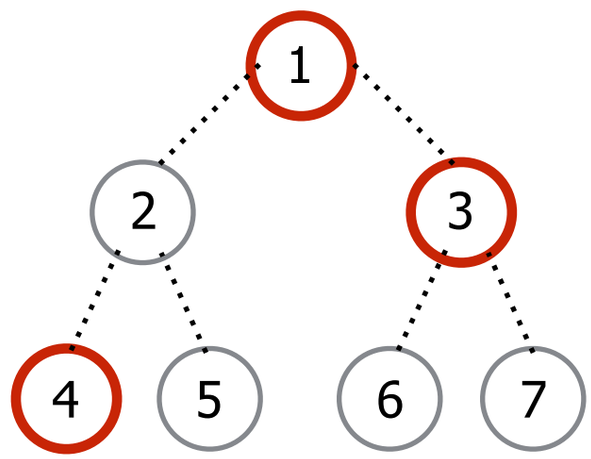
System reaches a silent state

Cache functionality

Packets (SrcID / SeqNo)

NodeID	1	2	3	4
2	1/2	1/3	4/2	4/3

Cache



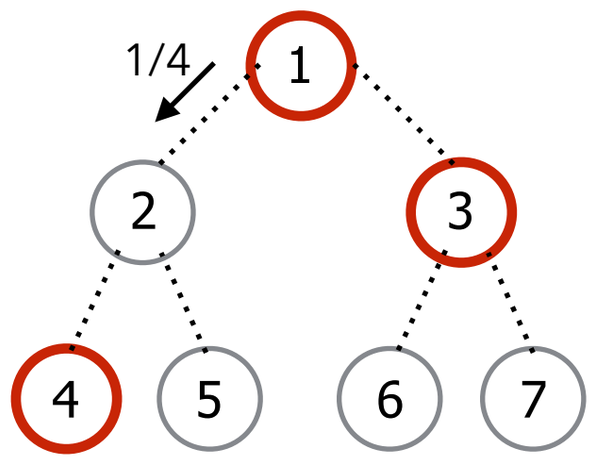
(*) Green arrow indicates the latest saved packet

(*) Purple arrow indicates the next position for forwarding

Cache functionality

Packets (SrcID / SeqNo)

NodeID	1	2	3	4
2	1/2	1/3	**1/4**	4/3

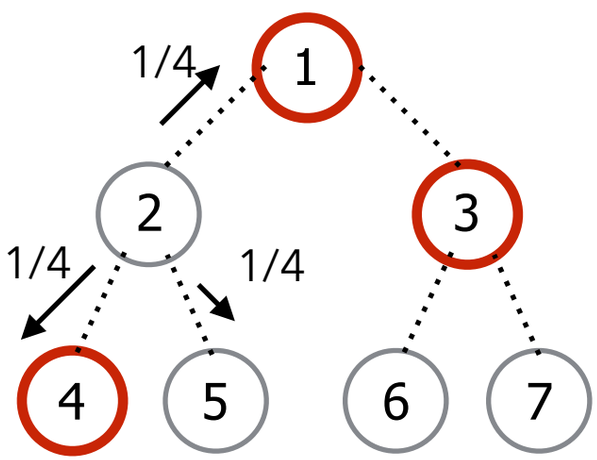


Node 2 receives a packet with tag **1/4**. Then checks it cache and since it doesn't find a packet from the same source with latter seqNo, it saves the packet, advances the green arrow and schedules it for forwarding

Cache functionality

Packets (SrcID / SeqNo)

NodeID	1	2	3	4
2	1/2	1/3	1/4	4/3

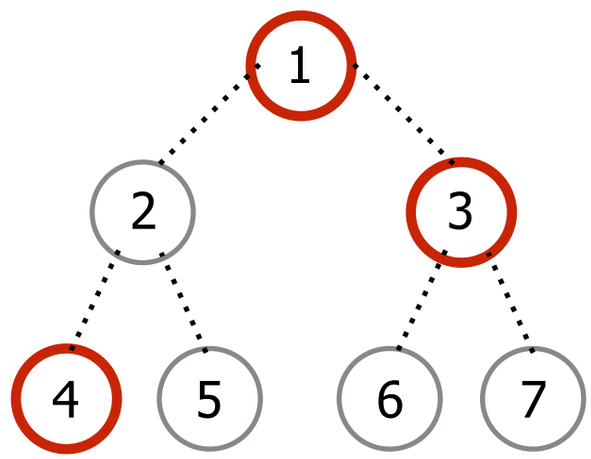


Node 2 forwards the scheduled packet and the purple arrow advances

Algorithms weak point

Packets (SrcID / SeqNo)

NodeID	1	2	3	4
2	3/4	1/3	1/4	4/3

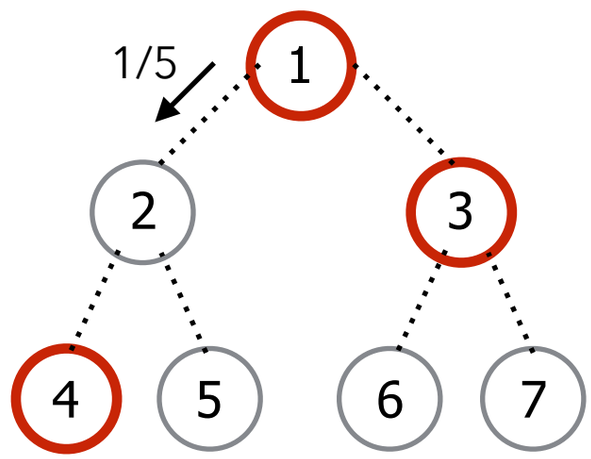


Initial scenario

Algorithms weak point

Packets (SrcID / SeqNo)

NodeID	1	2	3	4
2	3/4	1/3	1/4	**1/5**

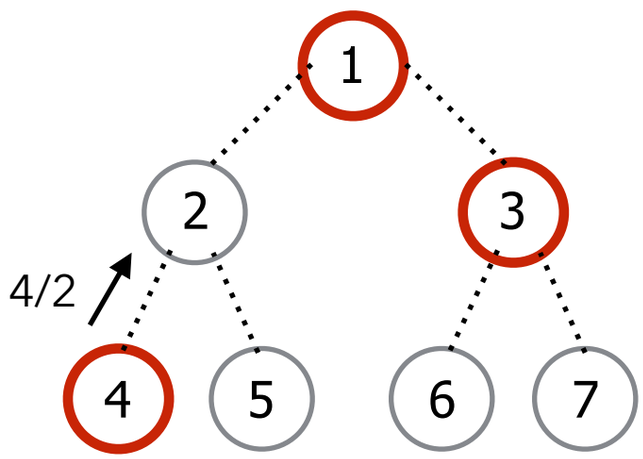


Node 2 received packet **1/5**, saves the packet and schedules it for forwarding

Algorithms weak point

Packets (SrcID / SeqNo)

NodeID	1	2	3	4
2	4/2	1/3	1/4	1/5

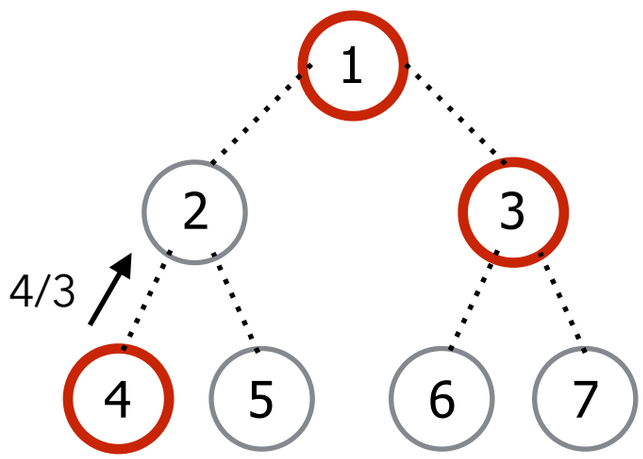


Node 2 before forwarding the packet with tag 1/5, receives another packet

Algorithms weak point

Packets (SrcID / SeqNo)

NodeID	1	2	3	4
2	4/2	**4/3**	1/4	1/5

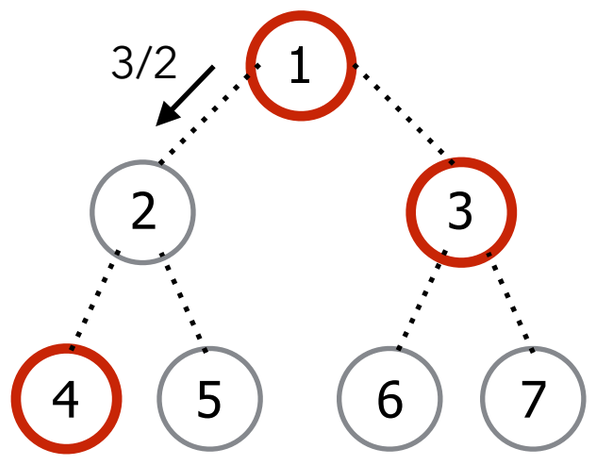


Node 2 before forwarding the packet with tag 1/5, receives yet another packet

Algorithms weak point

Packets (SrcID / SeqNo)

NodeID	1	2	3	4
2	4/2	4/3	**3/2**	1/5

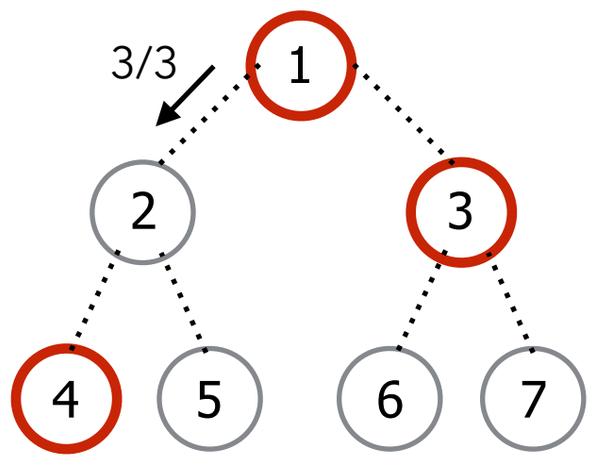


Node 2 before forwarding the packet with tag 1/5, receives yet another packet

Algorithms weak point

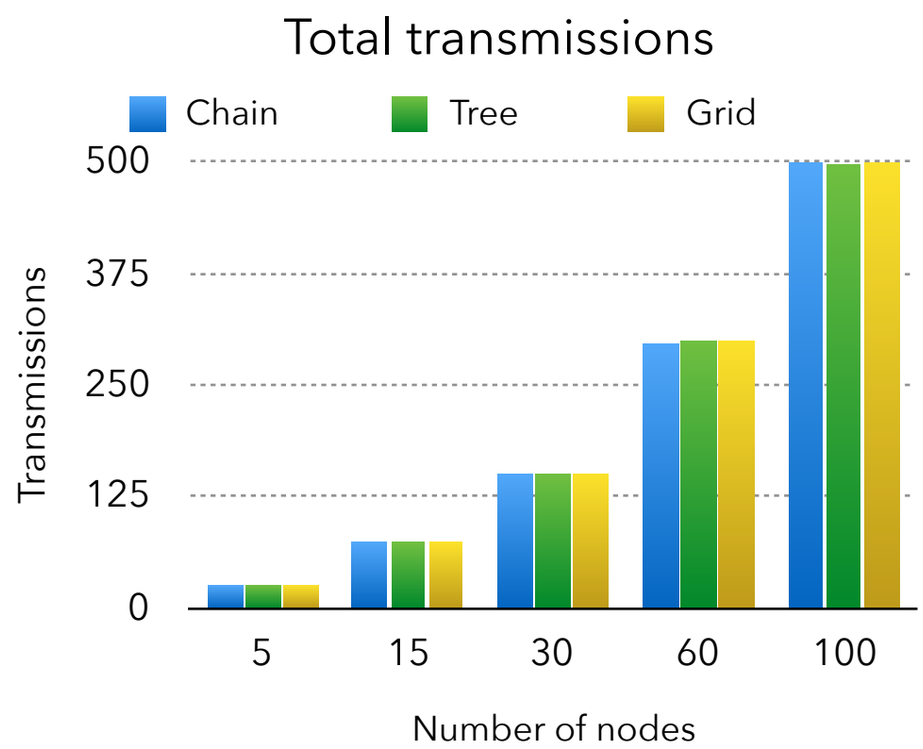
Packets (SrcID / SeqNo)

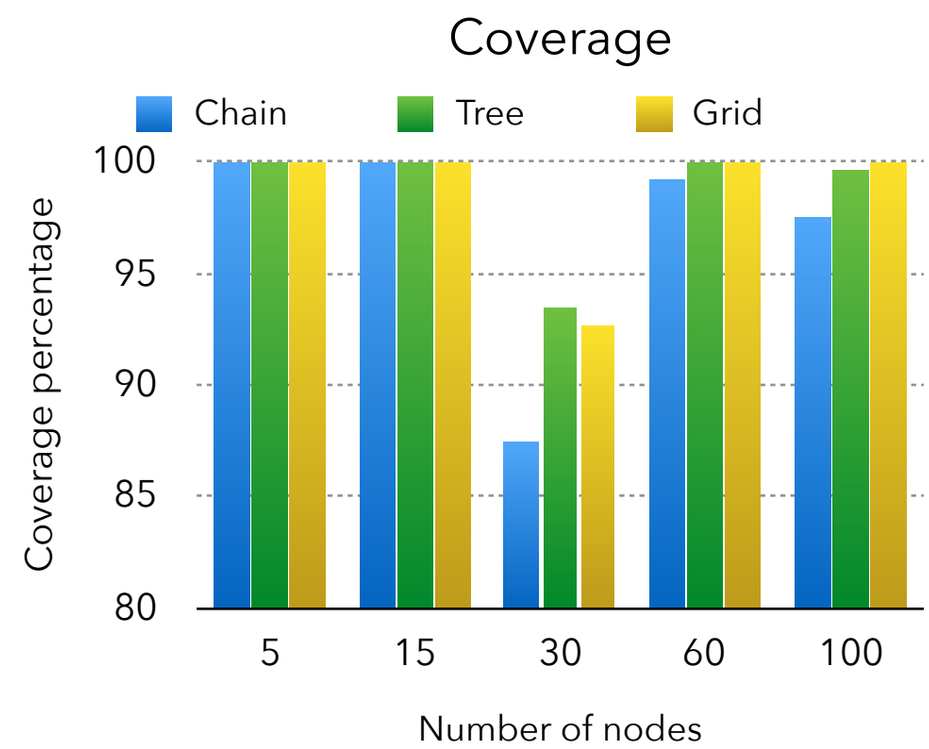
NodeID	1	2	3	4
2	4/2	4/3	3/2	**3/3**

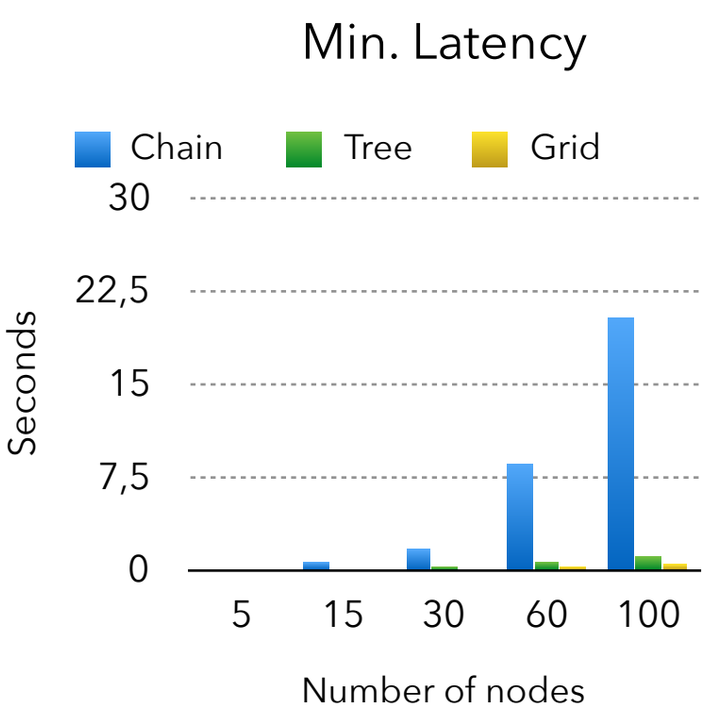


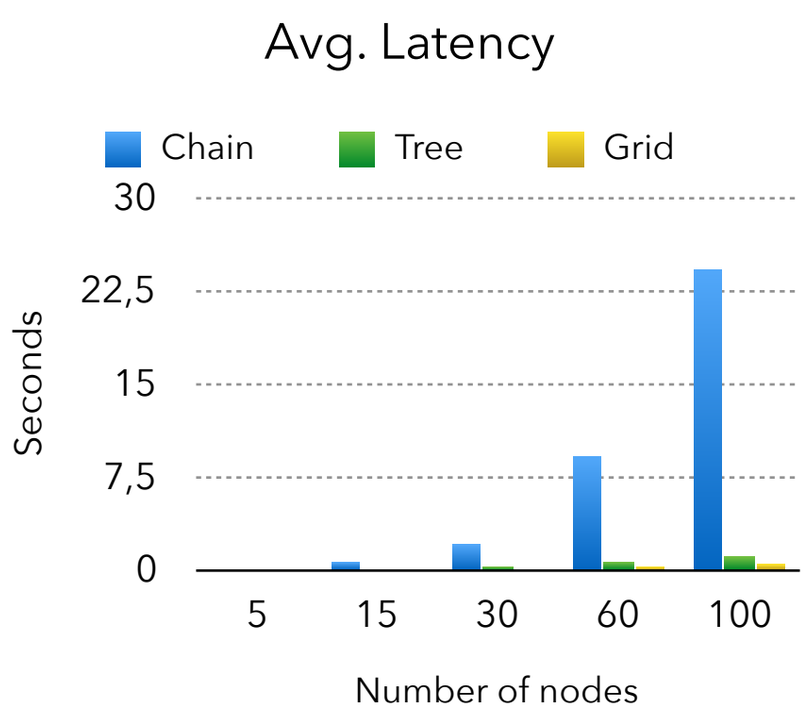
Node 2 before forwarding the packet with tag 1/5, receives yet another packet.
It saves the received the packet and overwrites the 1/5 packet.
So then nodes 4,5 never receive that overwrited packet

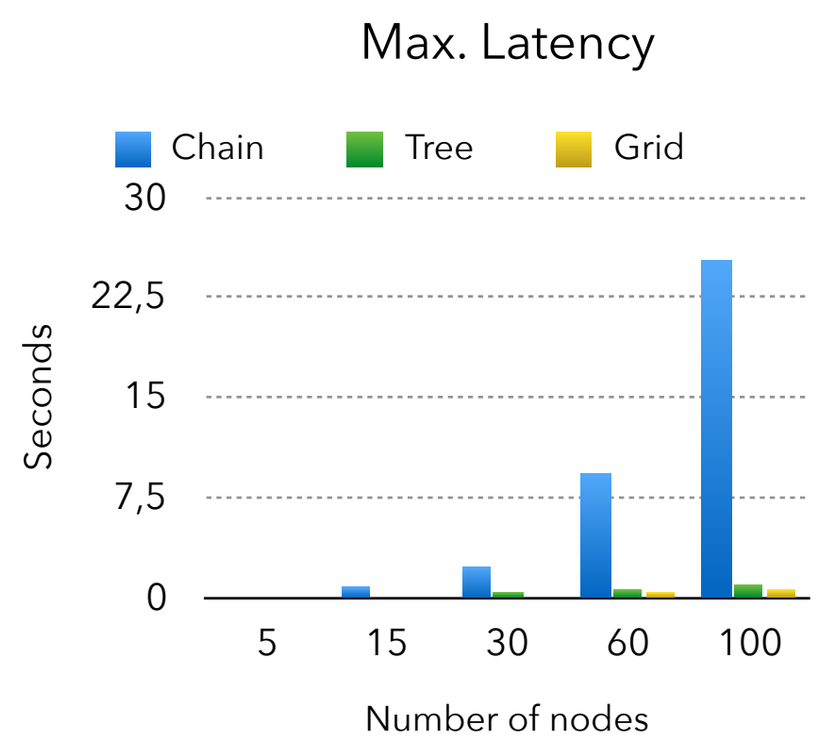
One sender


Total transmissions
Chain
Tree
Grid
500
375
250
125
0
Transmissions
5
15
30
60
100
Number of nodes

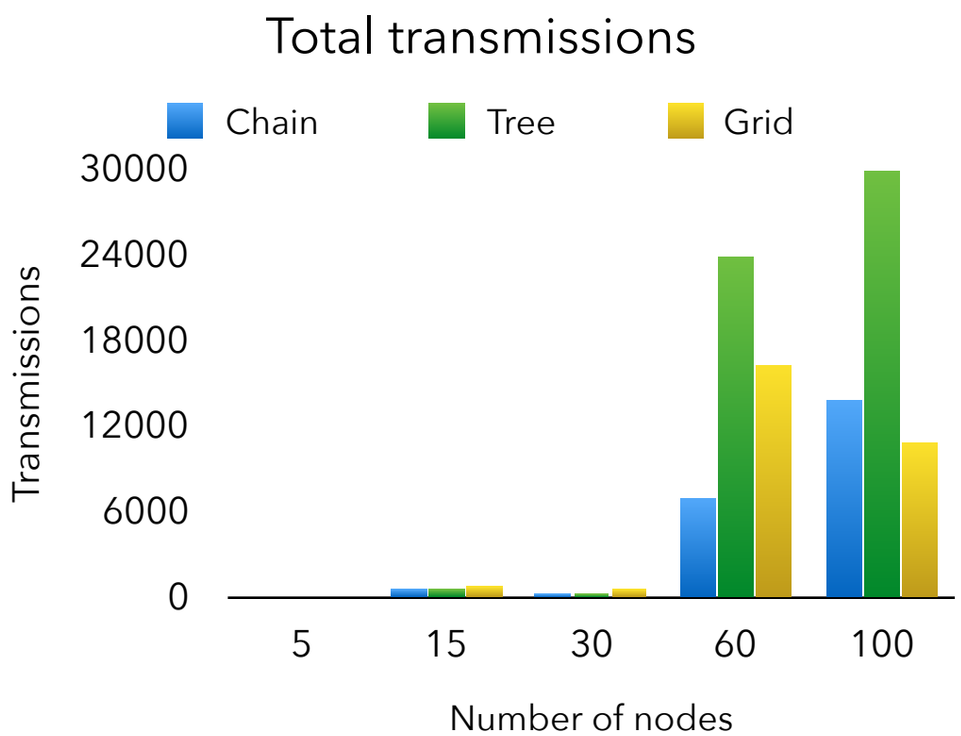

Coverage
Chain
Tree
Grid
100
95
90
85
80
Coverage percentage
5
15
30
60
100
Number of nodes

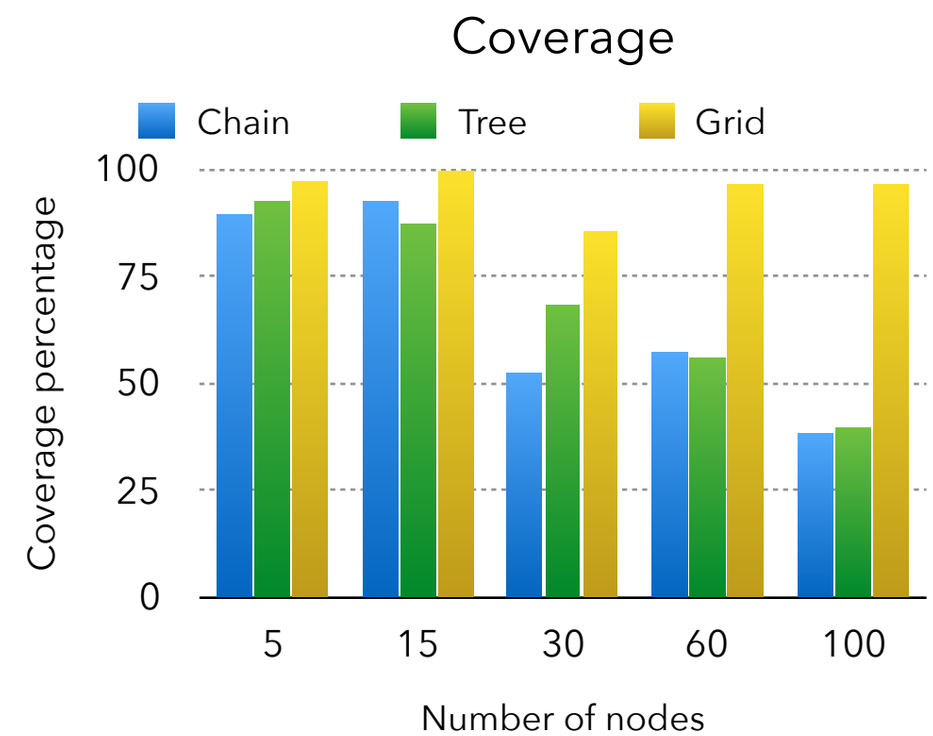

Min. Latency
Chain
Tree
Grid
30
22,5
15
7,5
0
Seconds
5
15
30
60
100
Number of nodes

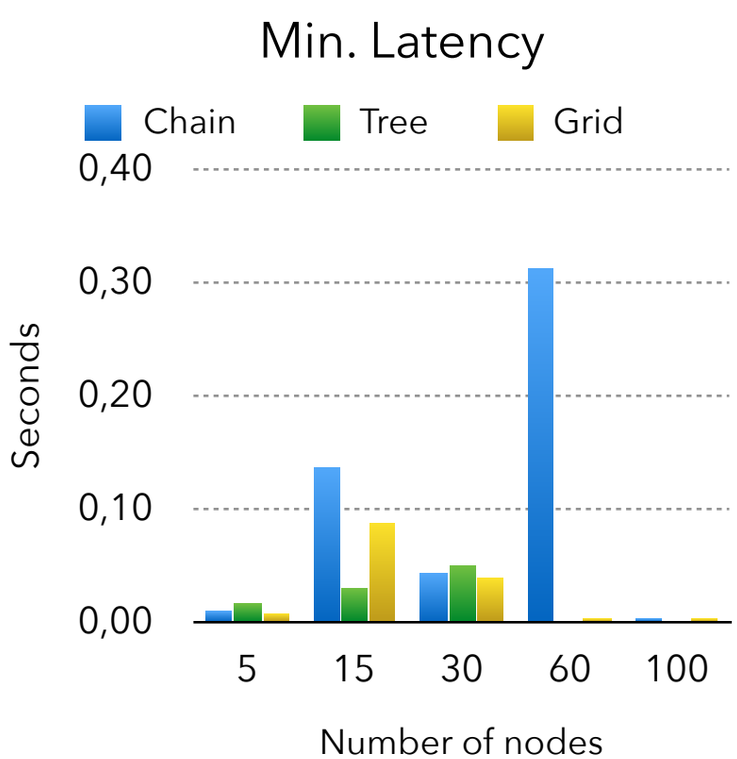

Avg. Latency
Chain
Tree
Grid
30
22,5
15
7,5
0
Seconds
5
15
30
60
100
Number of nodes

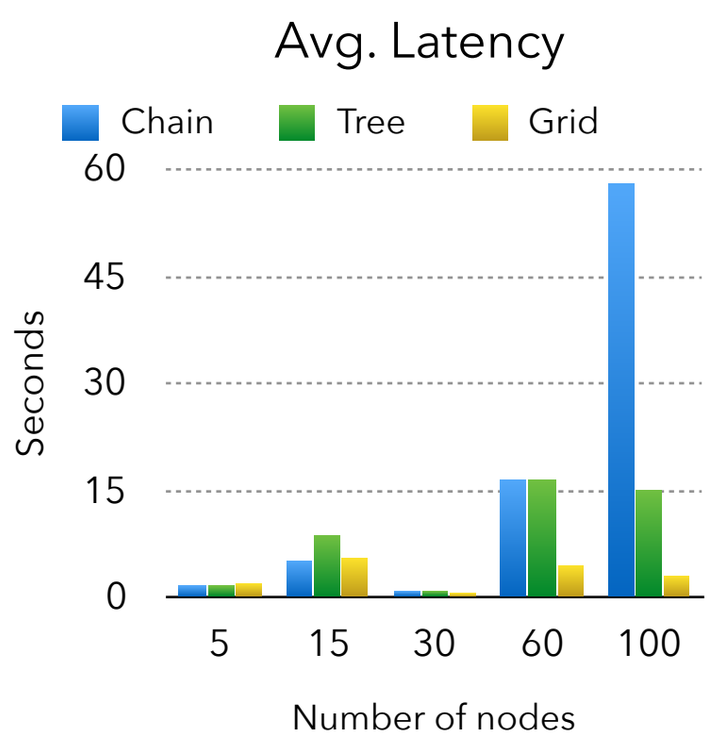

Max. Latency
Chain
Tree
Grid
30
22,5
15
7,5
0
Seconds
5
15
30
60
100
Number of nodes

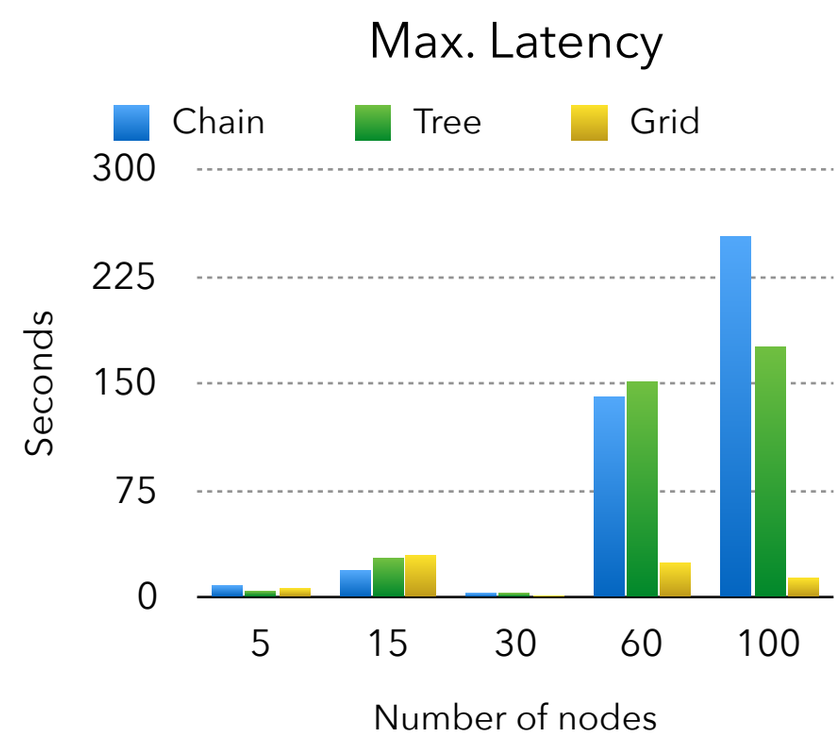
Odd sender


Total transmissions
Chain
Tree
Grid
Transmissions
30000
24000
18000
12000
6000
0
5
15
30
60
100
Number of nodes

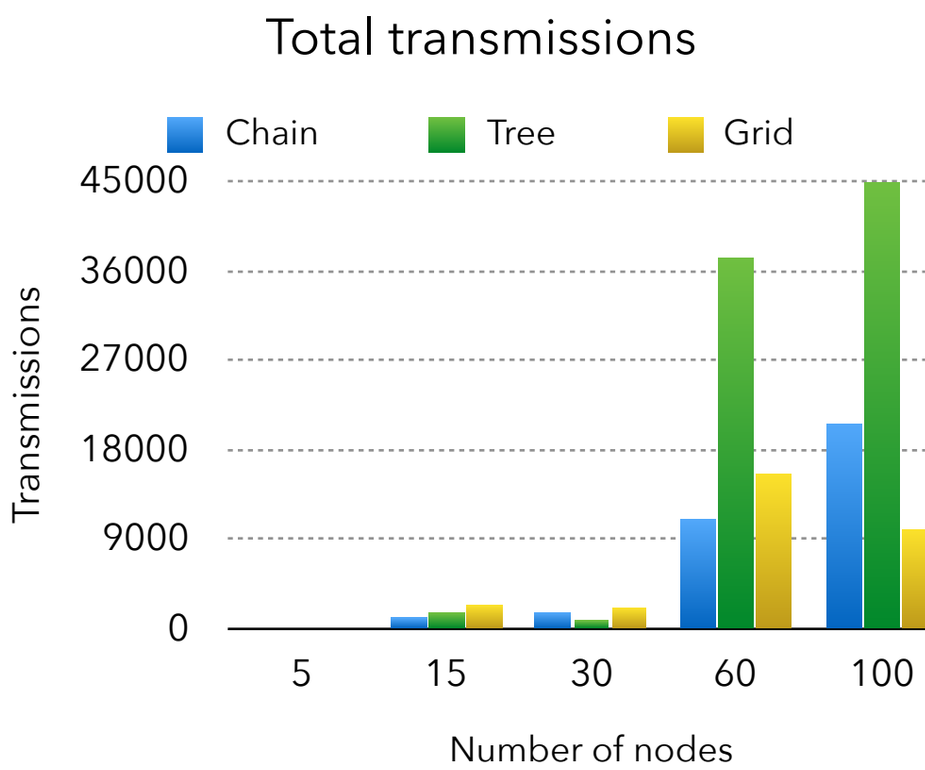

Coverage
Chain
Tree
Grid
Coverage percentage
100
75
50
25
0
5
15
30
60
100
Number of nodes

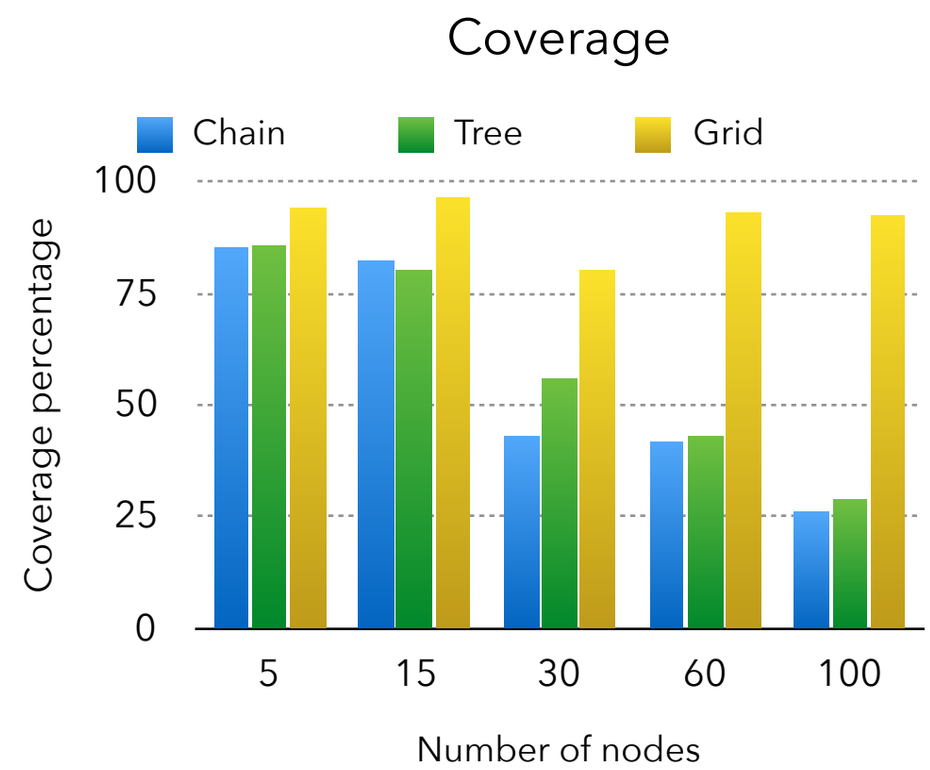

Min. Latency
Chain
Tree
Grid
Seconds
0,40
0,30
0,20
0,10
0,00
5
15
30
60
100
Number of nodes

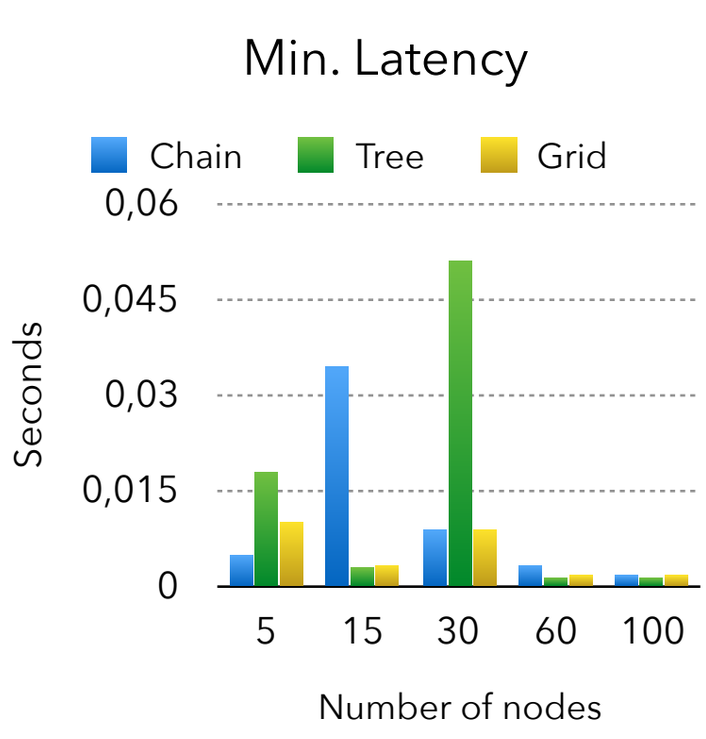

Avg. Latency
Chain
Tree
Grid
Seconds
60
45
30
15
0
5
15
30
60
100
Number of nodes

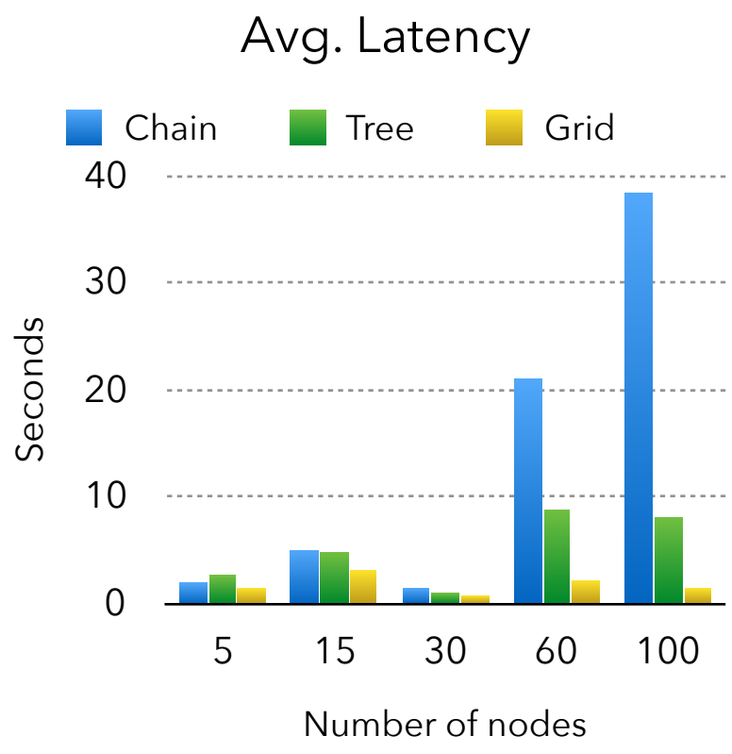

Max. Latency
Chain
Tree
Grid
Seconds
300
225
150
75
0
5
15
30
60
100
Number of nodes

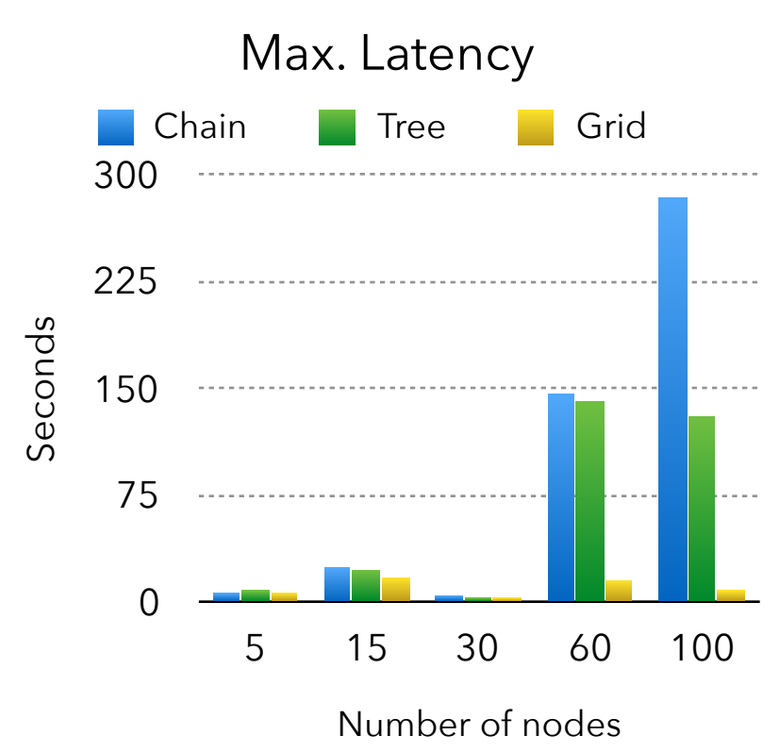
All senders


Total transmissions
Chain
Tree
Grid
45000
36000
27000
18000
9000
0
Transmissions
5
15
30
60
100
Number of nodes

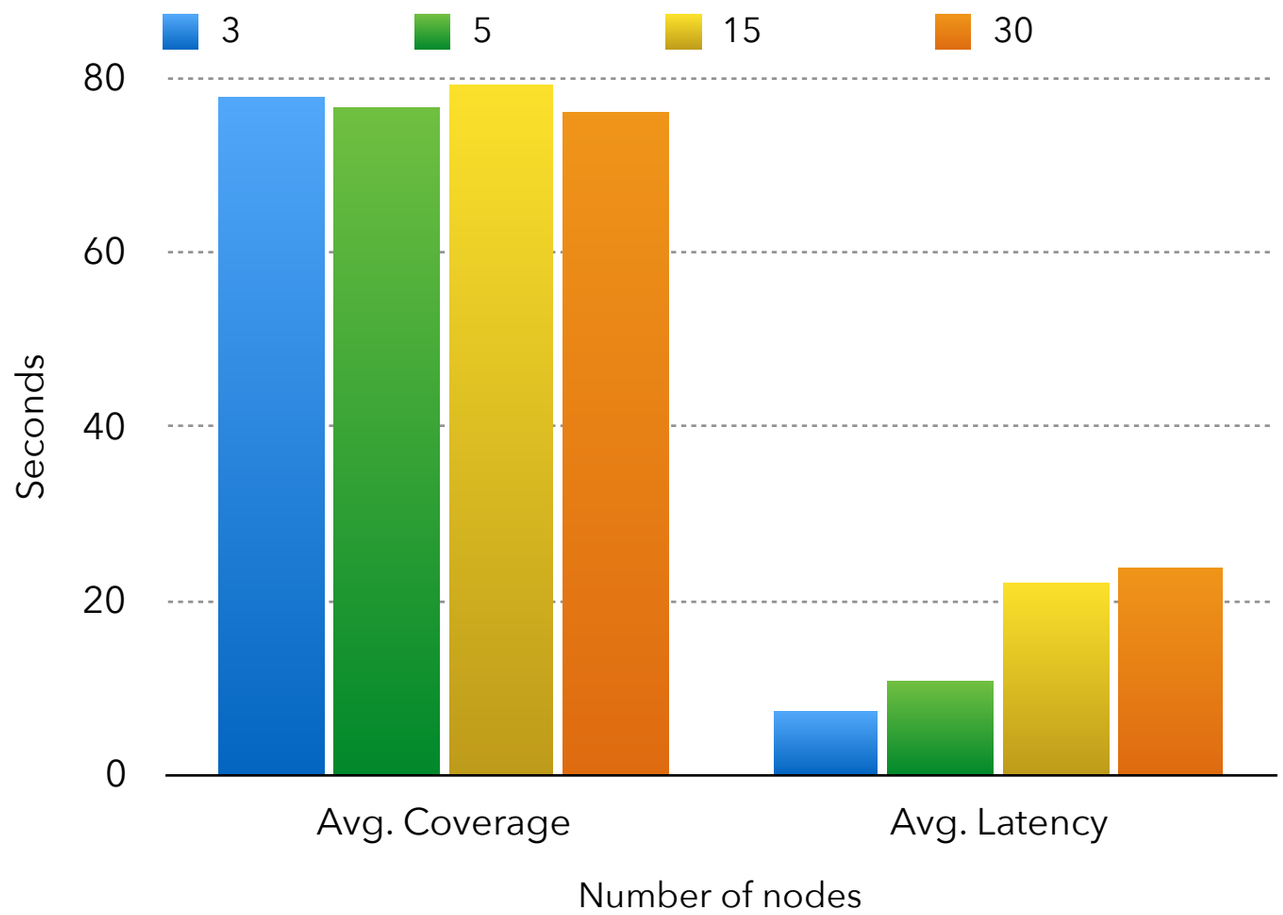

Coverage
Chain
Tree
Grid
100
75
50
25
0
Coverage percentage
5
15
30
60
100
Number of nodes


Min. Latency
Chain
Tree
Grid
0,06
0,045
0,03
0,015
0
Seconds
5
15
30
60
100
Number of nodes


Avg. Latency
Chain
Tree
Grid
40
30
20
10
0
Seconds
5
15
30
60
100
Number of nodes


Max. Latency
Chain
Tree
Grid
300
225
150
75
0
Seconds
5
15
30
60
100
Number of nodes

Cache size


3
5
15
30
80
60
40
20
0
Seconds
Avg. Coverage
Avg. Latency
Number of nodes