

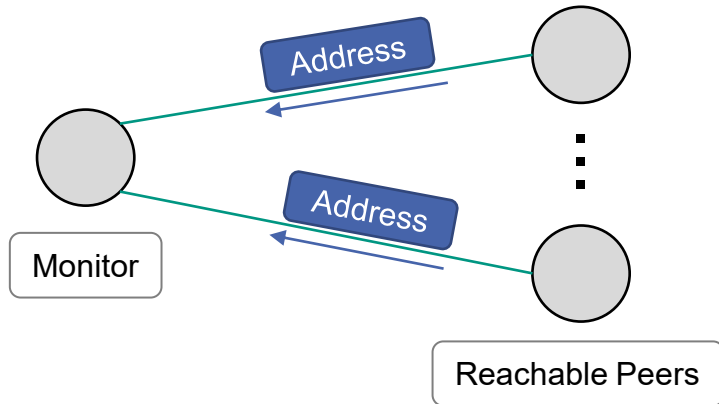
# On the Peer Degree Distribution of the Bitcoin P2P Network

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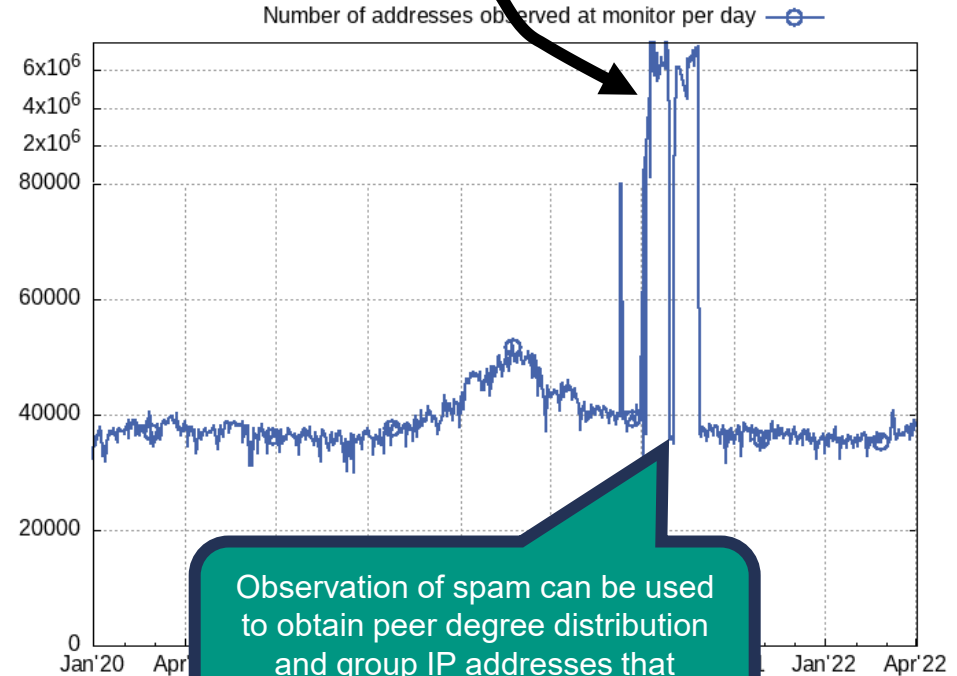


# Address Spam in the Bitcoin P2P Network

We run a monitor node that is connected to all reachable peers in the Bitcoin P2P Network



*Spam of bogus addresses*



Observation of spam can be used to obtain peer degree distribution and group IP addresses that belong to the same peer

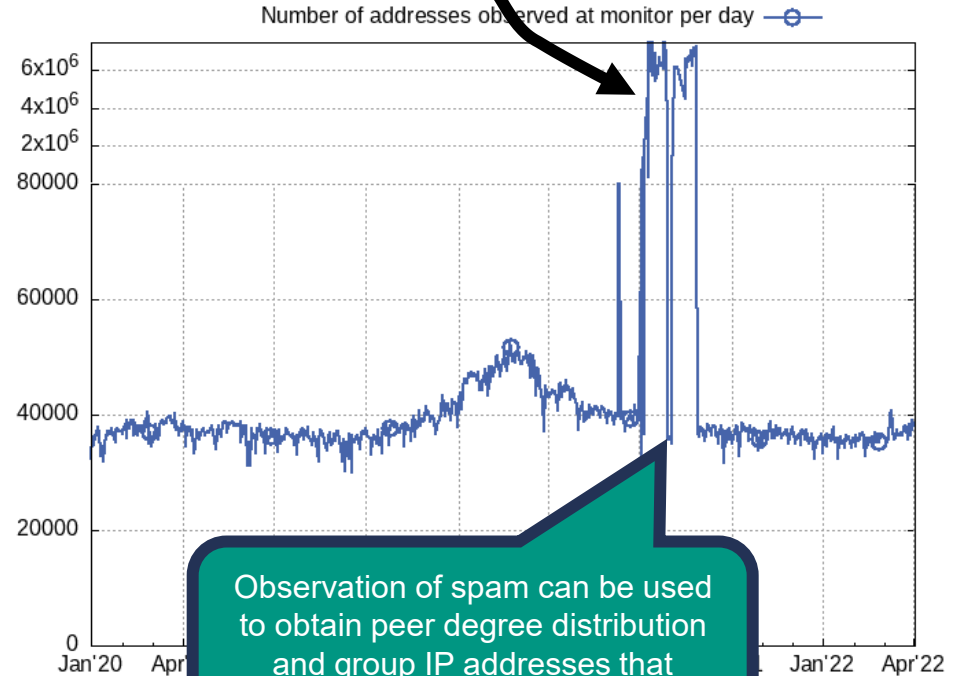
# Overview

1. Peer Degree Distribution

2. Count of Reachable Peers

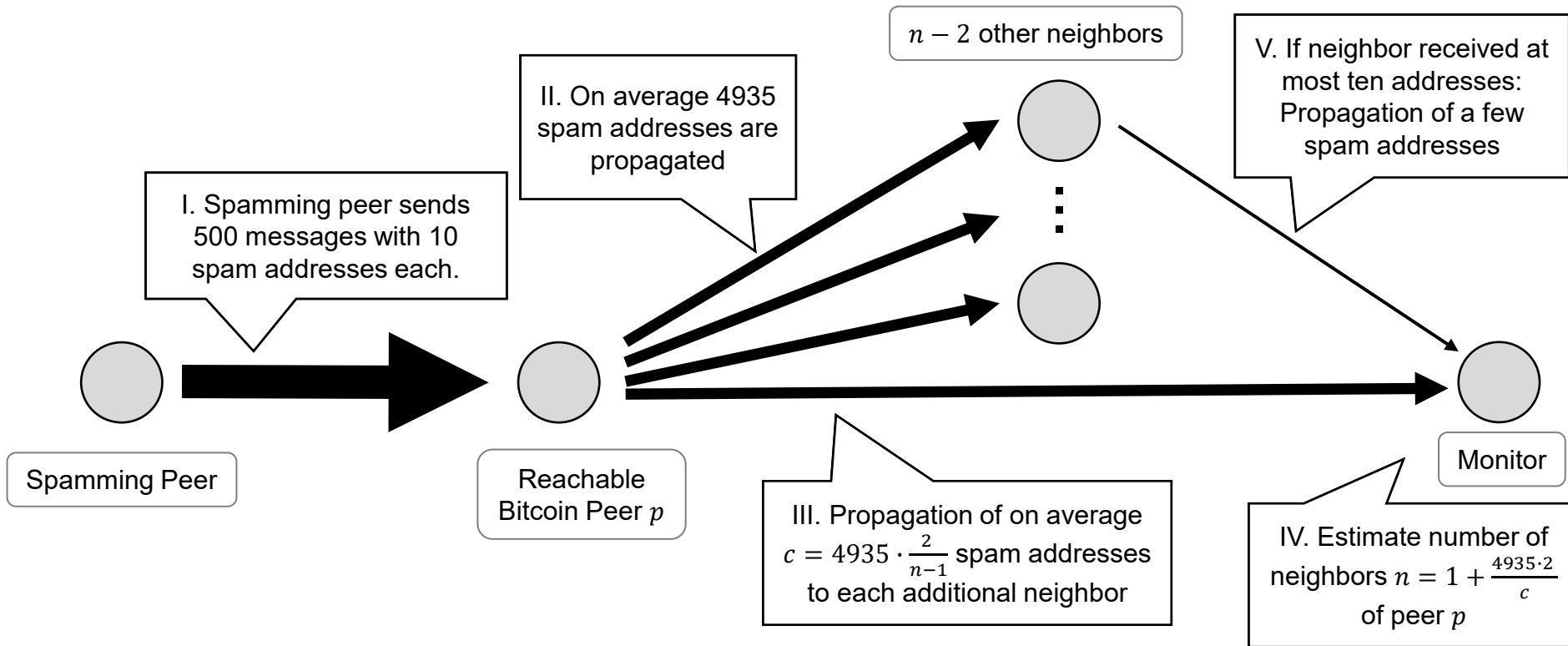
3. Model for Allocation of Connection Slots

*Spam of bogus addresses*

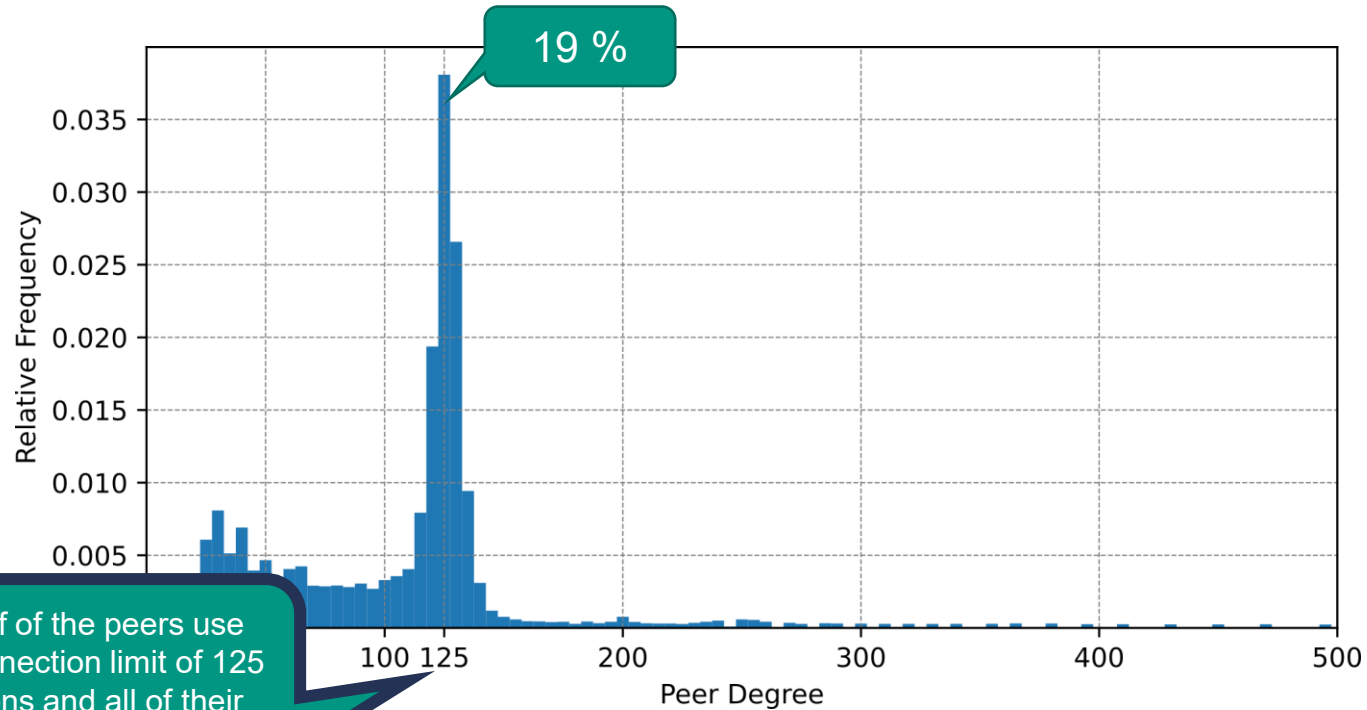


Observation of spam can be used to obtain peer degree distribution and group IP addresses that belong to the same peer

# Estimating Peer Degree from Observed Spam



# Peer Degree Distribution



About half of the peers use default connection limit of 125 connections and all of their connection slots are filled

# Available Slots for Incoming Connections

Hypothesis:

About half of the peers are close to their connection limit

Experiment:

Open up to five connections to each known peer and check whether the connections are closed

Result:

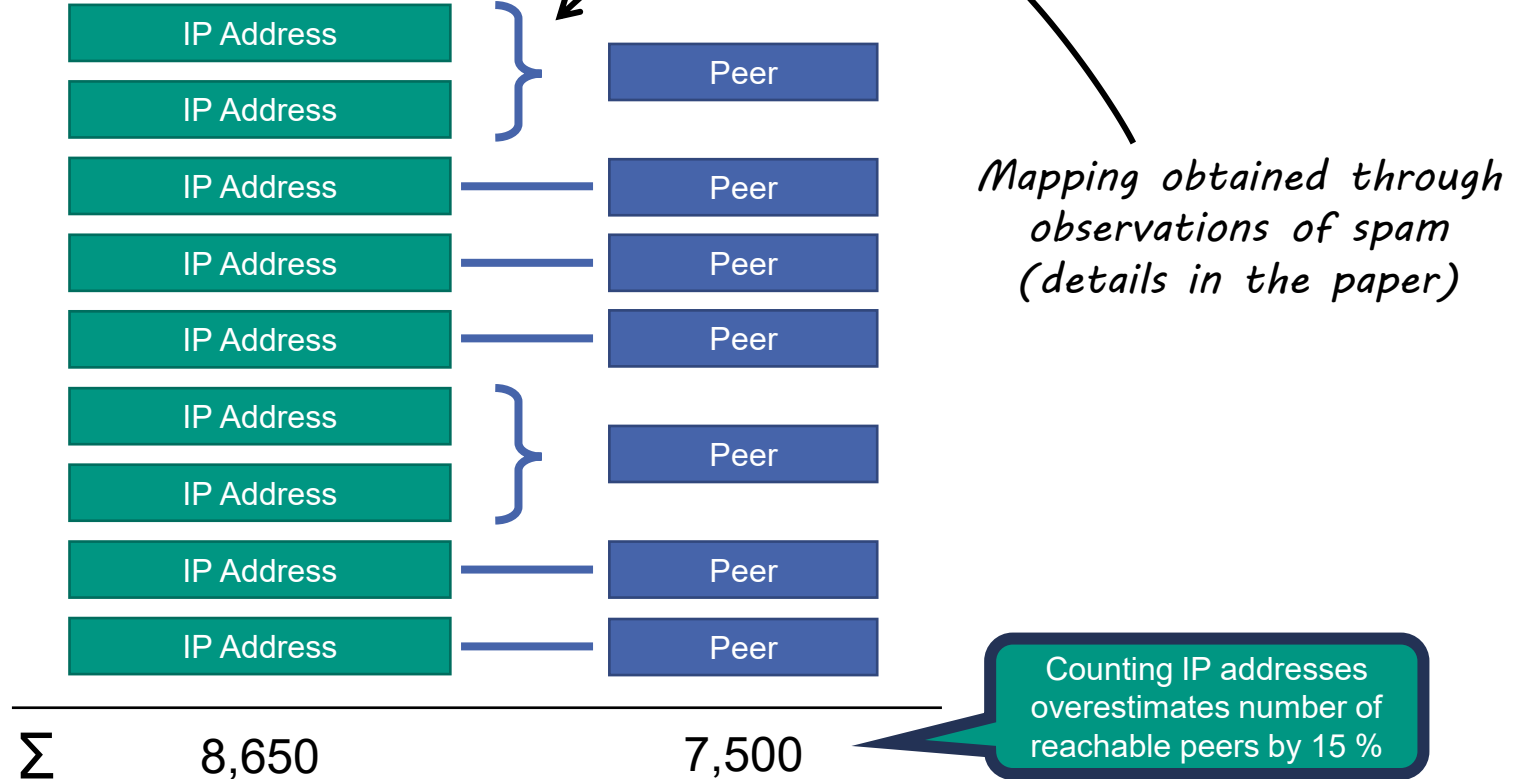
4,493 (47 %) peers accepted all five incoming connections  
2,360 (25 %) peers accepted the first connection but not all five connections  
2,608 (28%) peers directly closed the first connection

Conclusion:

Hypothesis confirmed



# Counting Reachable Peers



# Model of Allocated Connection Slots

Assumption:  
7,500 reachable peers with a  
connection limit of 125 connections

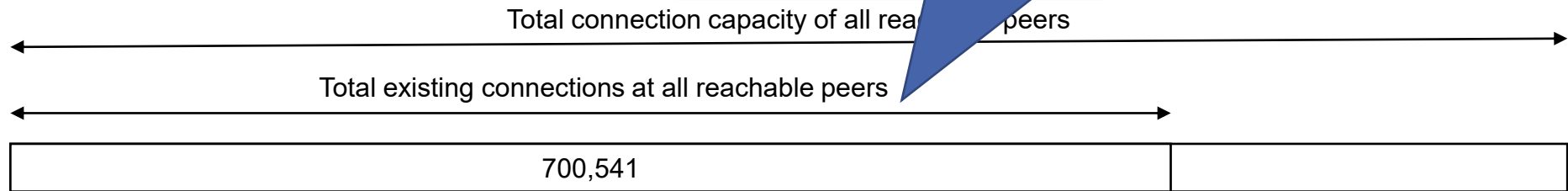
Total connection capacity of all reachable peers

$$7,500 \cdot 125 = 937,500$$



# Model of Allocated Connection Slots

Assumption:  
7,500 reachable peers with  
degrees distributed according to  
measured degree distribution



# Model of Allocated Connection Slots

Assumption:  
7,500 reachable peers  
10 outgoing connections each

Total connection capacity of all reachable peers

Total existing connections at all reachable peers

75,000

700,541

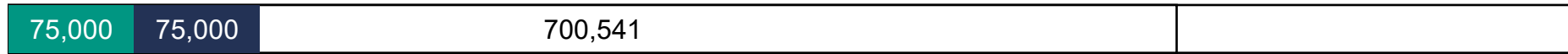
Outgoing  
connections of  
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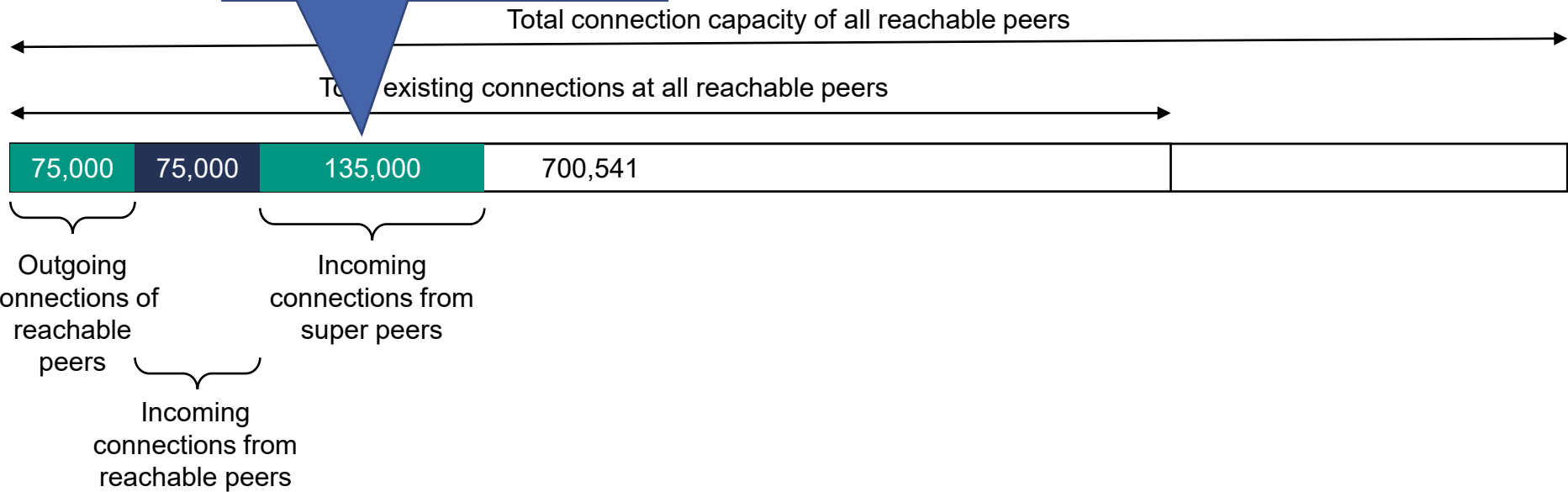


Outgoing connections of reachable peers

Incoming connections from reachable peers

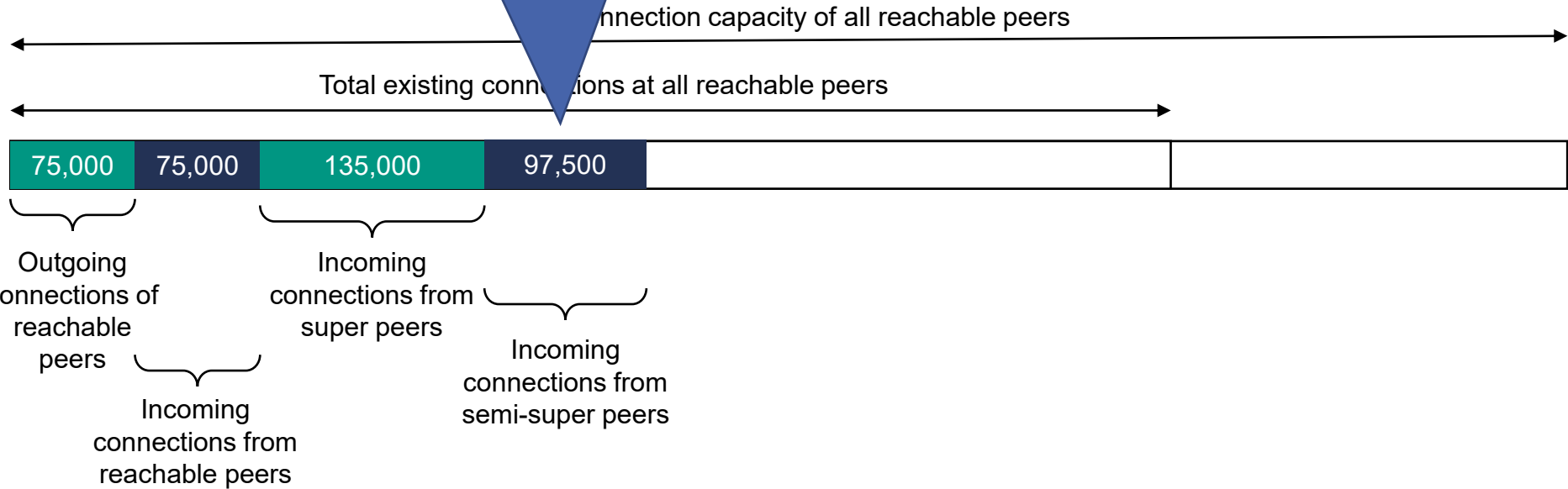
# Model of Allocated Connection Slots

Assumption:  
18 super peers with outgoing connections to all reachable peers

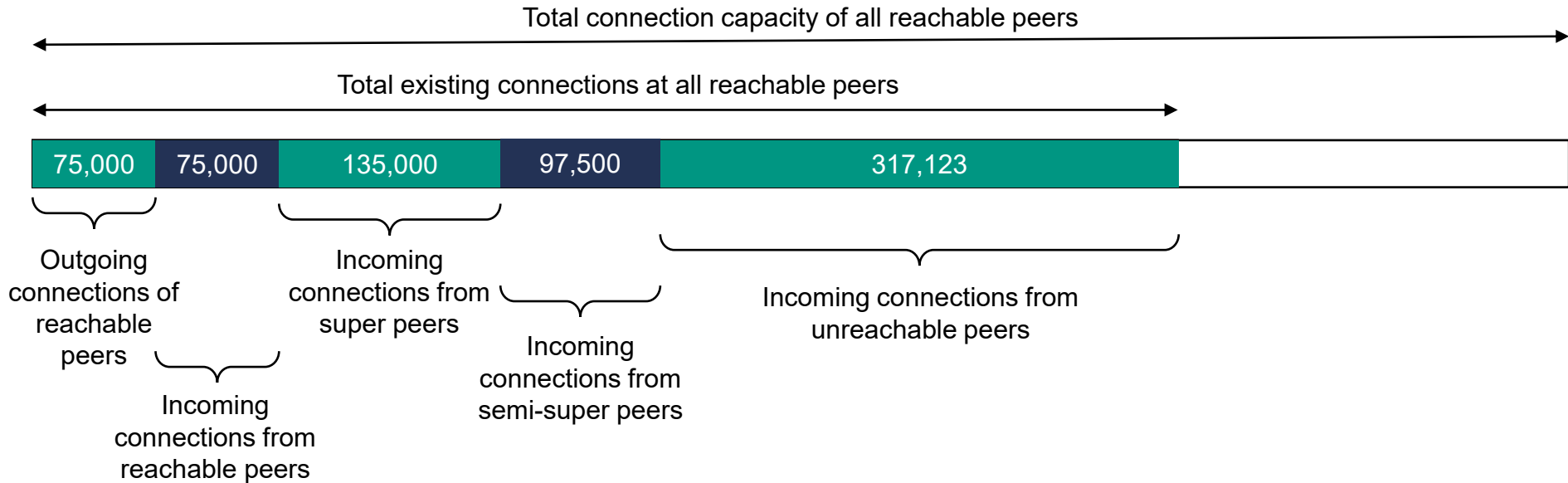


# Model of Allocated Connection Slots

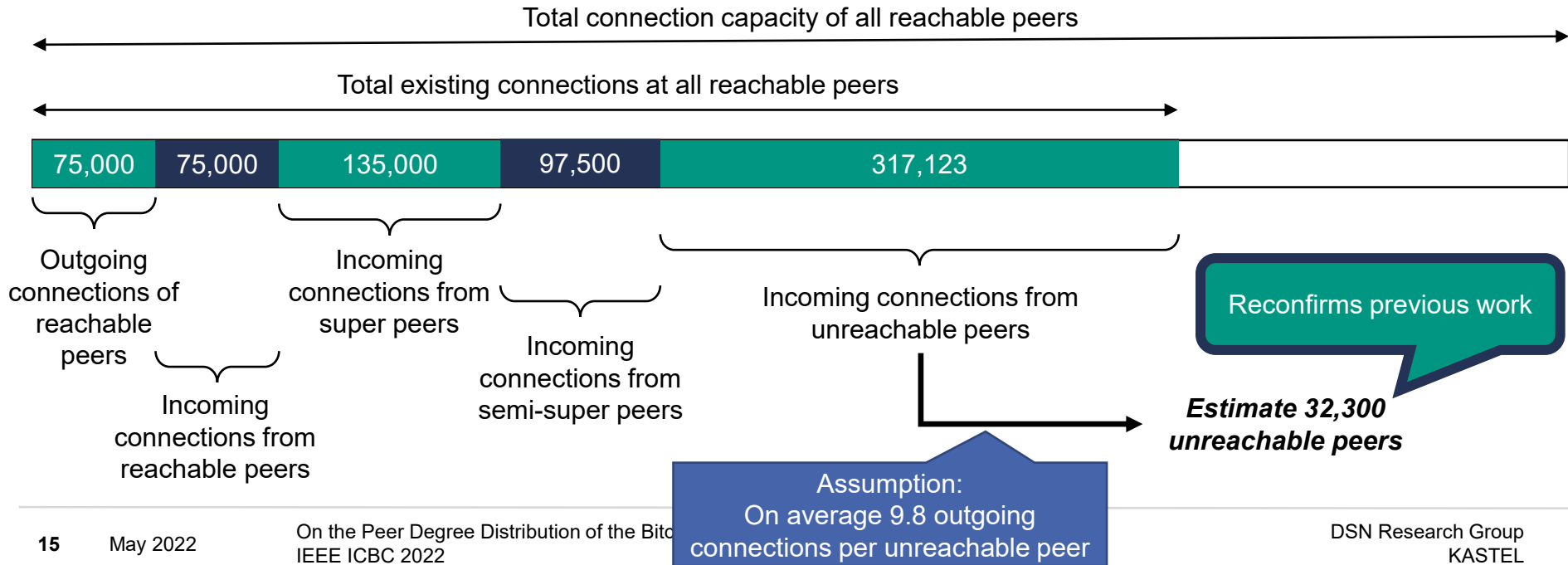
Assumption:  
26 semi-super peers with outgoing connections to half of the reachable peers



# Model of Allocated Connection Slots

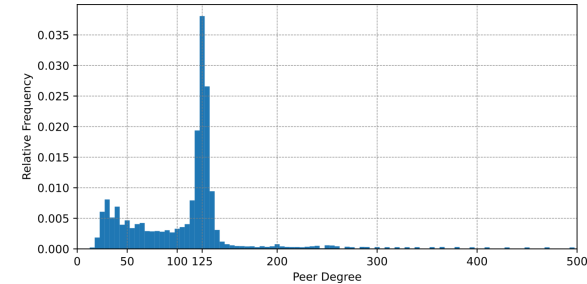


# Model of Allocated Connection Slots



# Conclusion

- Peer degree distribution of the Bitcoin P2P network obtained by observation of spam of addresses
  - About half of the reachable peers are close to their connection limit.
- Counting reachable IP addresses overestimates the number of reachable peers by 15 %.
- Rate-limiting of address propagation implemented in Bitcoin Core impedes future spam.



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