# Simulation analysis

2025-08-15

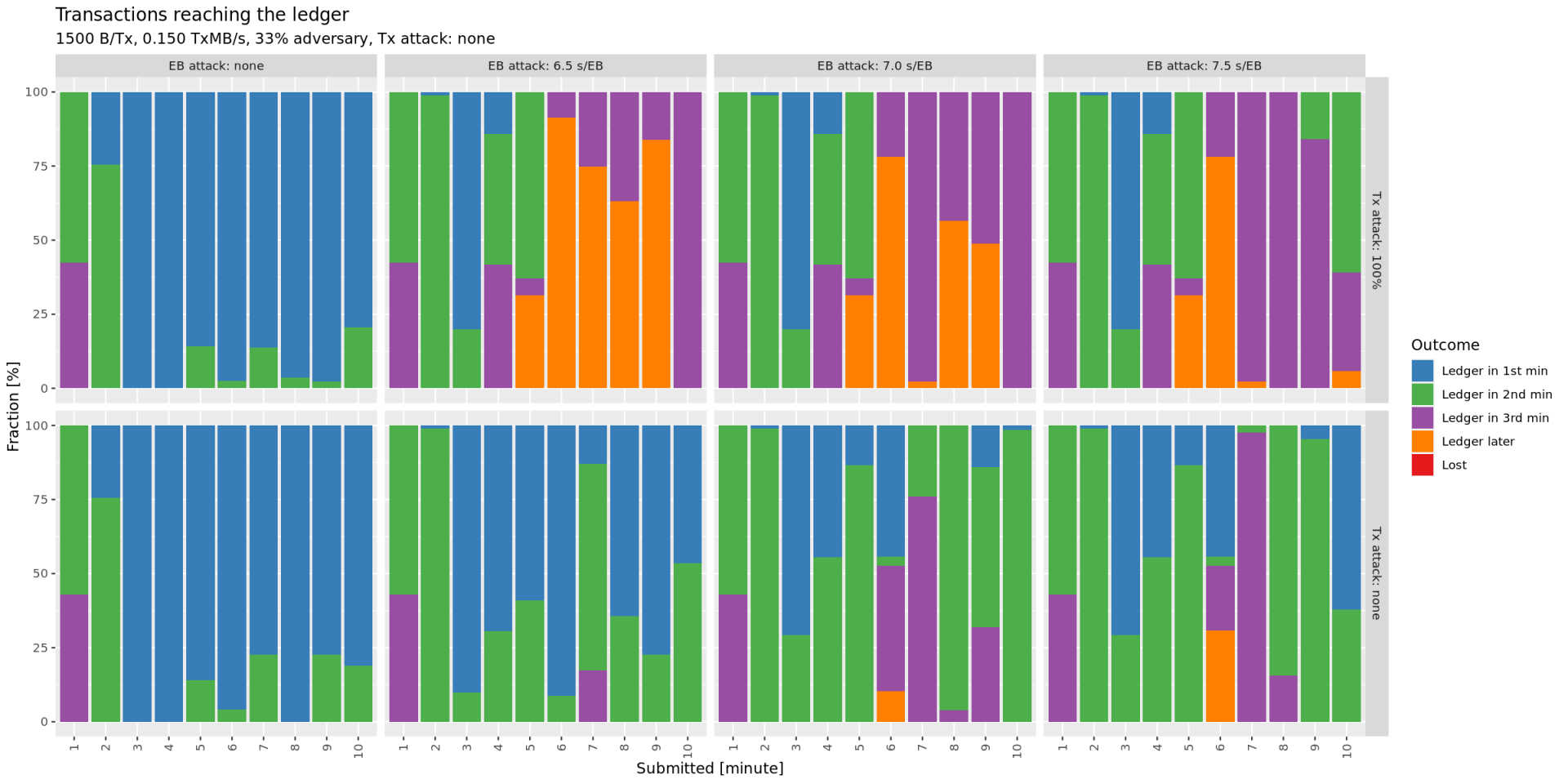
# Attacks experiment @ 6eb32386

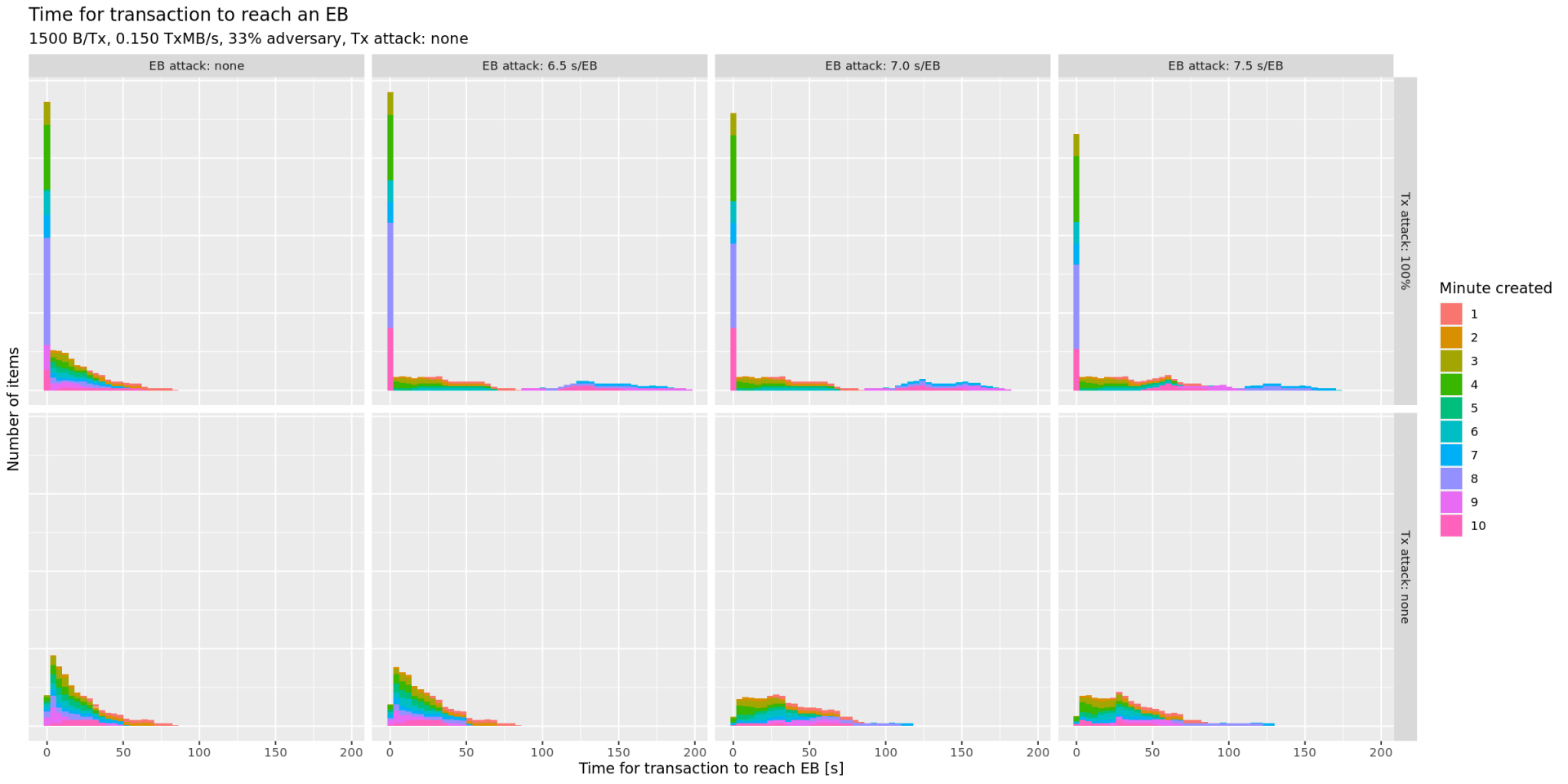
- Rust simulator
- Linear Leios
- Propagation
  - `txs-received`
- Maximum of 12 MB of txs referenced by each EB
- $L_{vote}$ = 7 slots
- $L_{diff}$ = 0 slots
- 33% adversarial stake

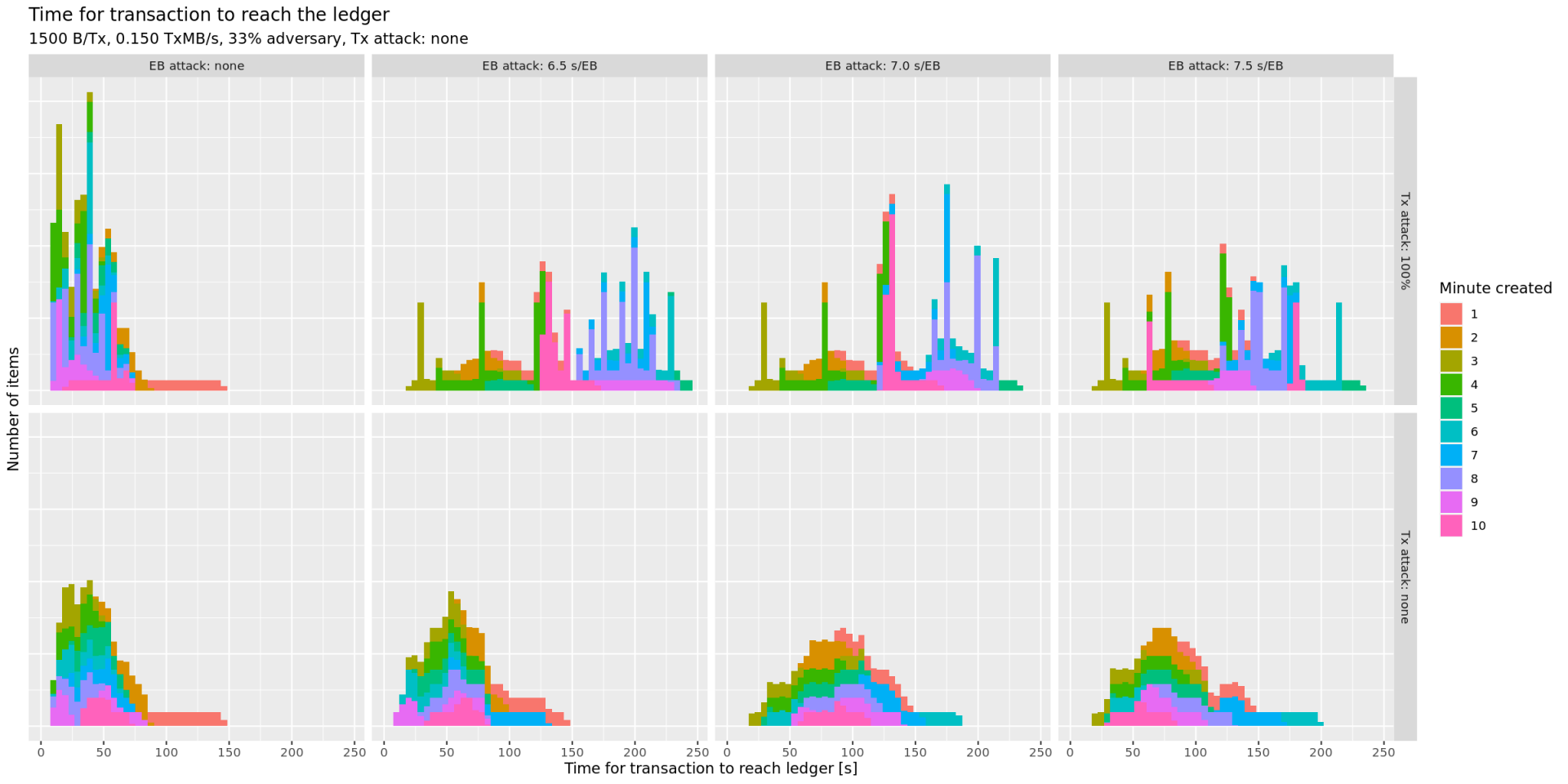
- EB attack
  - varied propagation delay
- Tx attack
  - 100% of adversarial EBs
- Throughput: 0.150 TxMb/s
- Tx size: 1500 B/Tx
- TPS: 100 Tx/s
- Mini-mainnet
- 4 vCPU/node
- 10 Mb/s bandwidth

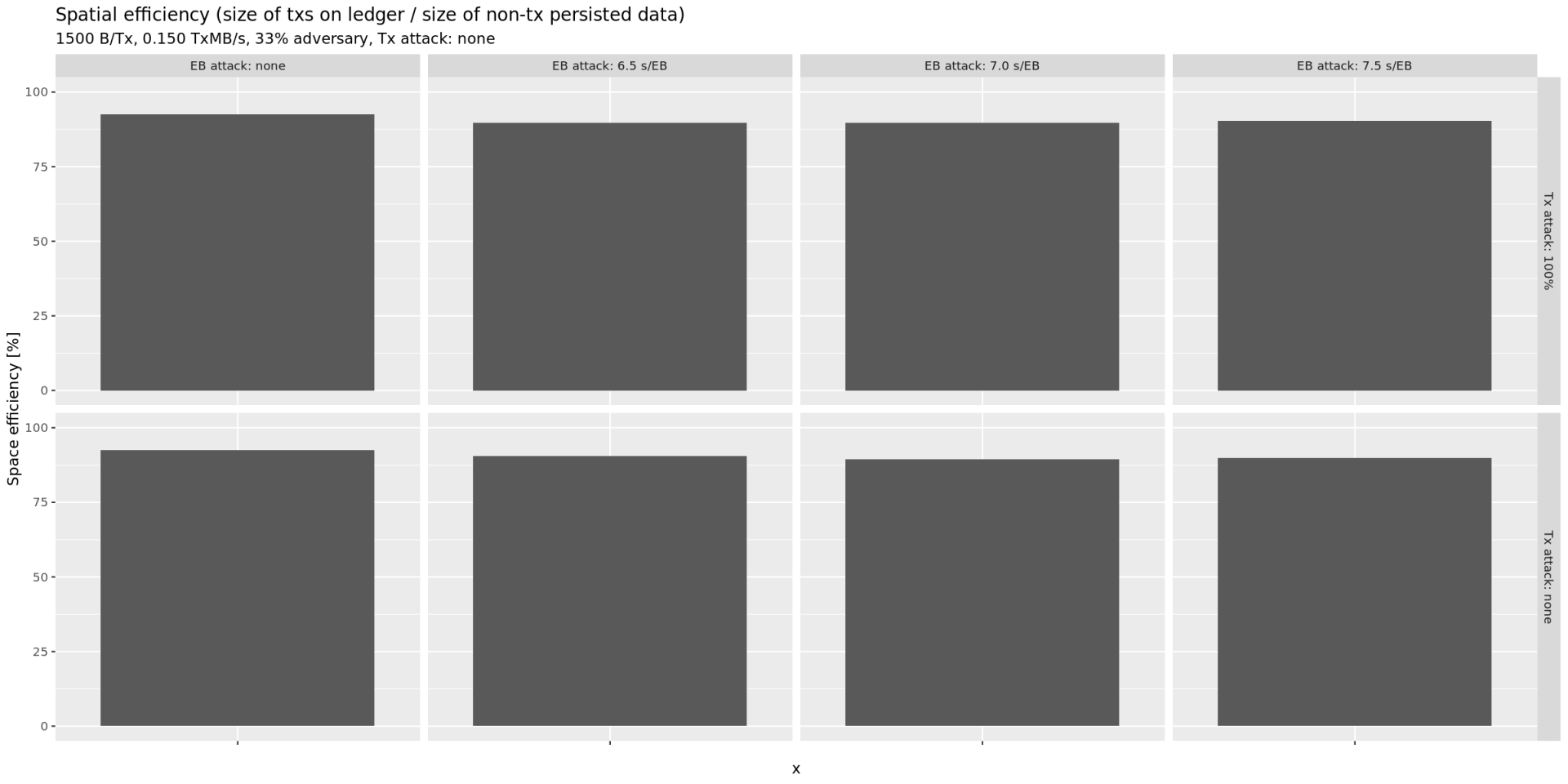
# Findings

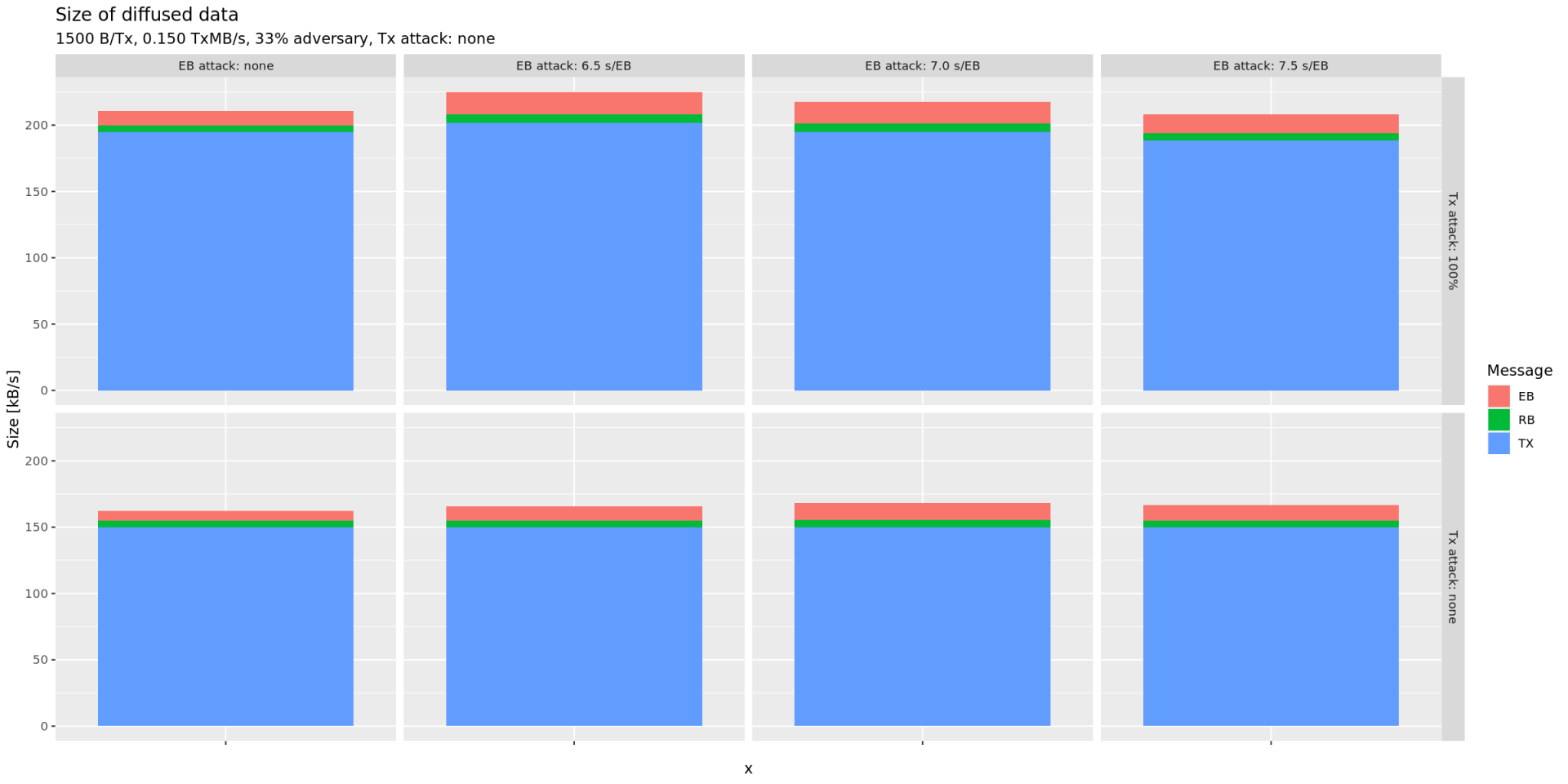
- Efficiency starts dropping when EBs and transactions are delayed 6.5 seconds.
- Efficiency doesn’t continue dropping much after delays of 7 seconds.
- $L_{diff}$ = 0s performs better than $L_{diff}$ = 7s.
- None of the cases, using `txs-received`, loses transactions or bogs down.

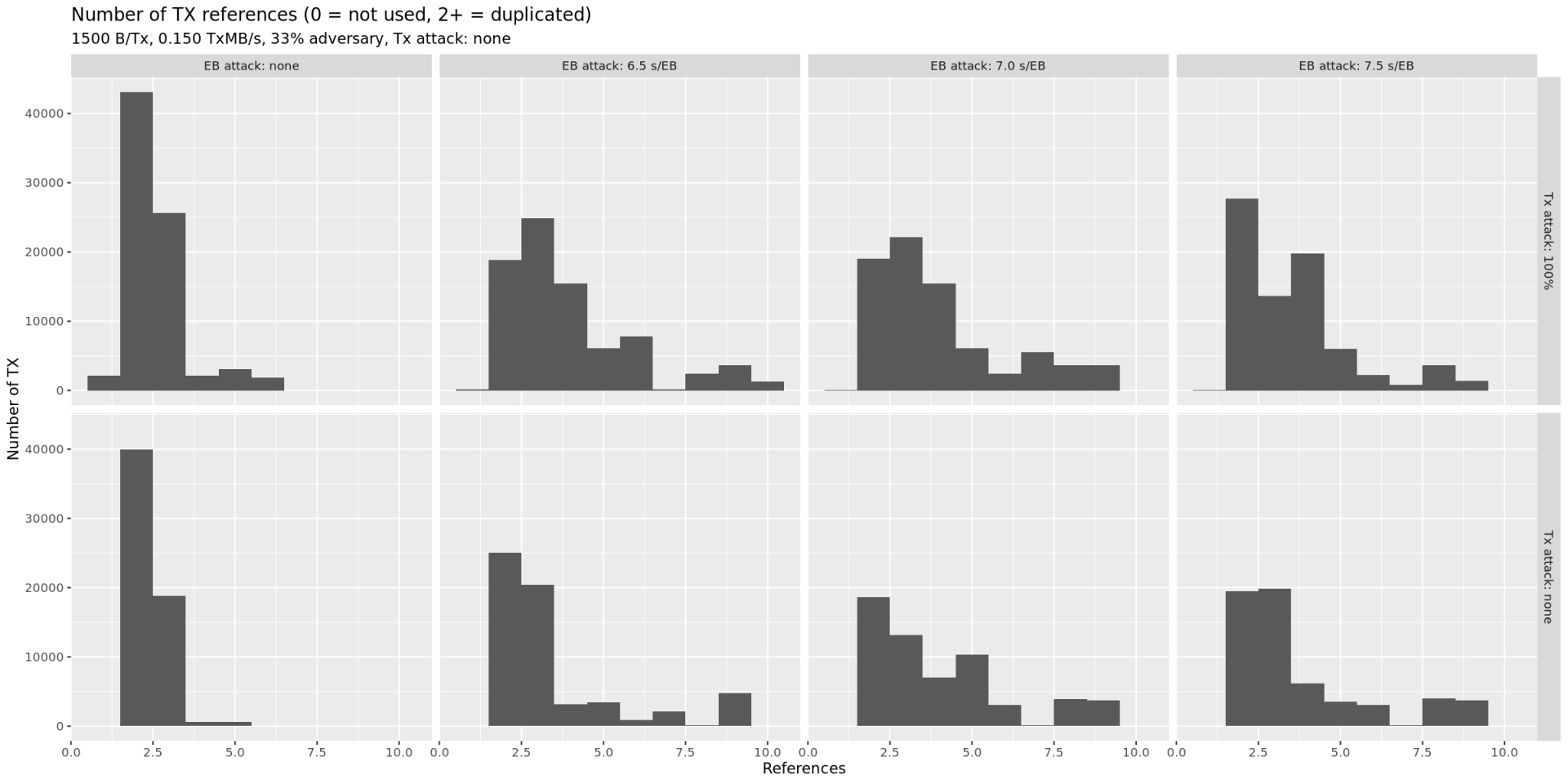

Transactions reaching the ledger
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Fraction [%]
0
25
50
75
100
1
2
3
4
5
6
7
8
9
10
Submitted [minute]
Outcome
Ledger in 1st min
Ledger in 2nd min
Ledger in 3rd min
Ledger later
Lost

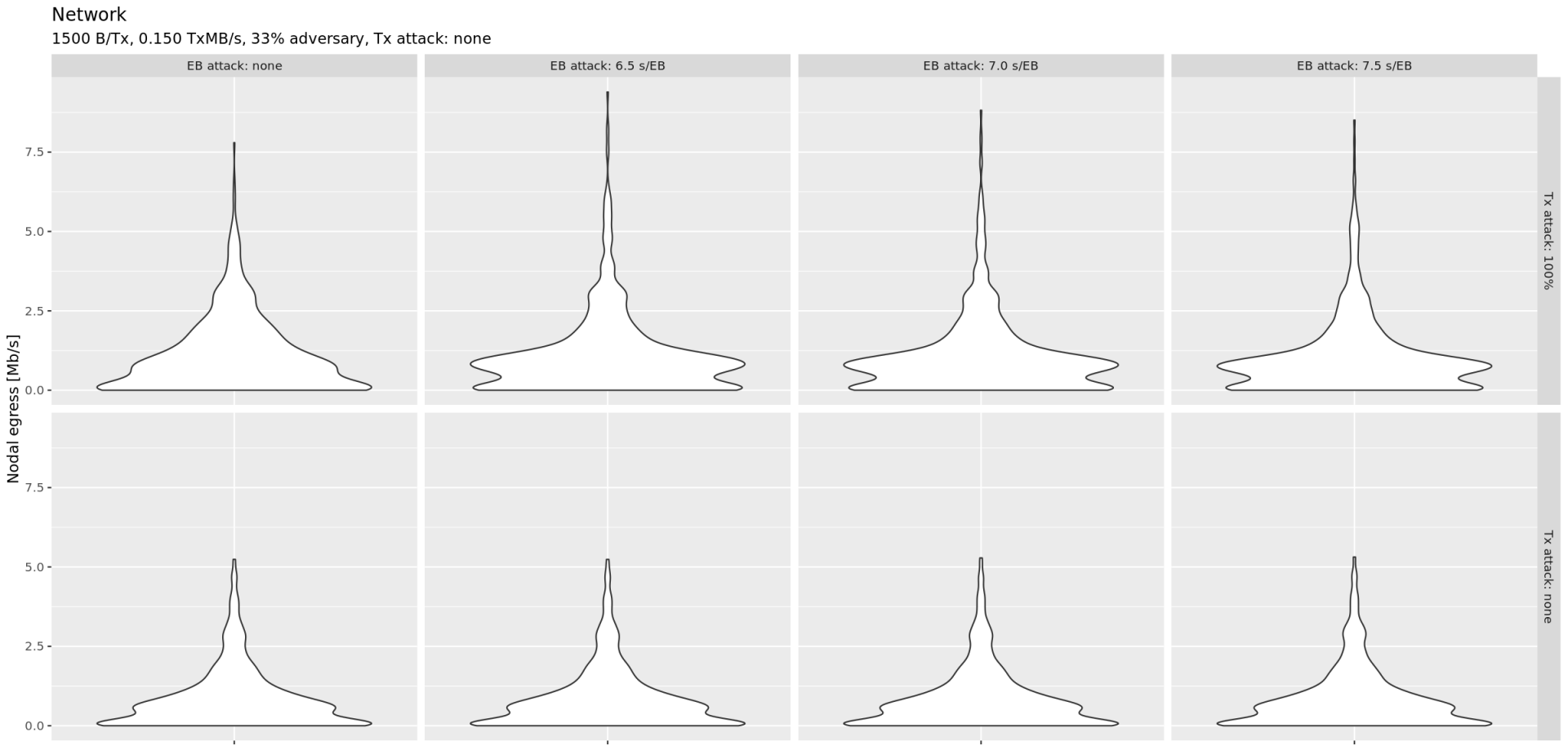

Time for transaction to reach an EB
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Number of items
0
50
100
150
200
Time for transaction to reach EB [s]
Minute created
1
2
3
4
5
6
7
8
9
10

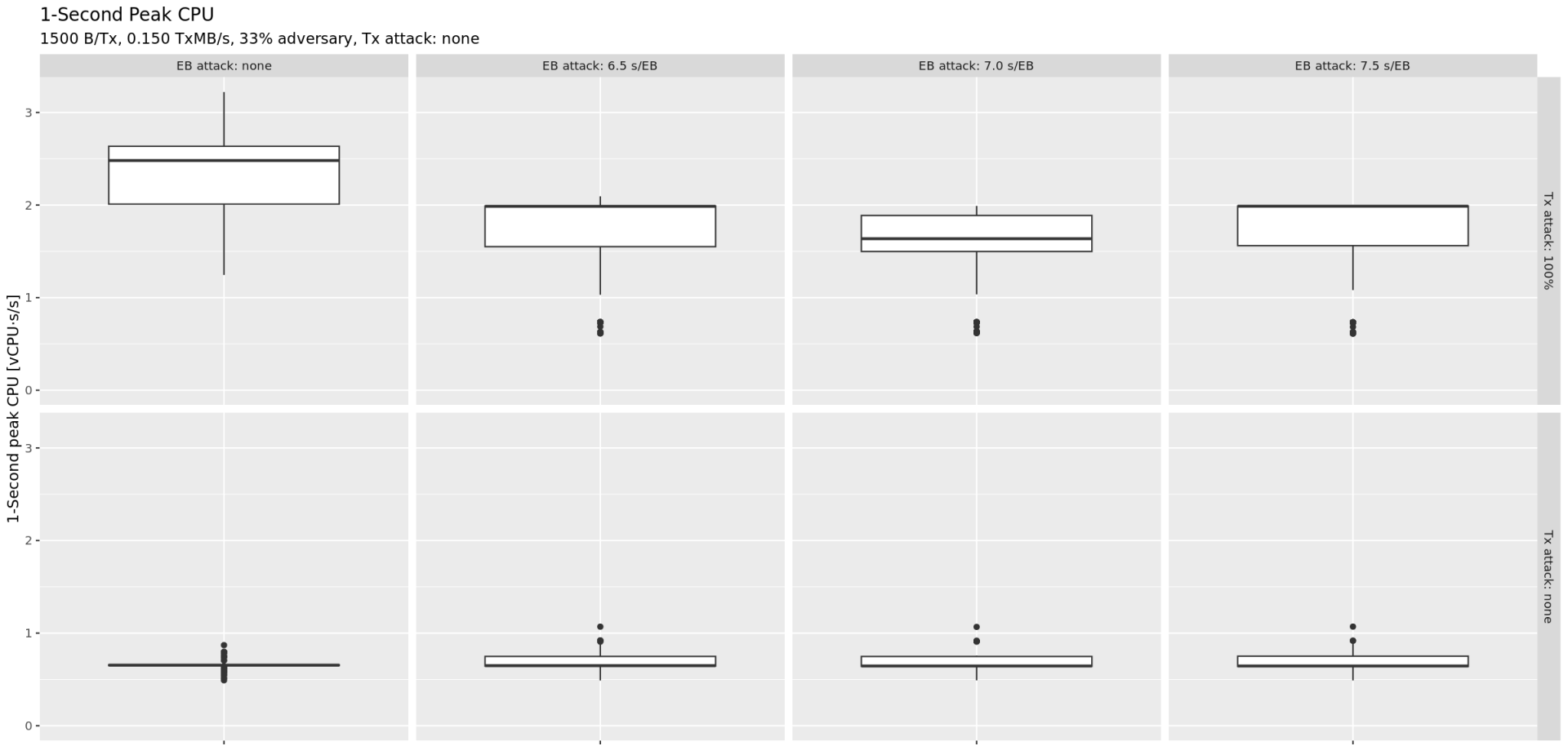

Time for transaction to reach the ledger
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Number of items
Time for transaction to reach ledger [s]
Minute created
1
2
3
4
5
6
7
8
9
10
0
50
100
150
200
250

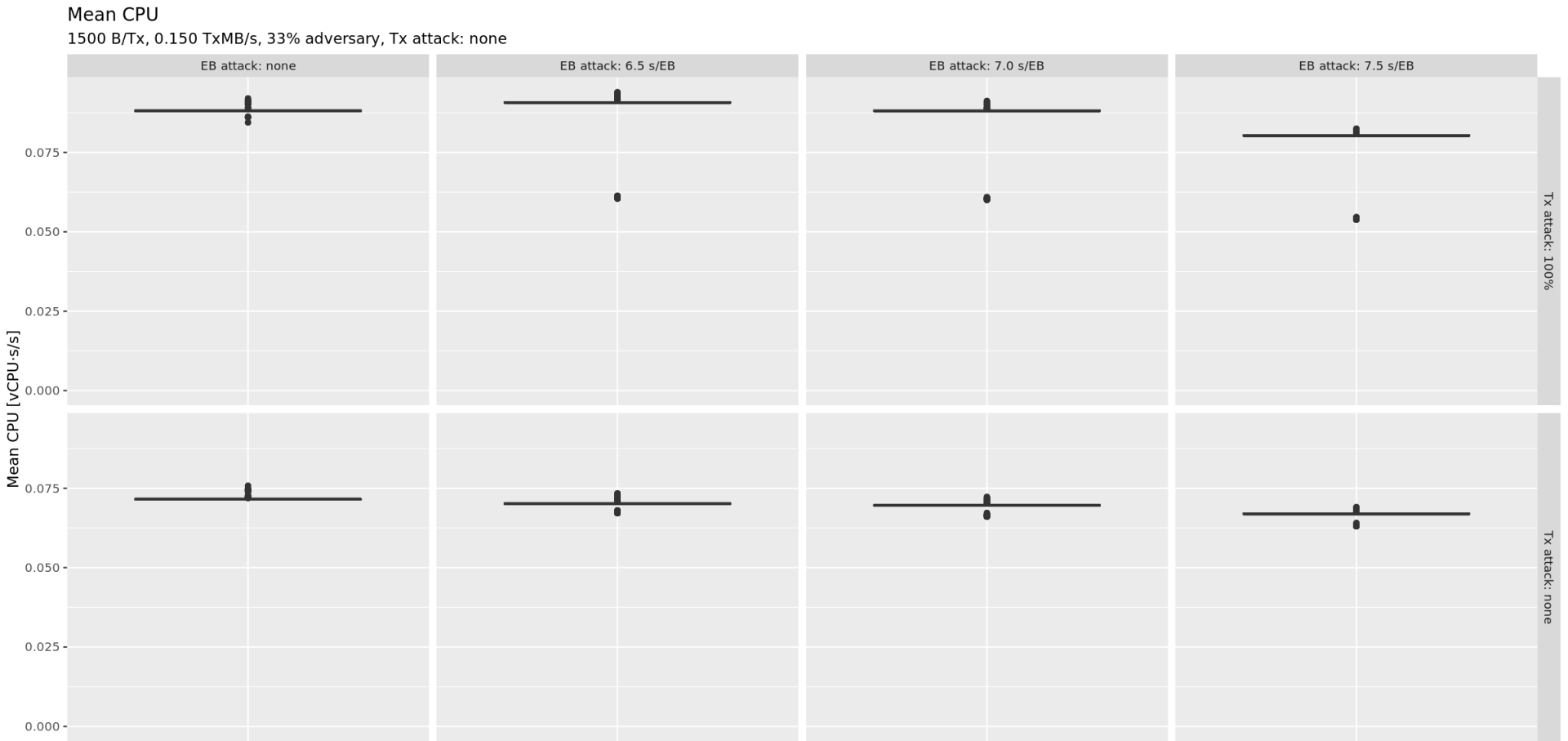

Spatial efficiency (size of txs on ledger / size of non-tx persisted data)
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Space efficiency [%]
100
75
50
25
0
x

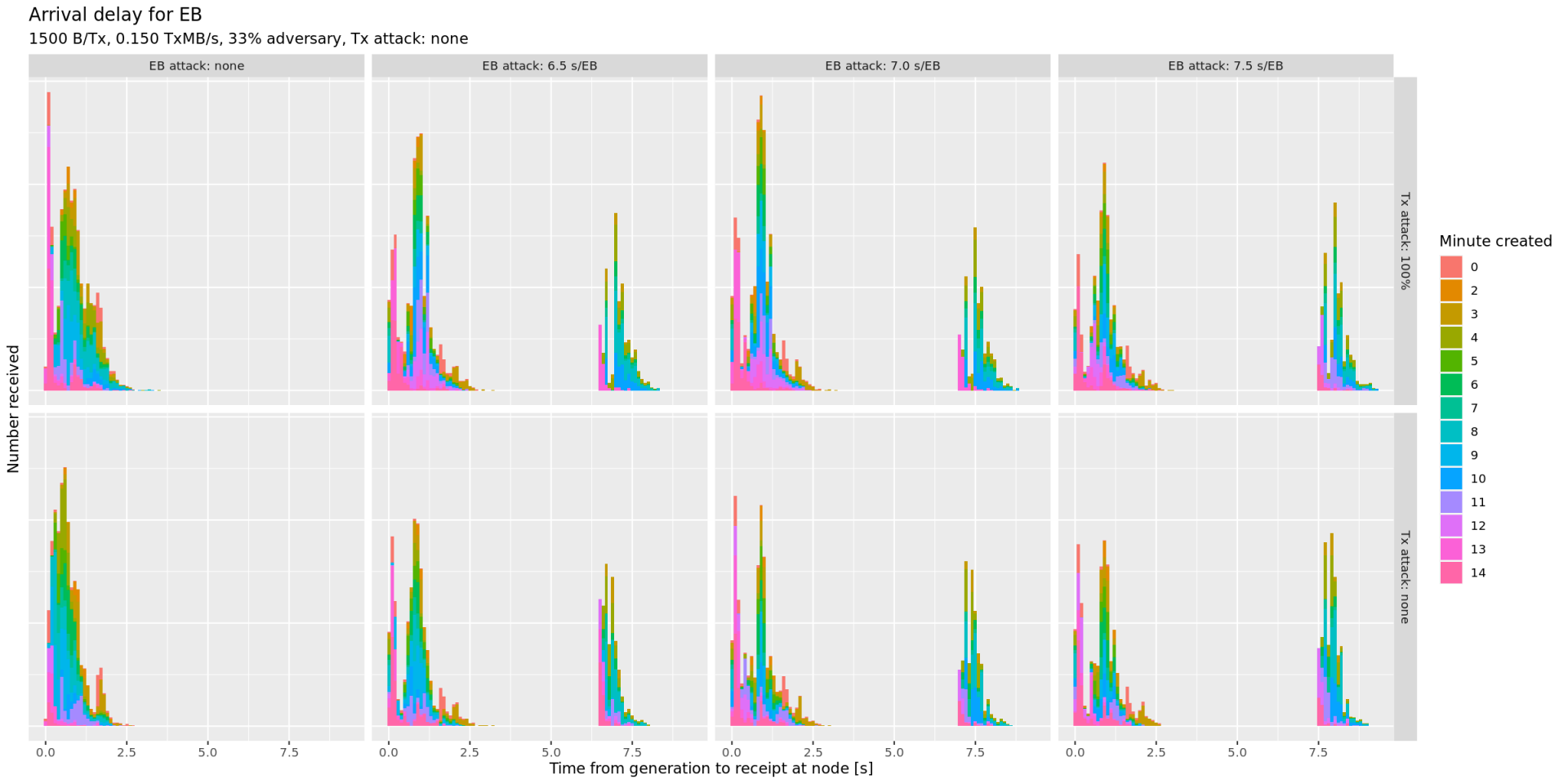

Size of diffused data
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Size [kB/s]
0
50
100
150
200
x
Message
EB
RB
TX

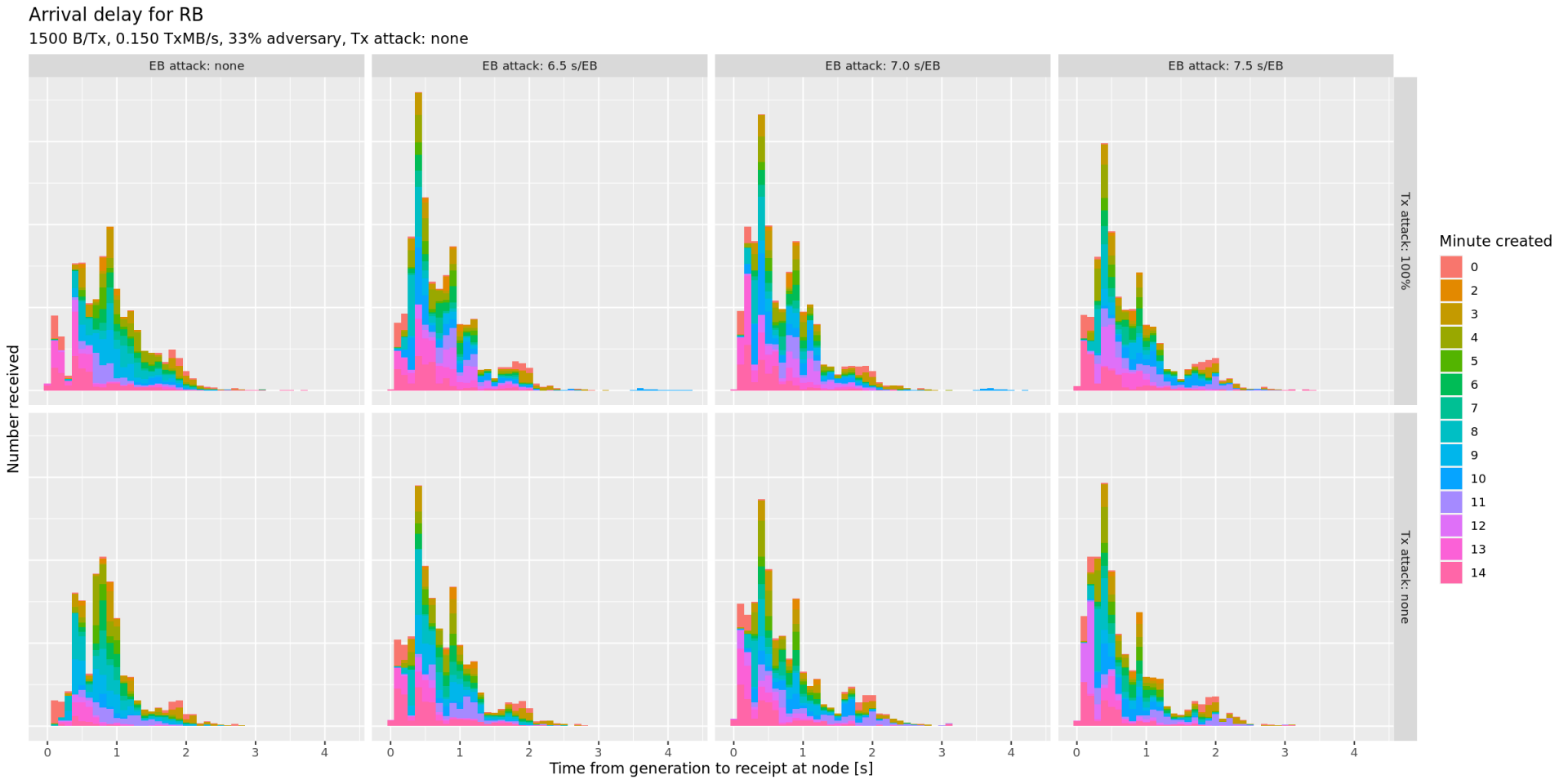

Number of TX references (0 = not used, 2+ = duplicated)
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Number of TX
References
0
10000
20000
30000
40000
0.0
2.5
5.0
7.5
10.0

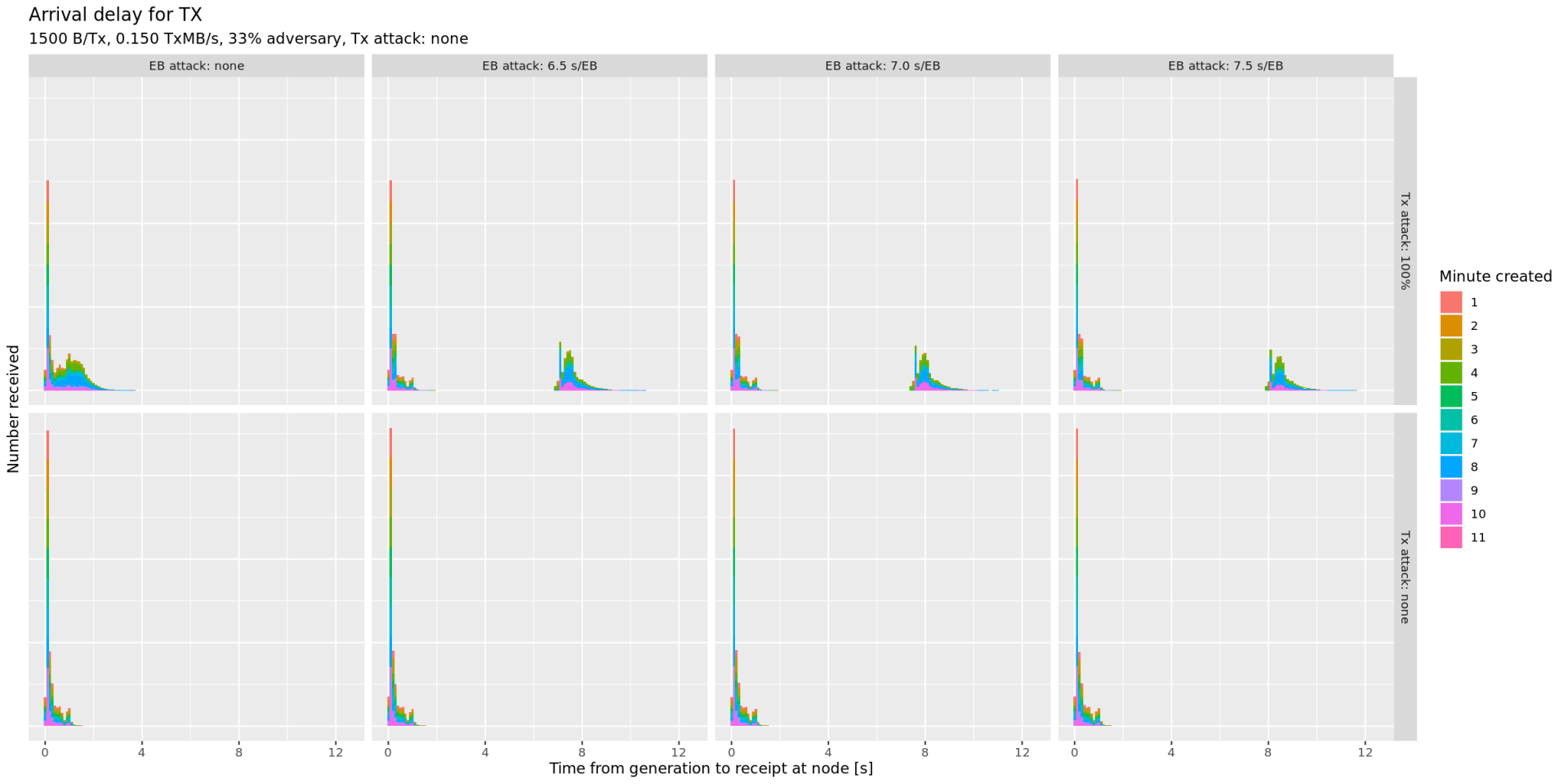

Network
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Nodal egress [Mb/s]
0.0
2.5
5.0
7.5

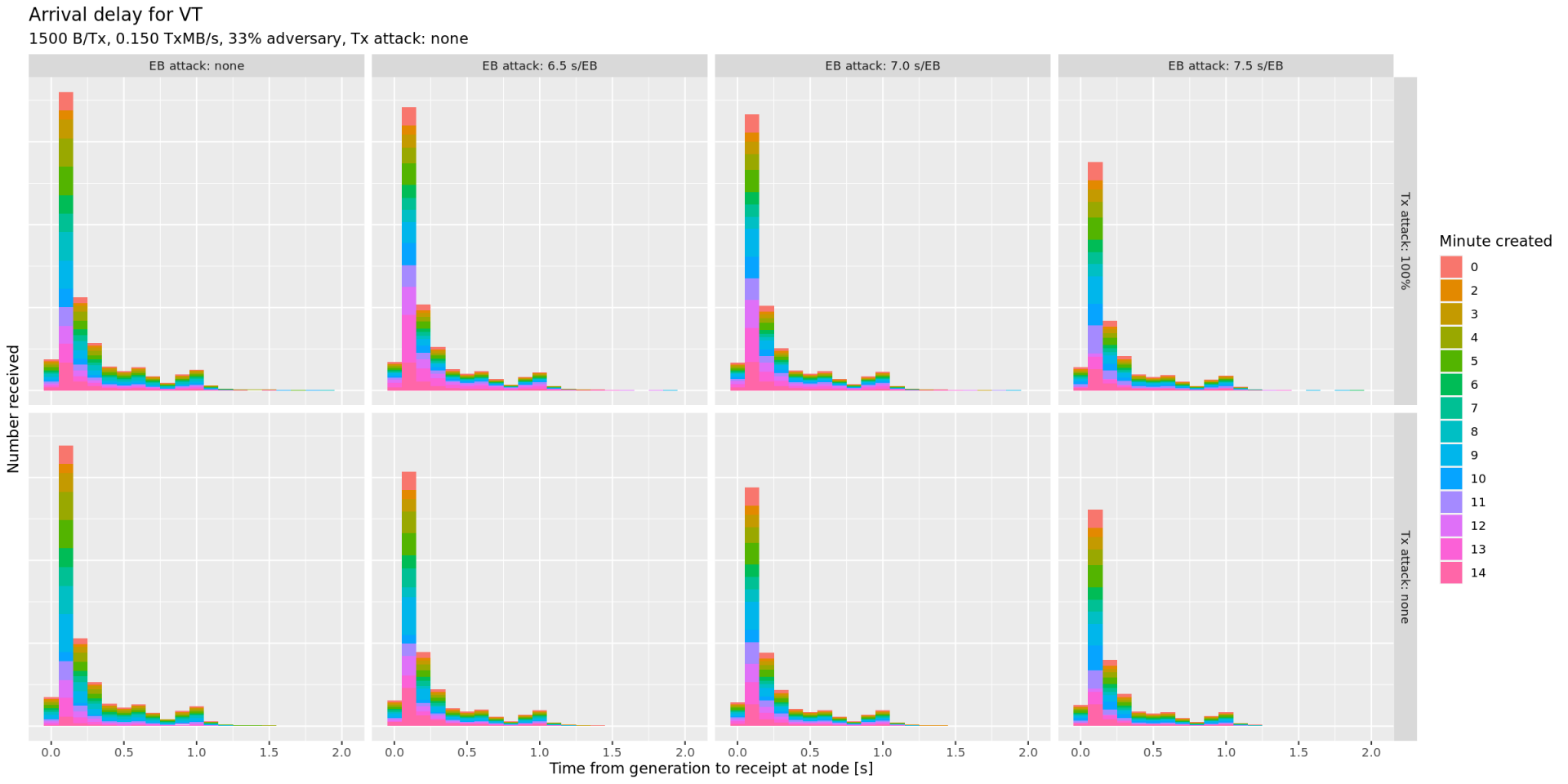

1-Second Peak CPU
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
1-Second peak CPU [vCPU·s/s]
0
1
2
3

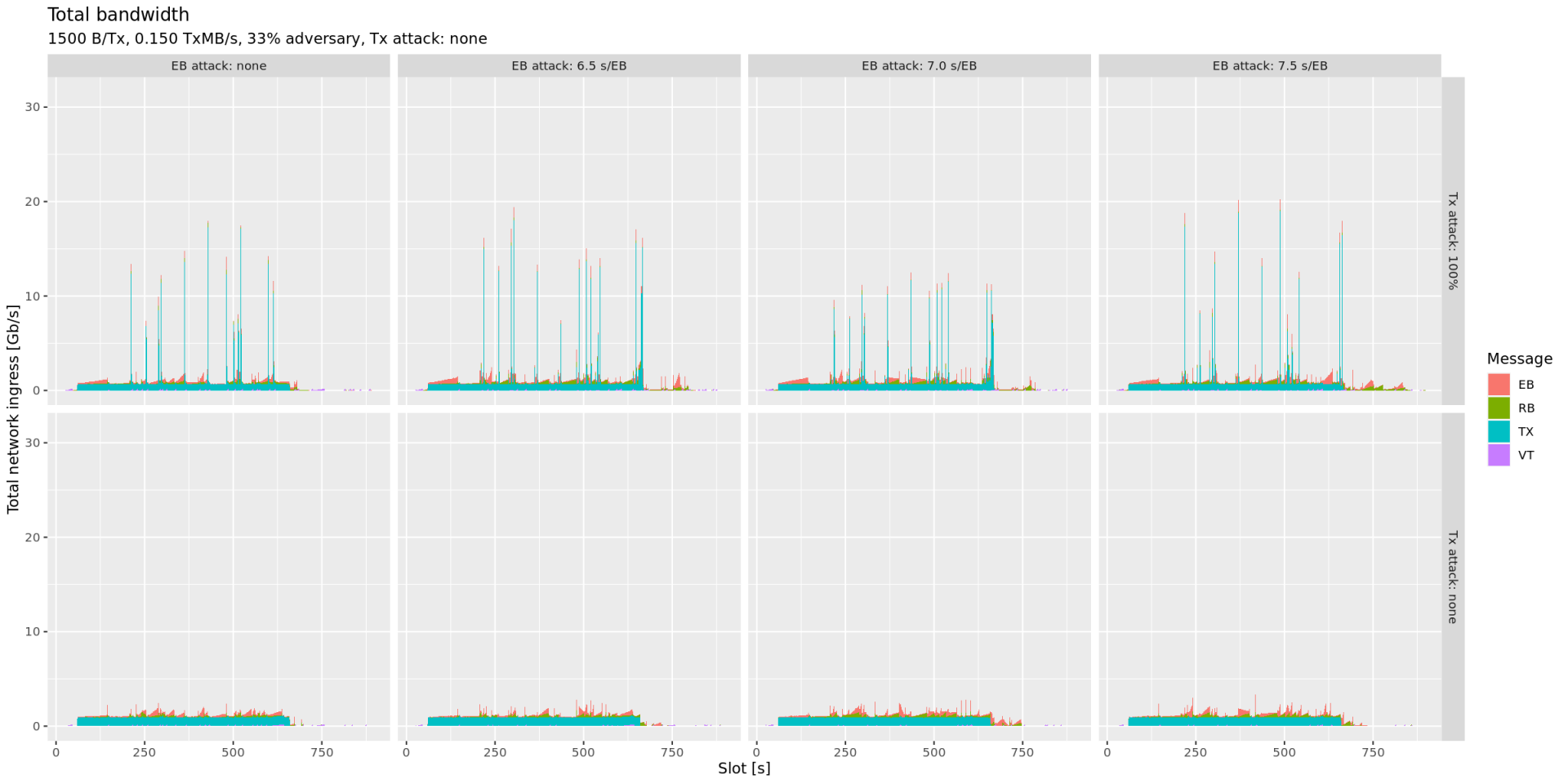

Mean CPU
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Mean CPU [vCPU·s/s]
0.075
0.050
0.025
0.000

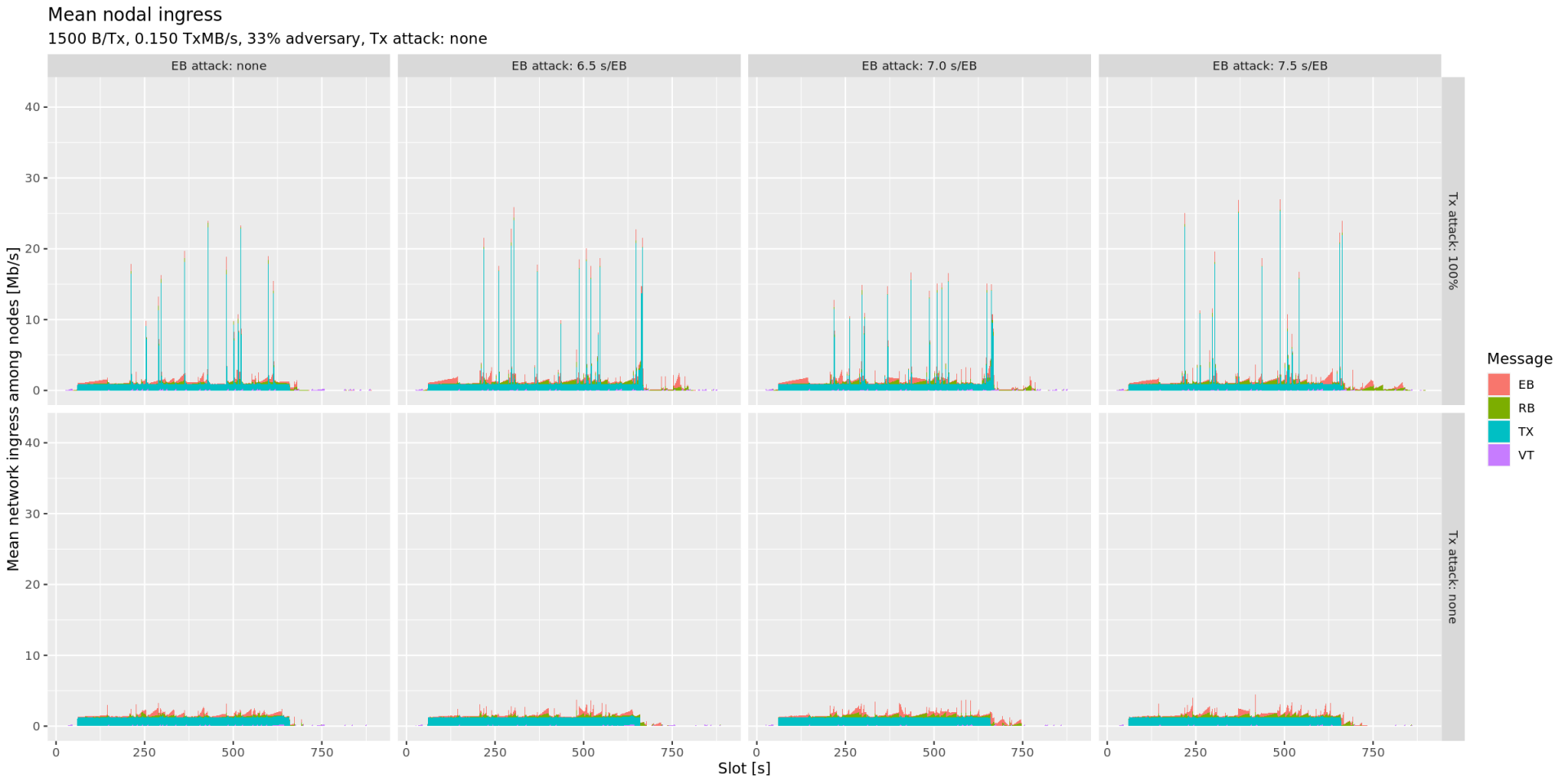

Arrival delay for EB
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Number received
Time from generation to receipt at node [s]
0.0
2.5
5.0
7.5
Minute created
0
2
3
4
5
6
7
8
9
10
11
12
13
14

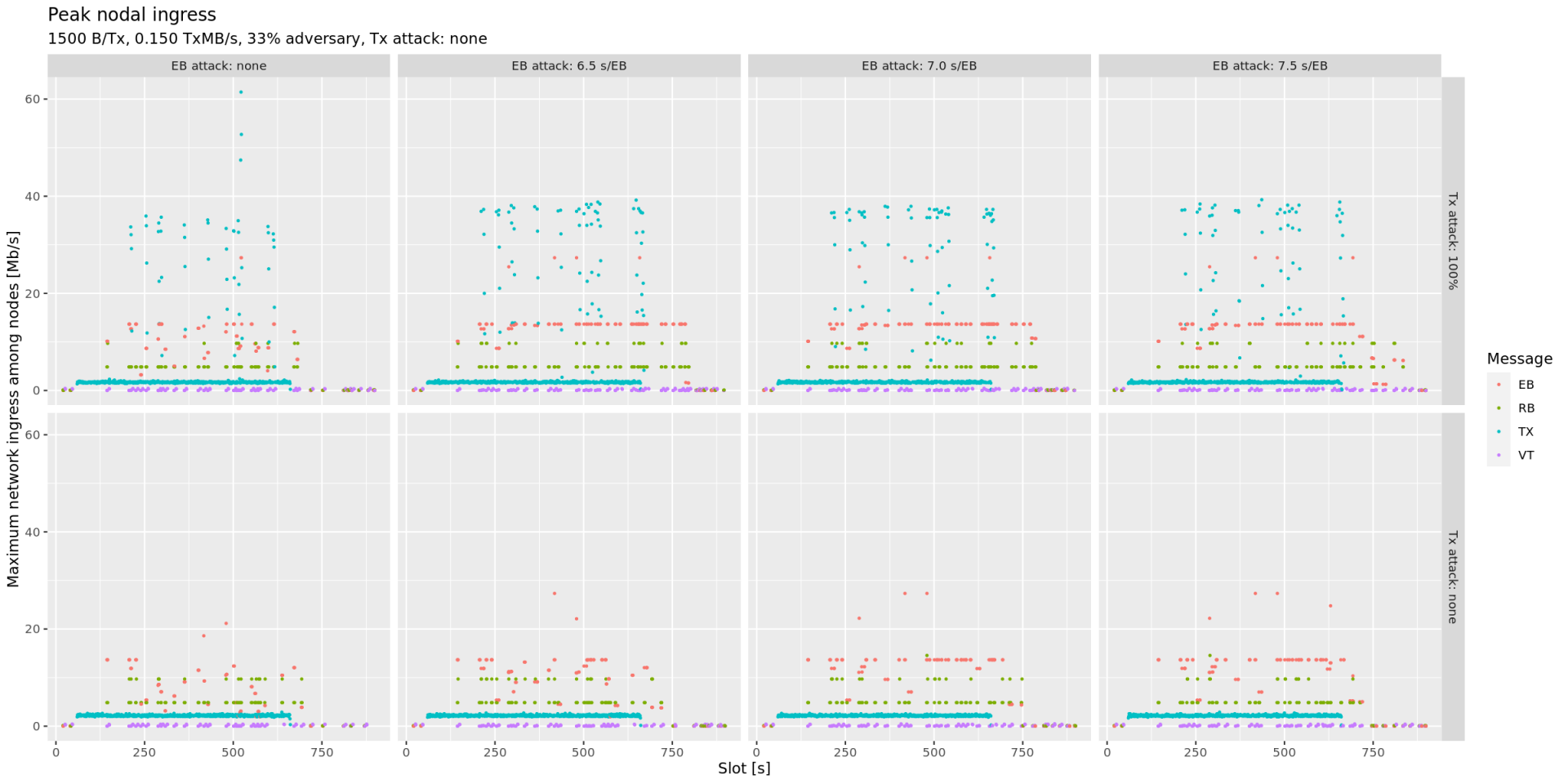

Arrival delay for RB
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Number received
Time from generation to receipt at node [s]
Minute created
0
2
3
4
5
6
7
8
9
10
11
12
13
14

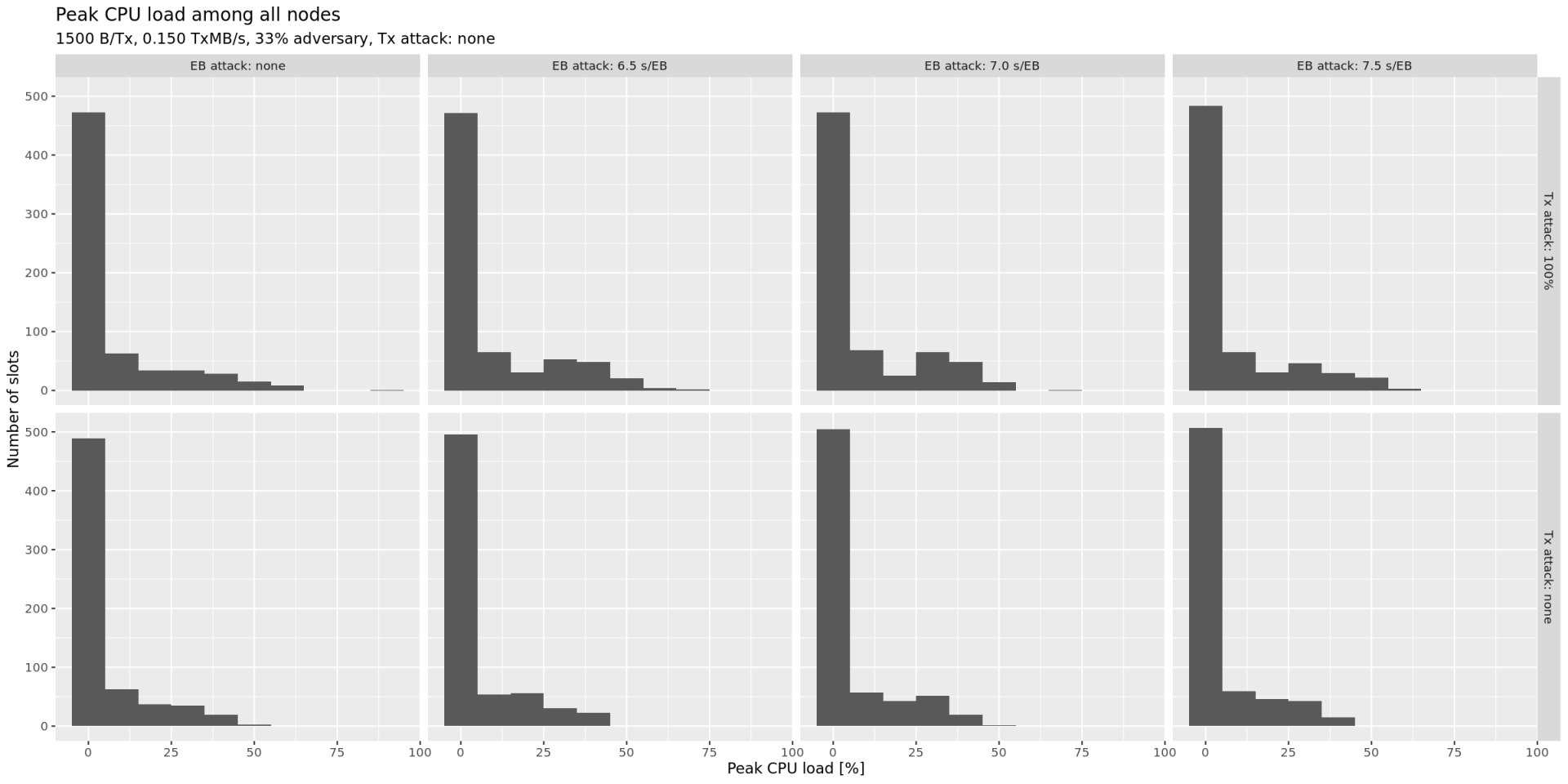

Arrival delay for TX
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Number received
0
4
8
12
Time from generation to receipt at node [s]
Minute created
1
2
3
4
5
6
7
8
9
10
11

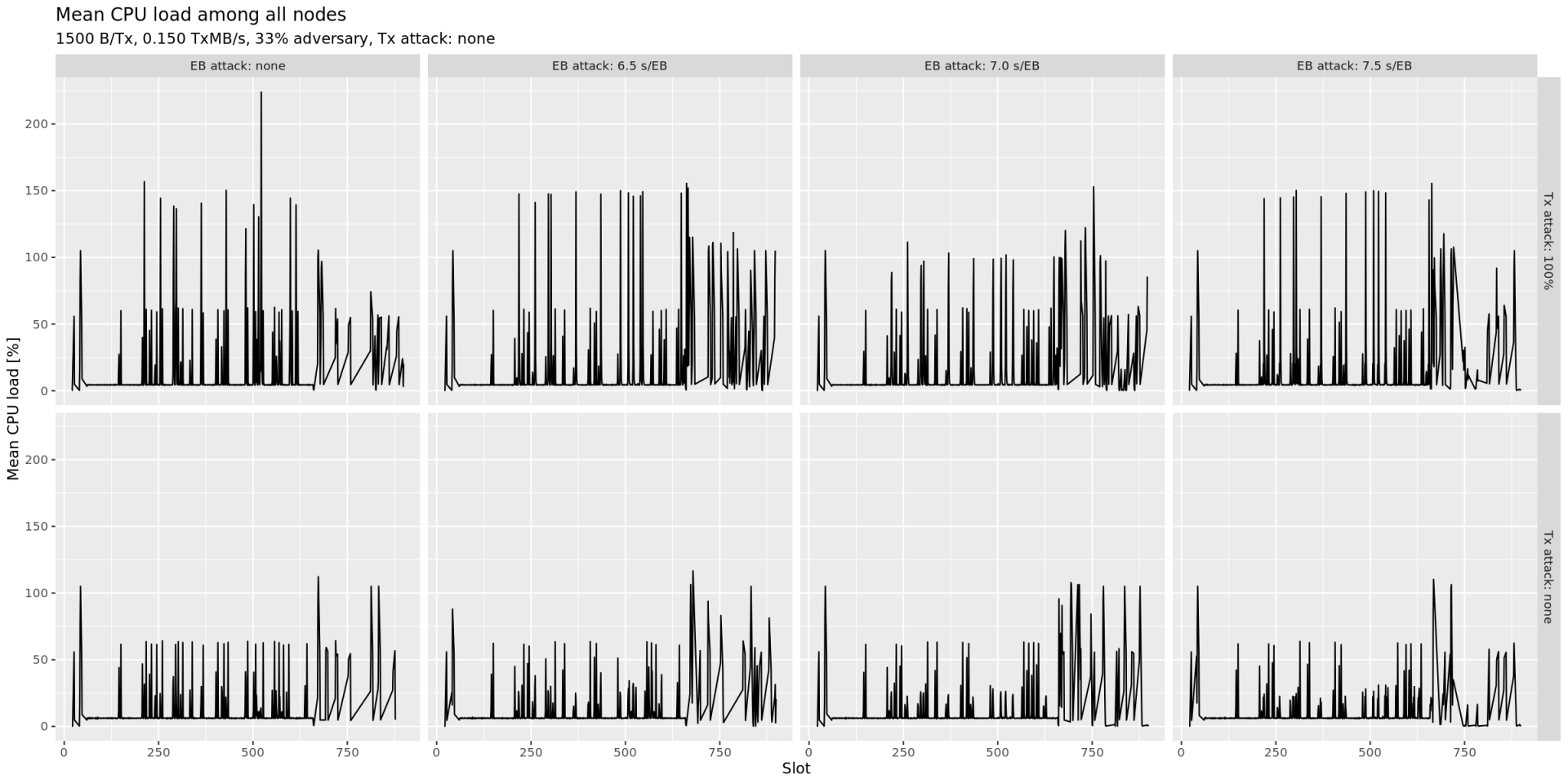

Arrival delay for VT
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Number received
Time from generation to receipt at node [s]
0.0
0.5
1.0
1.5
2.0
Minute created
0
2
3
4
5
6
7
8
9
10
11
12
13
14

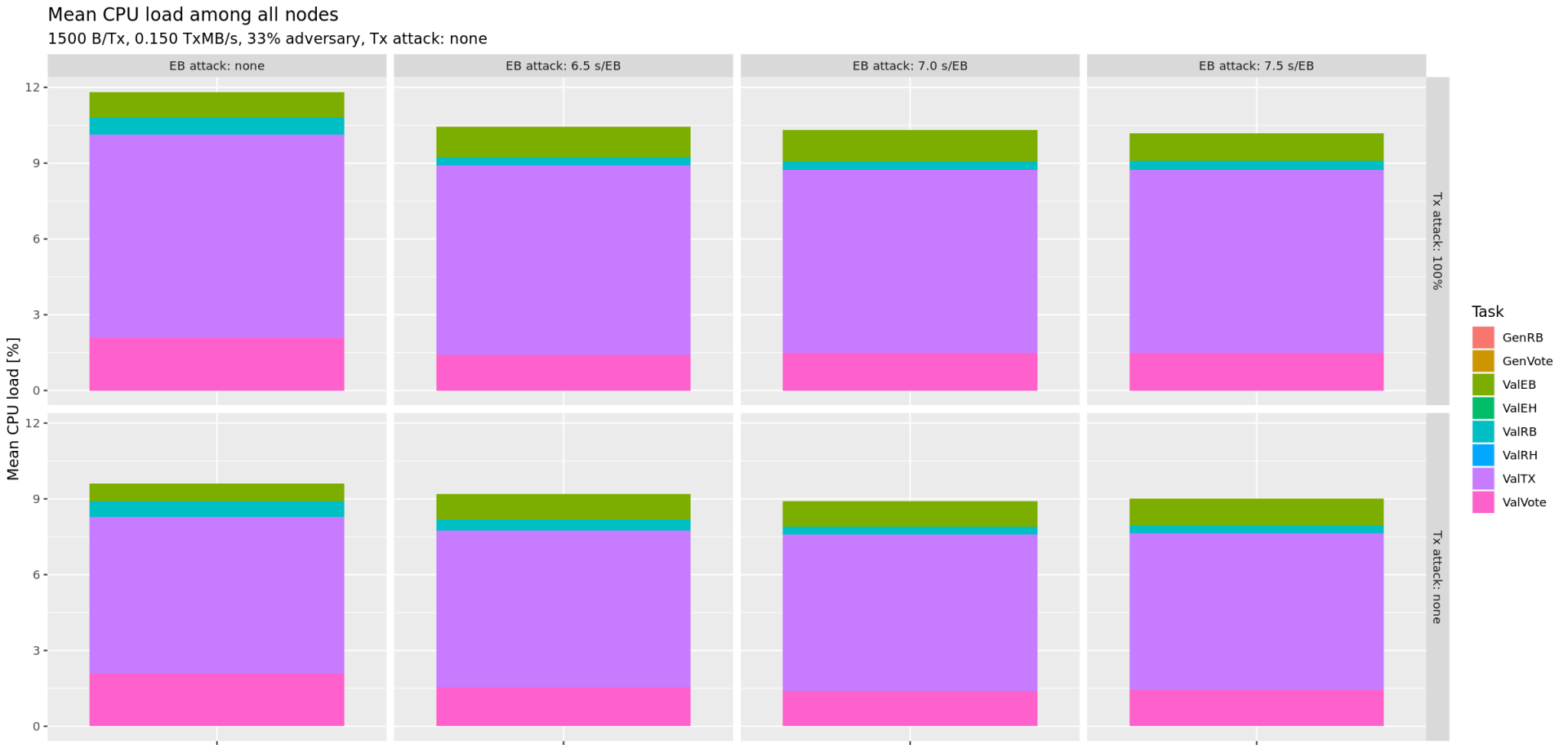

Total bandwidth
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Total network ingress [Gb/s]
Slot [s]
Message
EB
RB
TX
VT

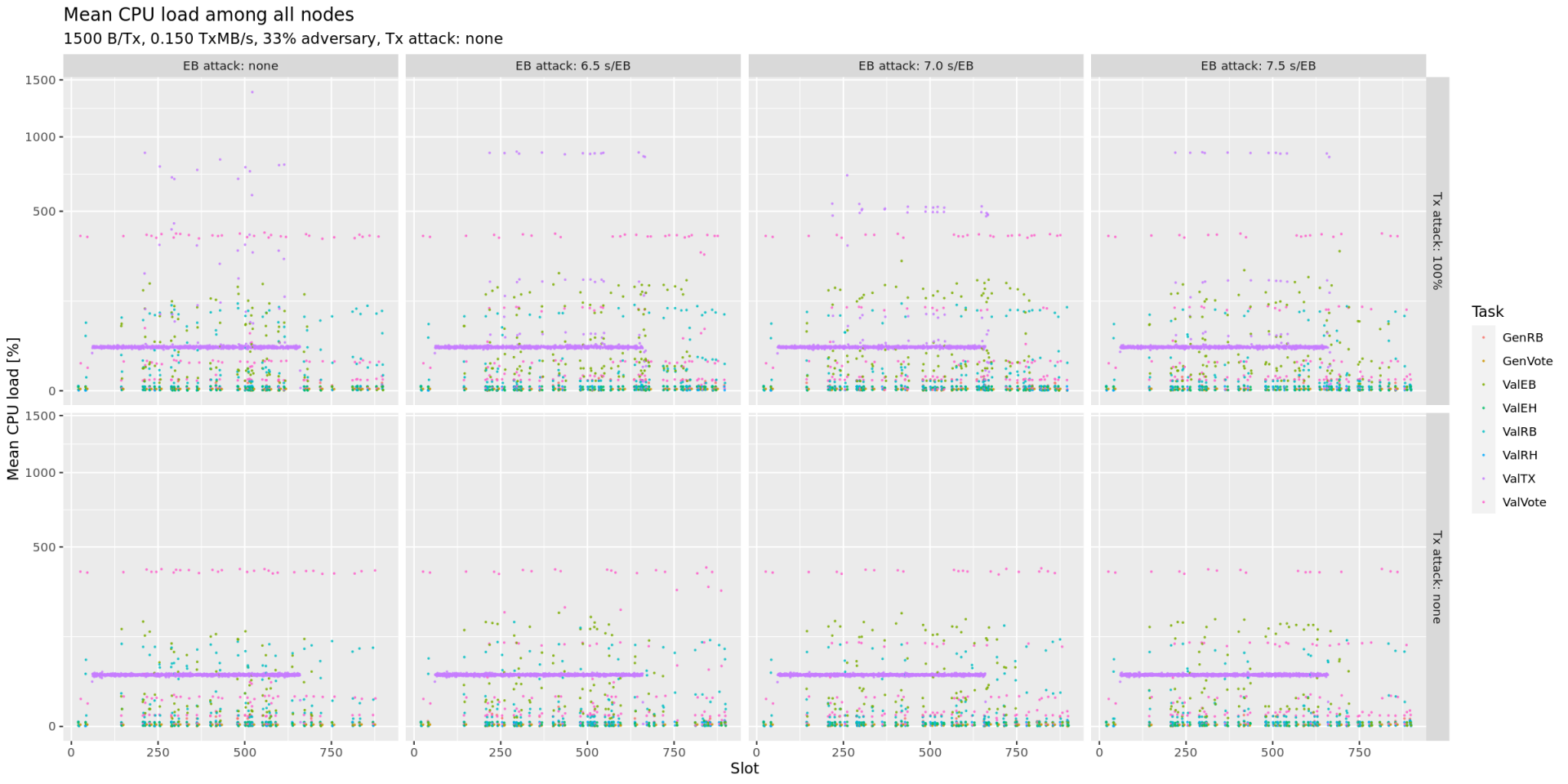

Mean nodal ingress
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Mean network ingress among nodes [Mb/s]
Slot [s]
Message
EB
RB
TX
VT

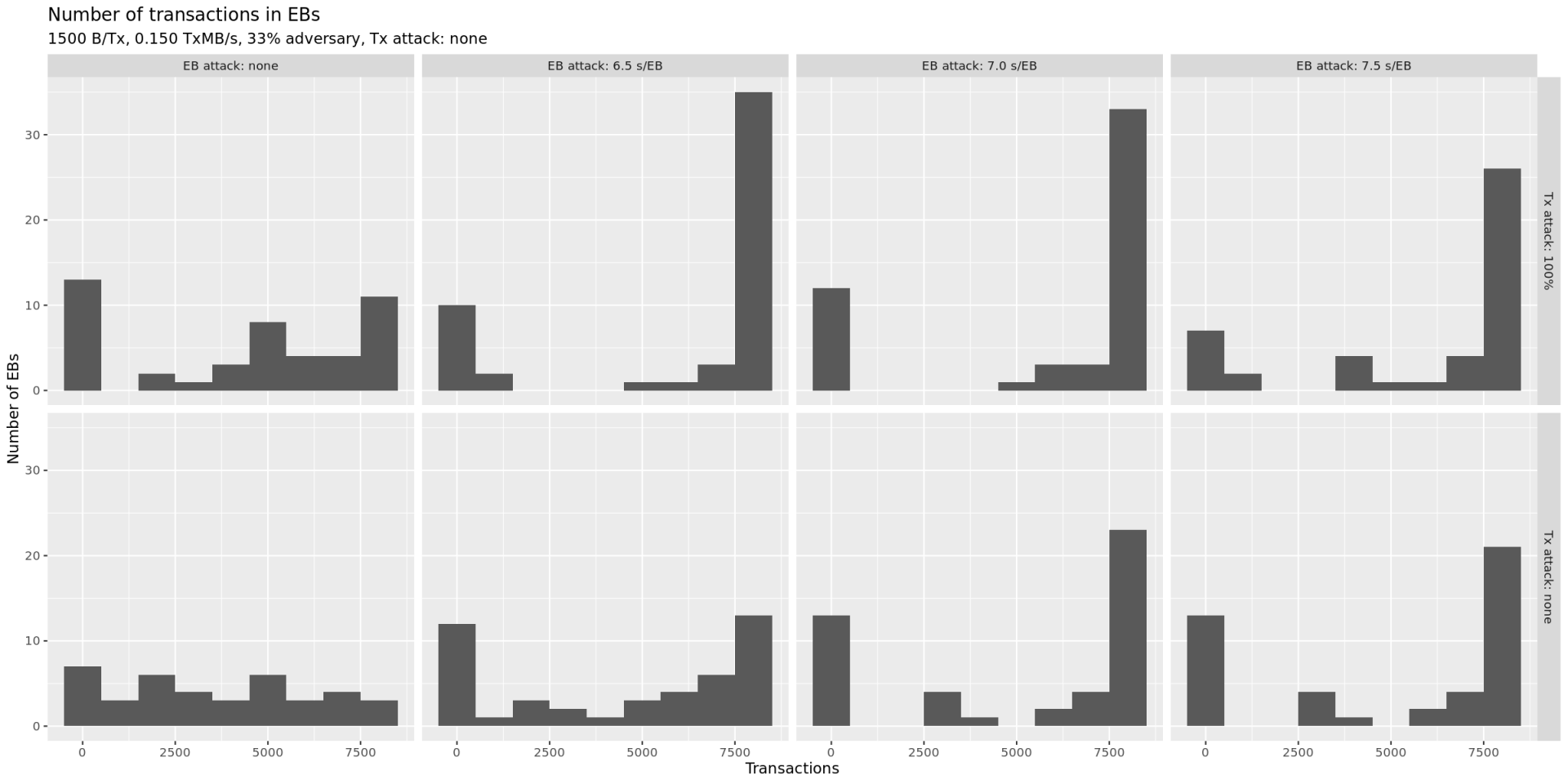

Peak nodal ingress
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Maximum network ingress among nodes [Mb/s]
Slot [s]
Message
EB
RB
TX
VT

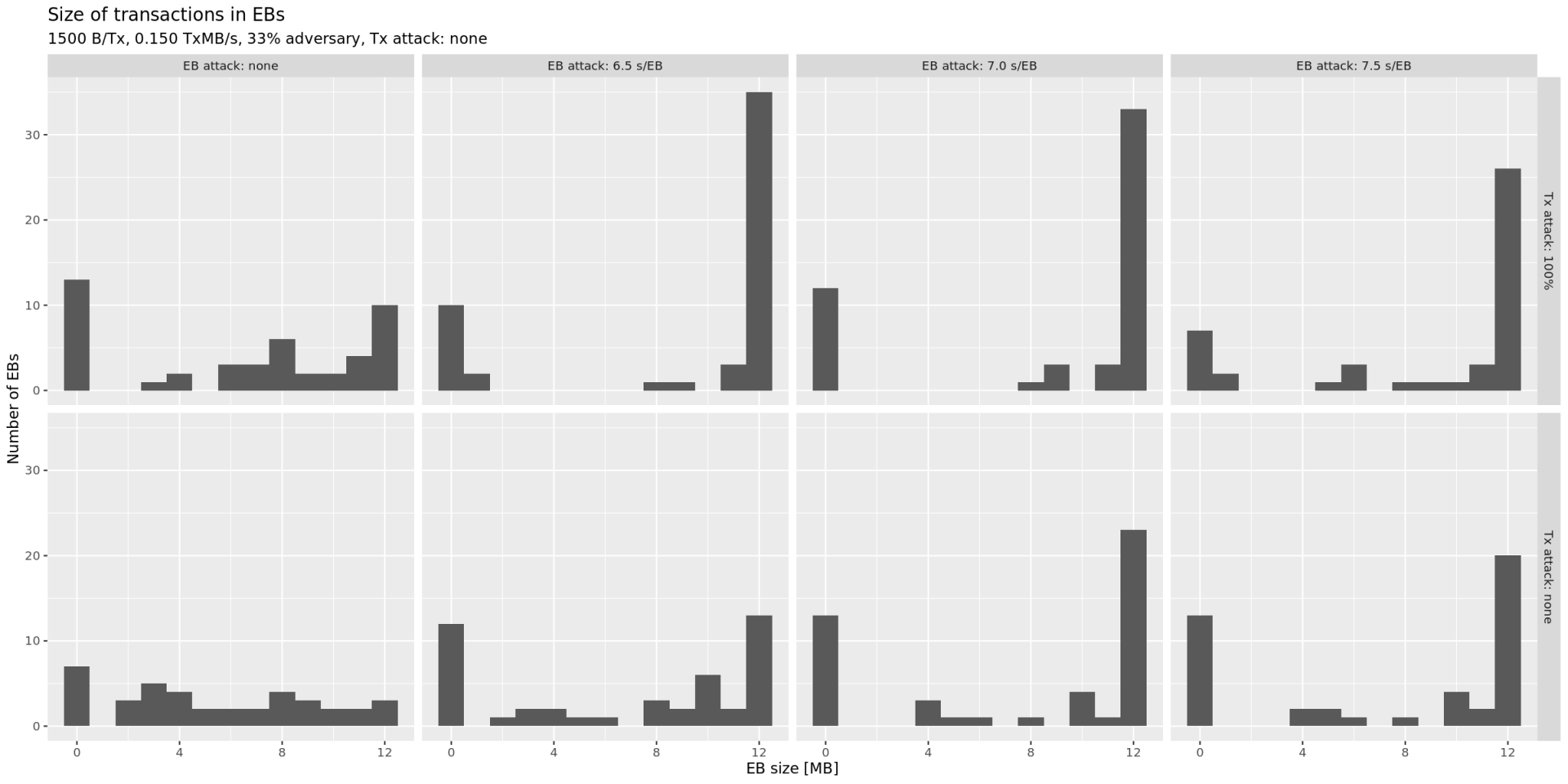

Peak CPU load among all nodes
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Number of slots
Peak CPU load [%]
0
100
200
300
400
500
0
25
50
75
100

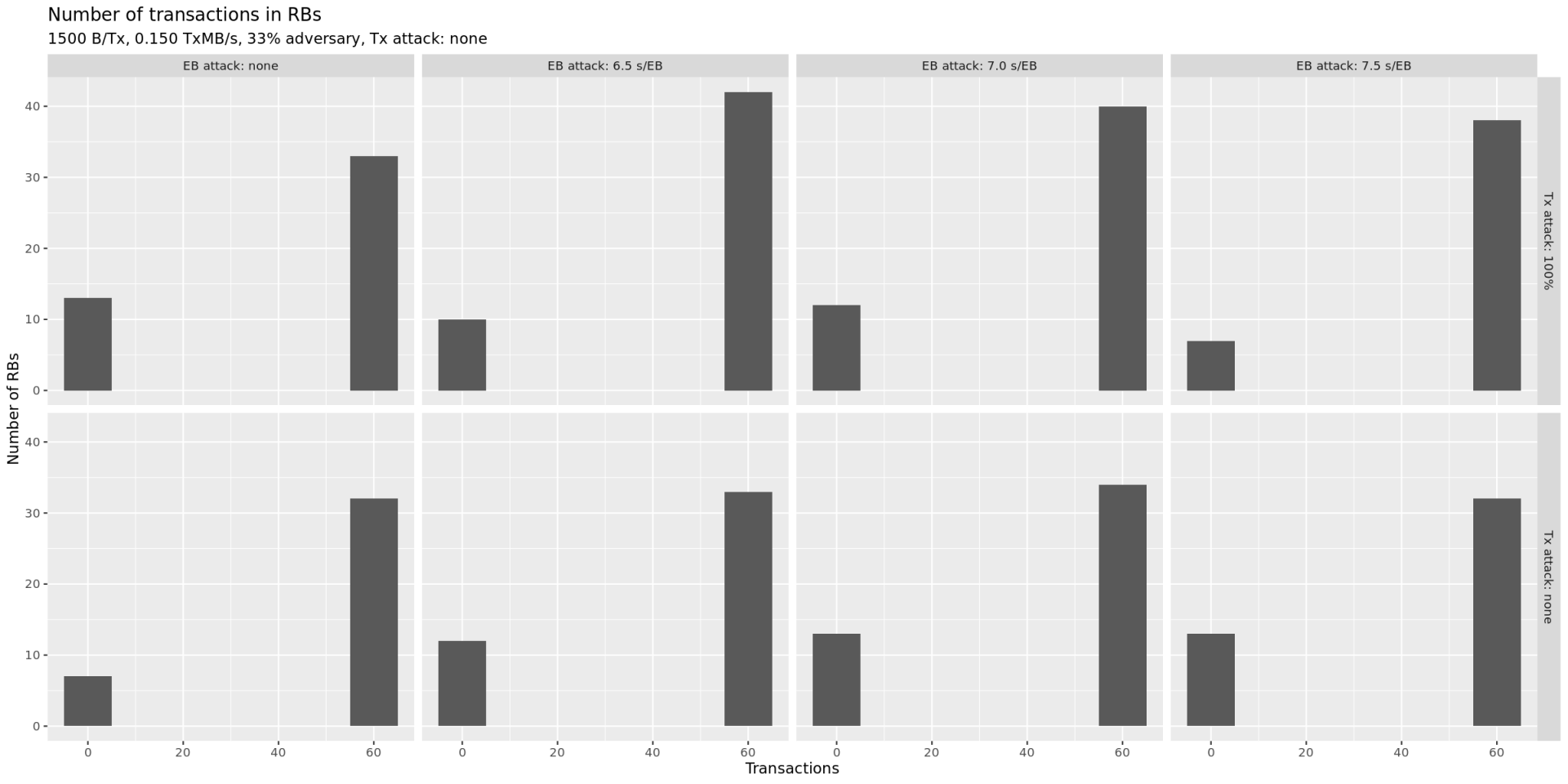

Mean CPU load among all nodes
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Mean CPU load [%]
0
50
100
150
200
0
250
500
750
Slot

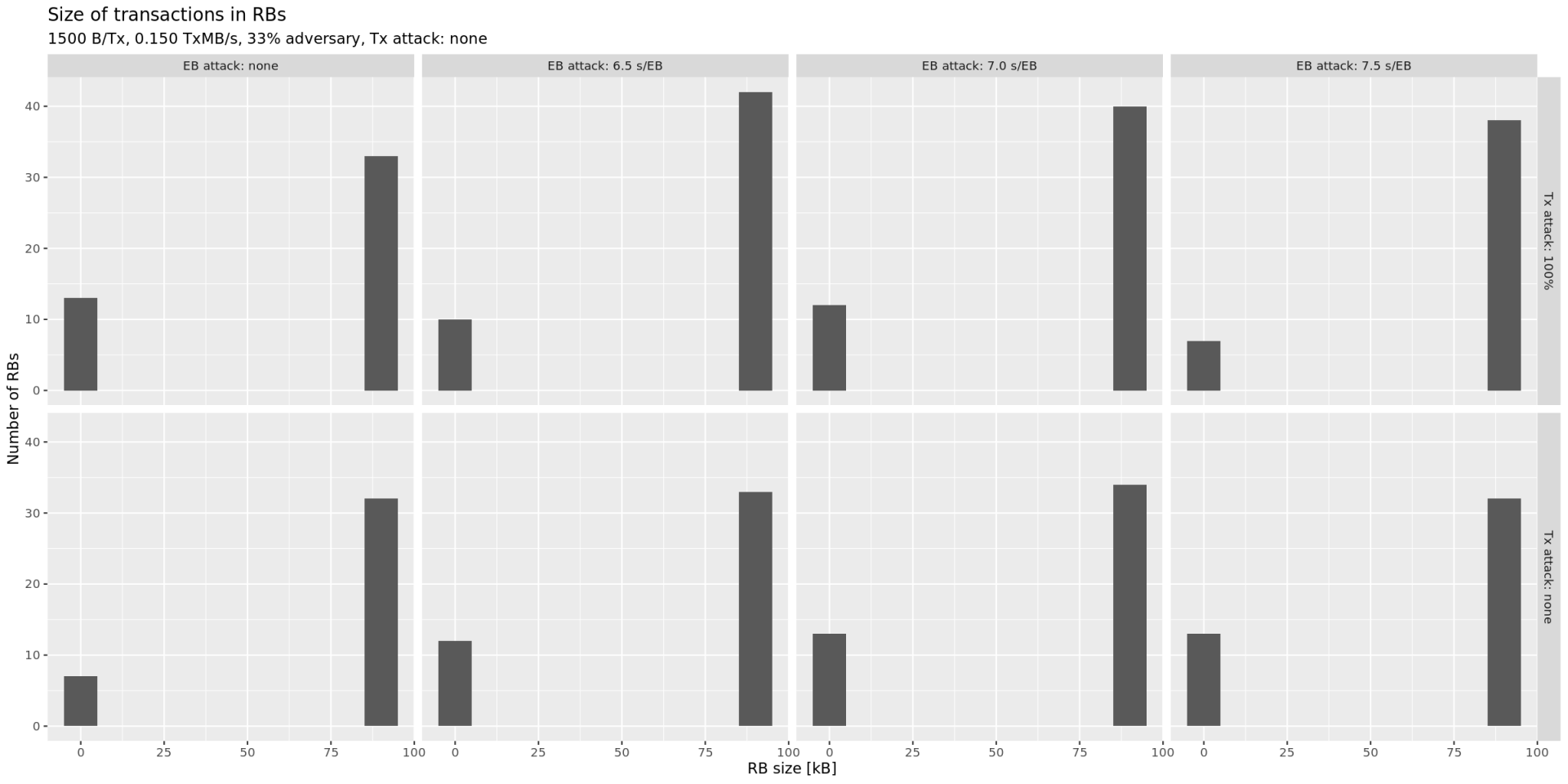

Mean CPU load among all nodes
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Mean CPU load [%]
0
3
6
9
12
Task
GenRB
GenVote
ValEB
ValEH
ValRB
ValRH
ValTX
ValVote

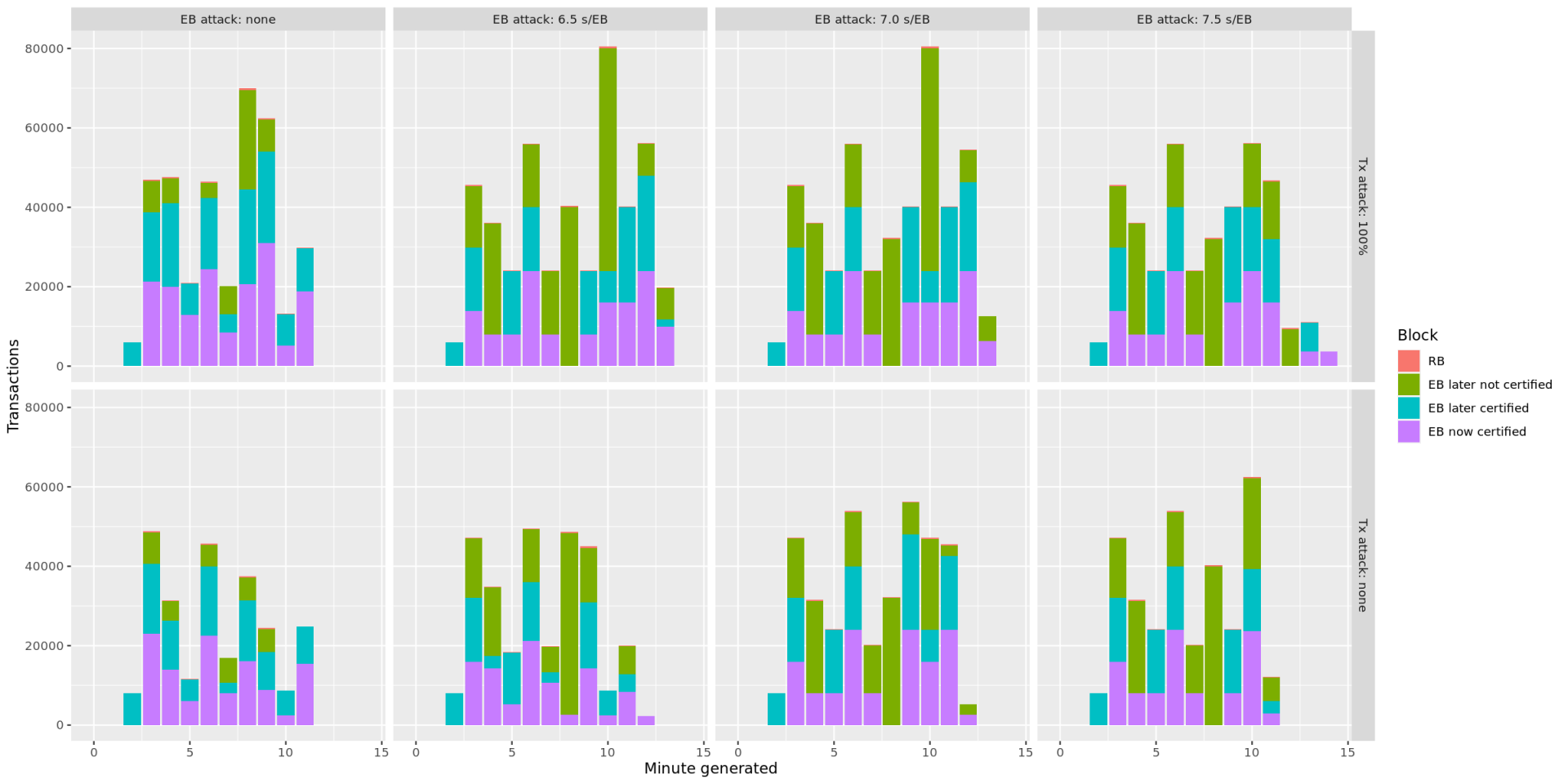

Mean CPU load among all nodes
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Mean CPU load [%]
Slot
Task
GenRB
GenVote
ValEB
ValEH
ValRB
ValRH
ValTX
ValVote

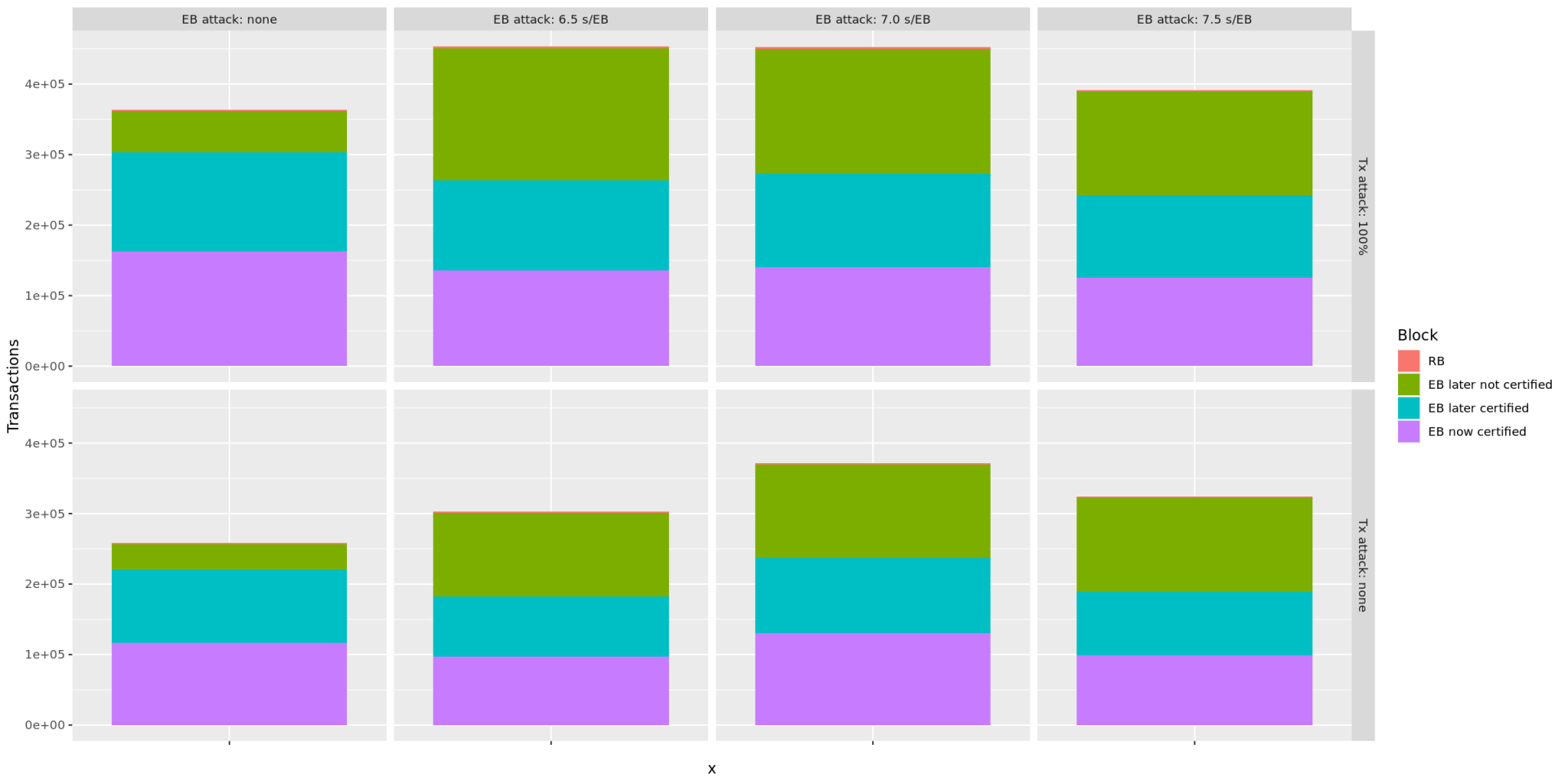

Number of transactions in EBs
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Number of EBs
Transactions
0
10
20
30
0
2500
5000
7500

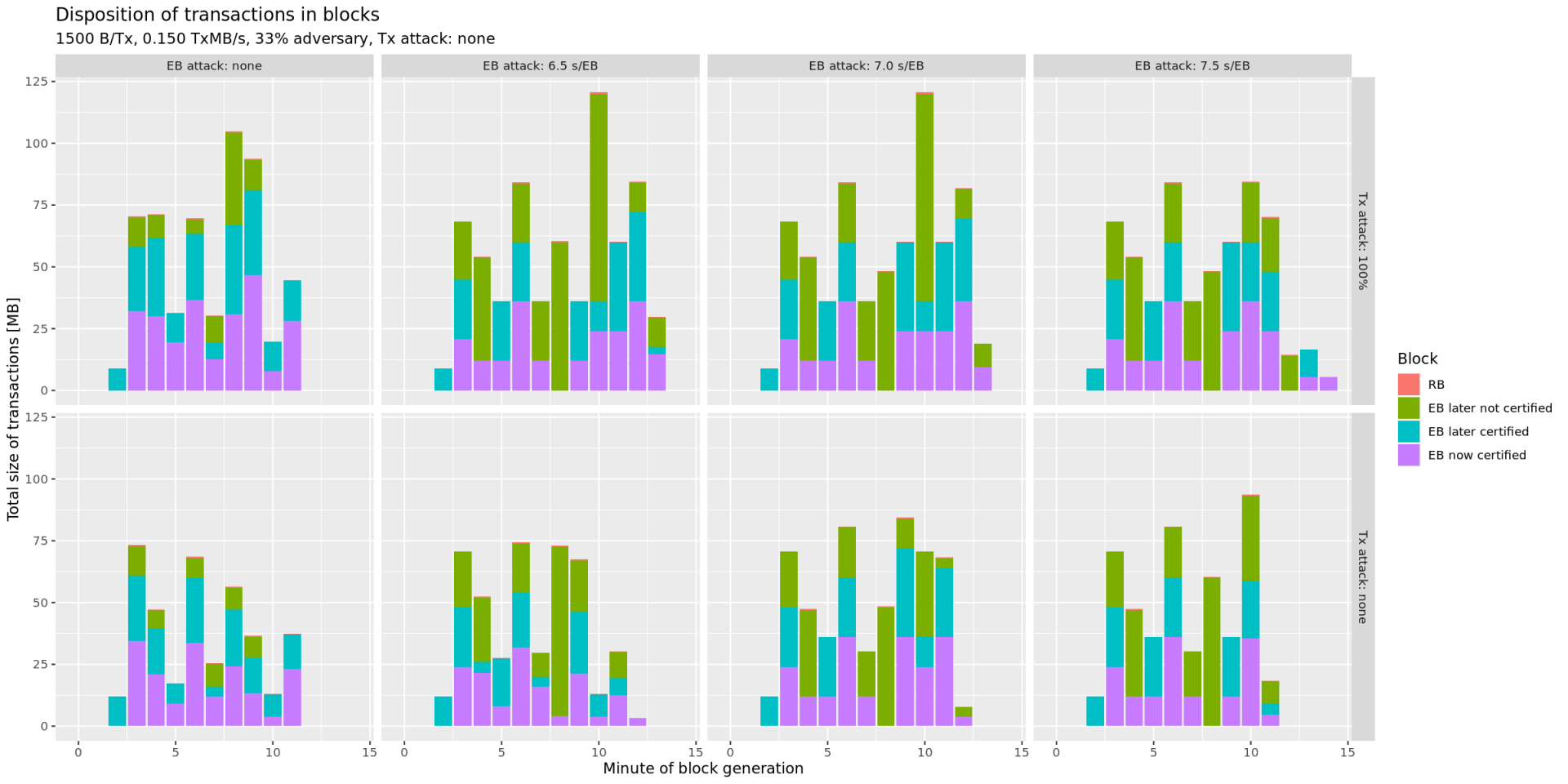

Size of transactions in EBs
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Number of EBs
EB size [MB]
0
10
20
30
0
4
8
12

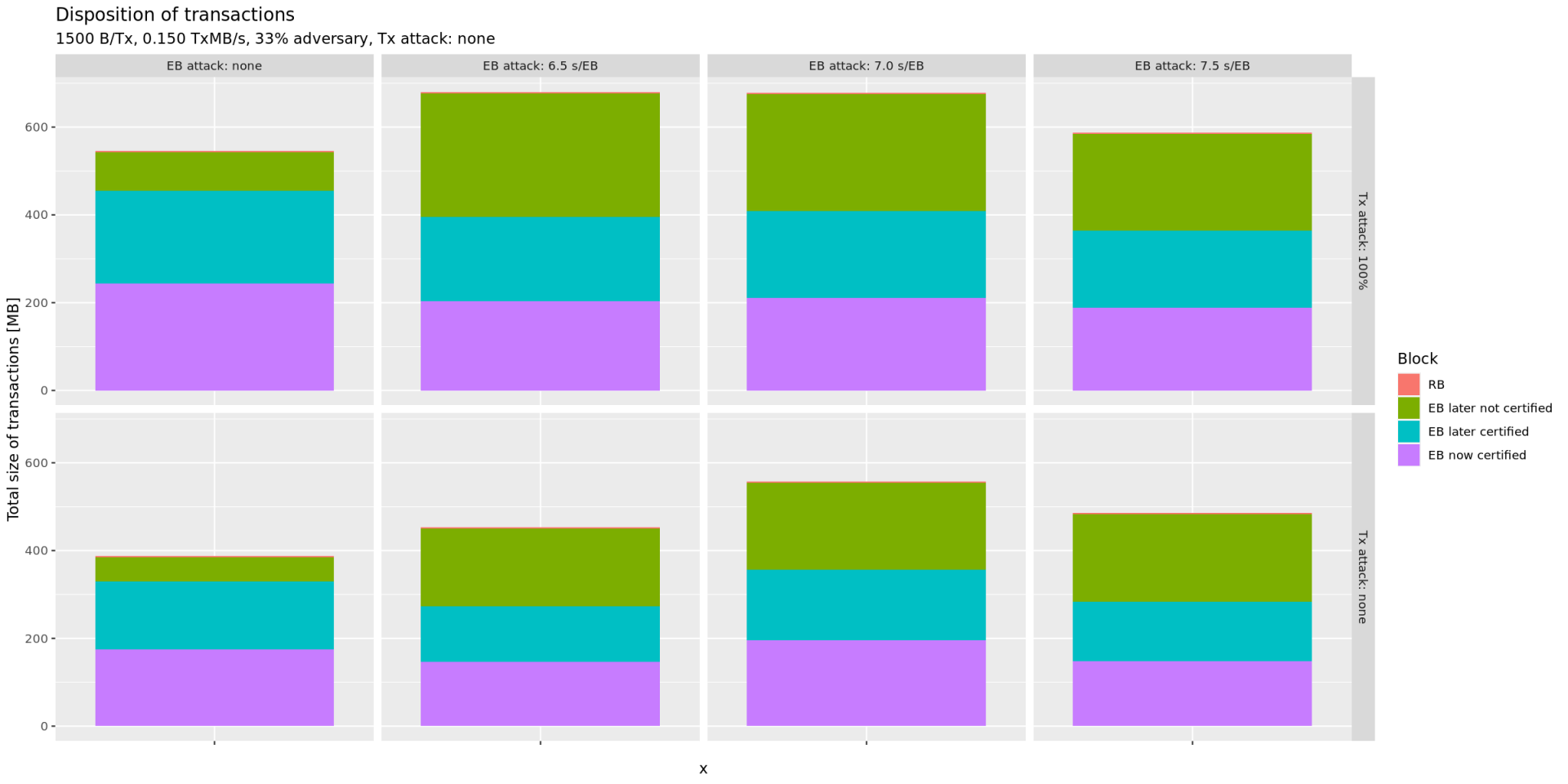

Number of transactions in RBs
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Number of RBs
Transactions
0
10
20
30
40
0
20
40
60


Size of transactions in RBs
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Number of RBs
RB size [kB]
0
10
20
30
40
0
25
50
75
100


EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Transactions
Minute generated
Block
RB
EB later not certified
EB later certified
EB now certified


EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Transactions
0e+00
1e+05
2e+05
3e+05
4e+05
x
Block
RB
EB later not certified
EB later certified
EB now certified


Disposition of transactions in blocks
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Total size of transactions [MB]
Minute of block generation
Block
RB
EB later not certified
EB later certified
EB now certified


Disposition of transactions
1500 B/Tx, 0.150 TxMB/s, 33% adversary, Tx attack: none
EB attack: none
EB attack: 6.5 s/EB
EB attack: 7.0 s/EB
EB attack: 7.5 s/EB
Tx attack: 100%
Tx attack: none
Total size of transactions [MB]
0
200
400
600
x
Block
RB
EB later not certified
EB later certified
EB now certified