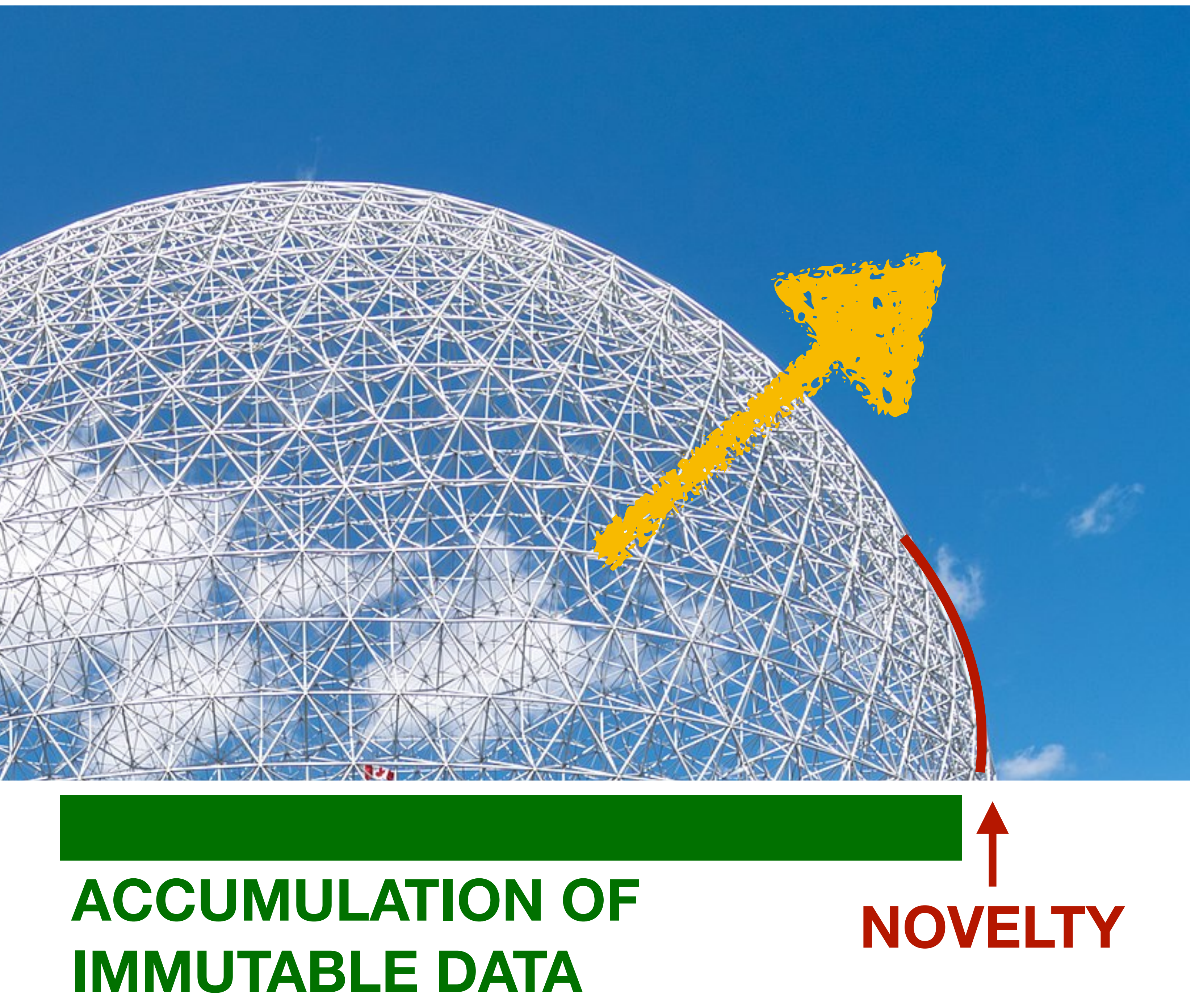
Push it - update 2: a P2P protocol for Append-Only Push (AOP)

Christian Tschudin, U of Basel, Switzerland

ICNRG interim meeting in Macao, China
September 27, 2019

Context



- Accumulative information, items typically named by some hash
- Global broadcast-only semantics:
  novelty is replicated everywhere, eventually
- History:
  - Sep 2018 / panel at ICN18
  - Mar 2019 / ICNRG Prague: broadcast-only
  - Jul 2019 / ICNRG Montreal, update 1:
    problems of pull (e.g., “recursion corridor”)
- Today’s update 2: zoom-in to the protocol level

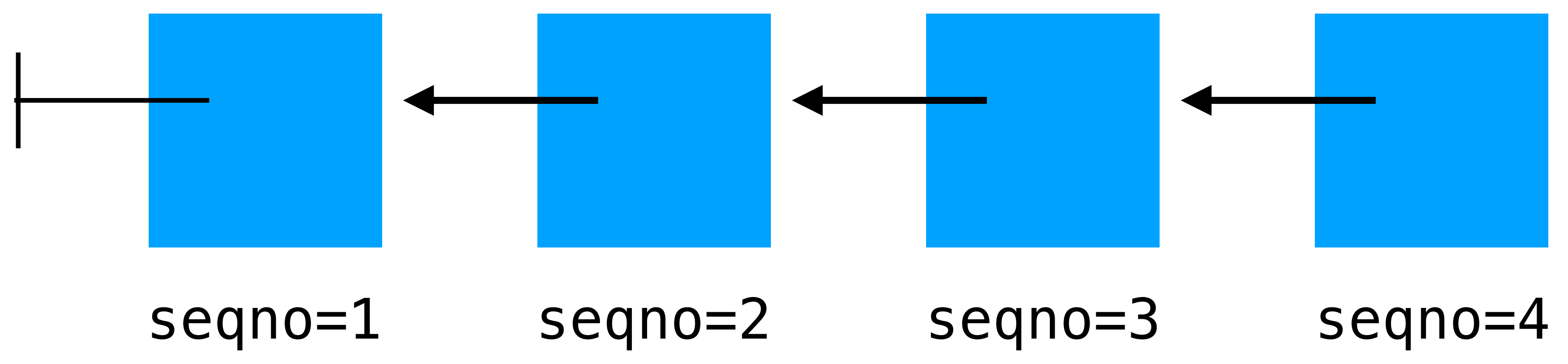
Overview

1) Append-only logs (SSB fame)

- Producer ID
  = public key of a key pair

- Append-only log
  = hash chain of signed events

- Task of the replication layer:
  - propagate **novelty** unconditionally
  - often called "push"



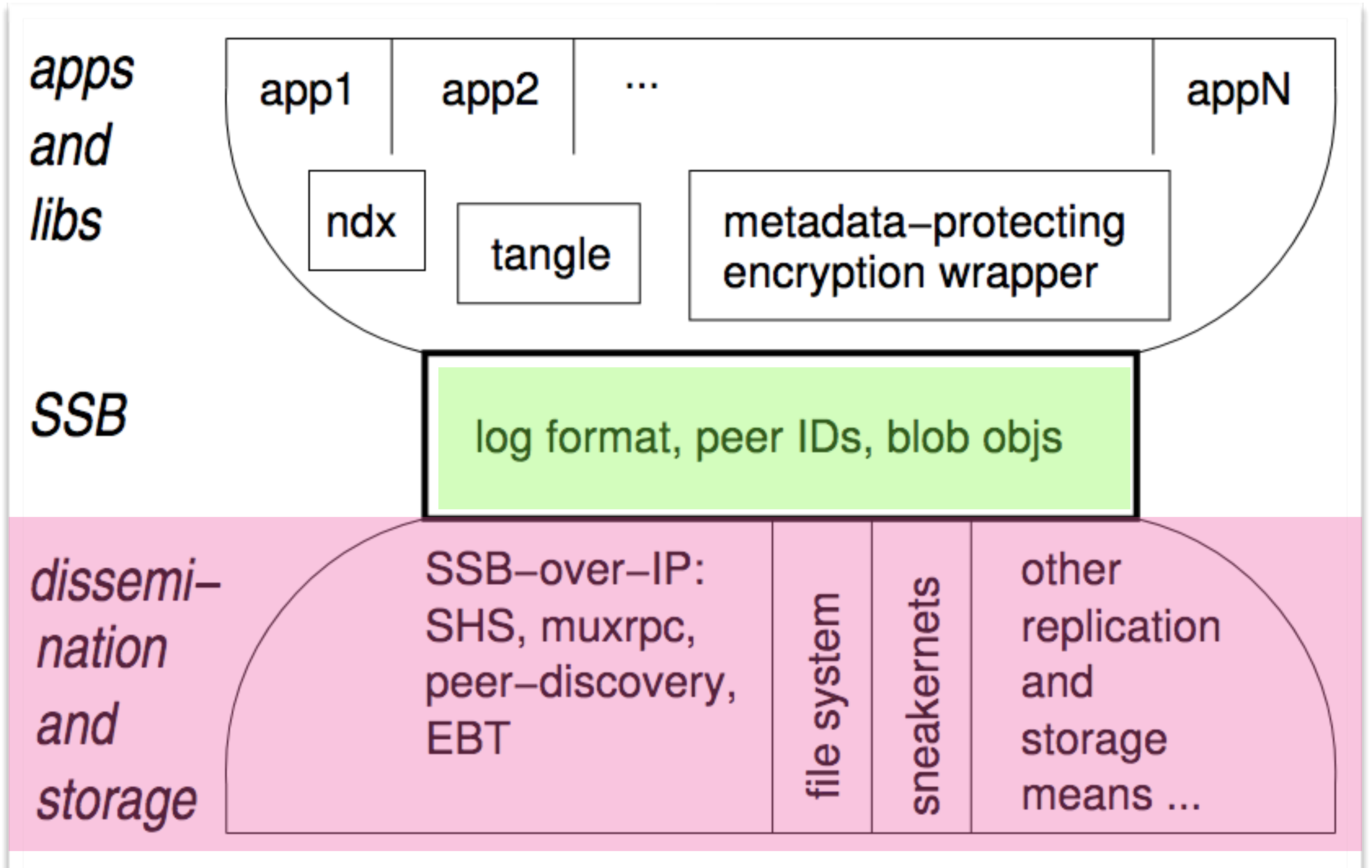
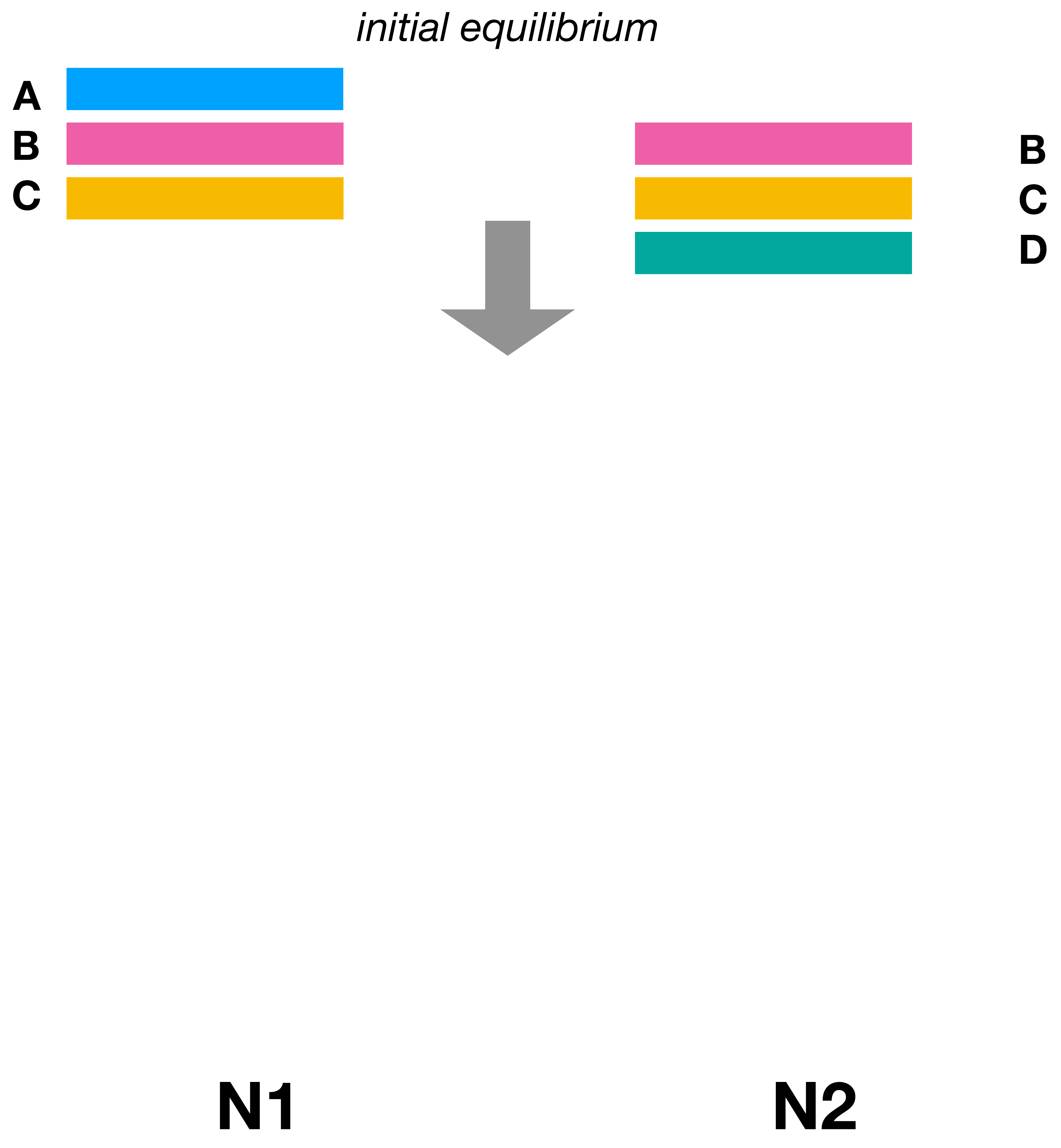

apps and libs
app1
app2
...
appN
ndx
tangle
metadata–protecting encryption wrapper
SSB
log format, peer IDs, blob objs
dissemi–nation and storage
SSB–over–IP: SHS, muxrpc, peer–discovery, EBT
file system
sneakernets
other replication and storage means ...

Figure 2: Secure Scuttlebutt's protocol stack.

1’) Append-Only logs

Given: Two nodes N1 and N2
with their sets of logs

Replication task when N1 and N2 peer:



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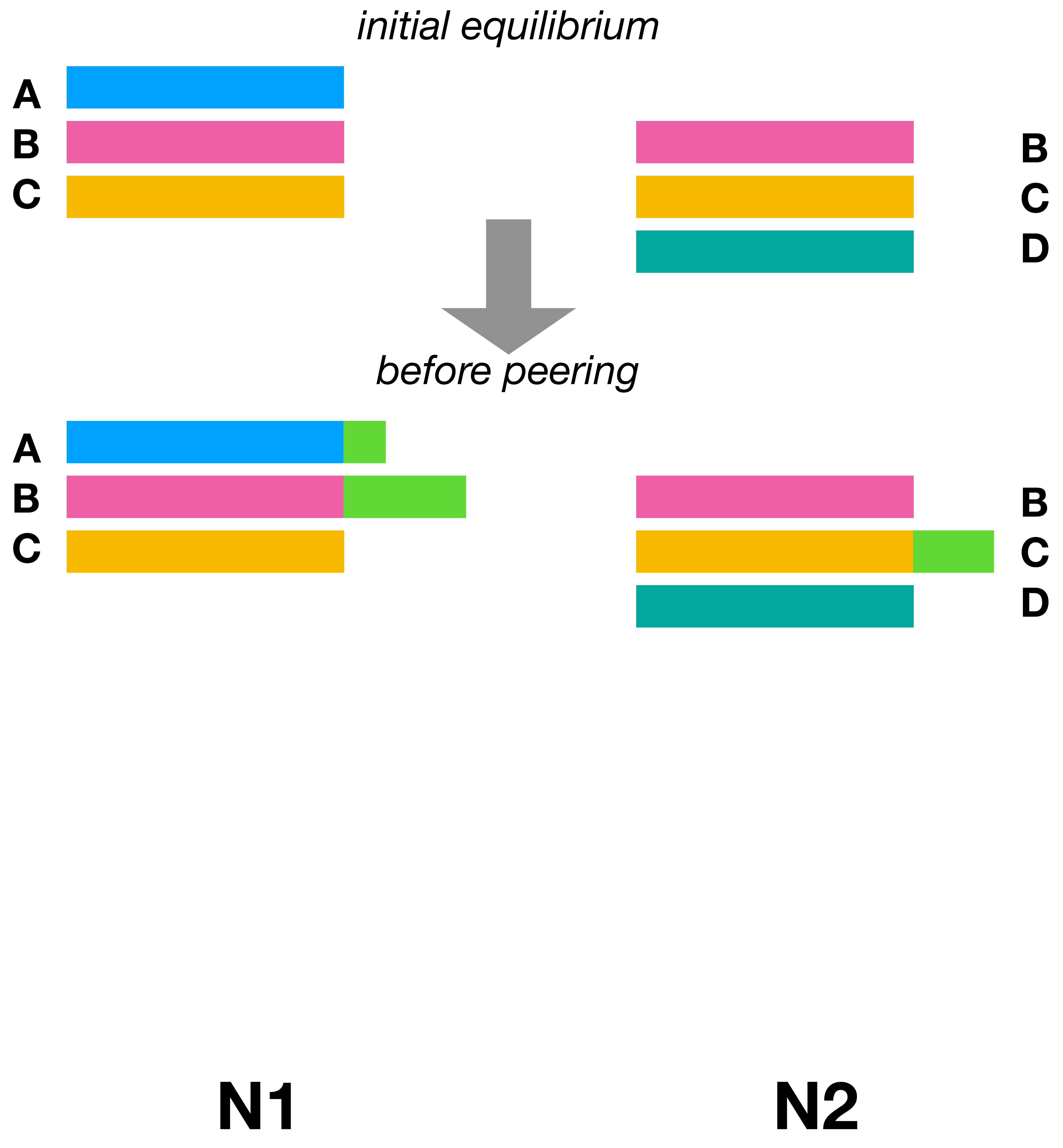

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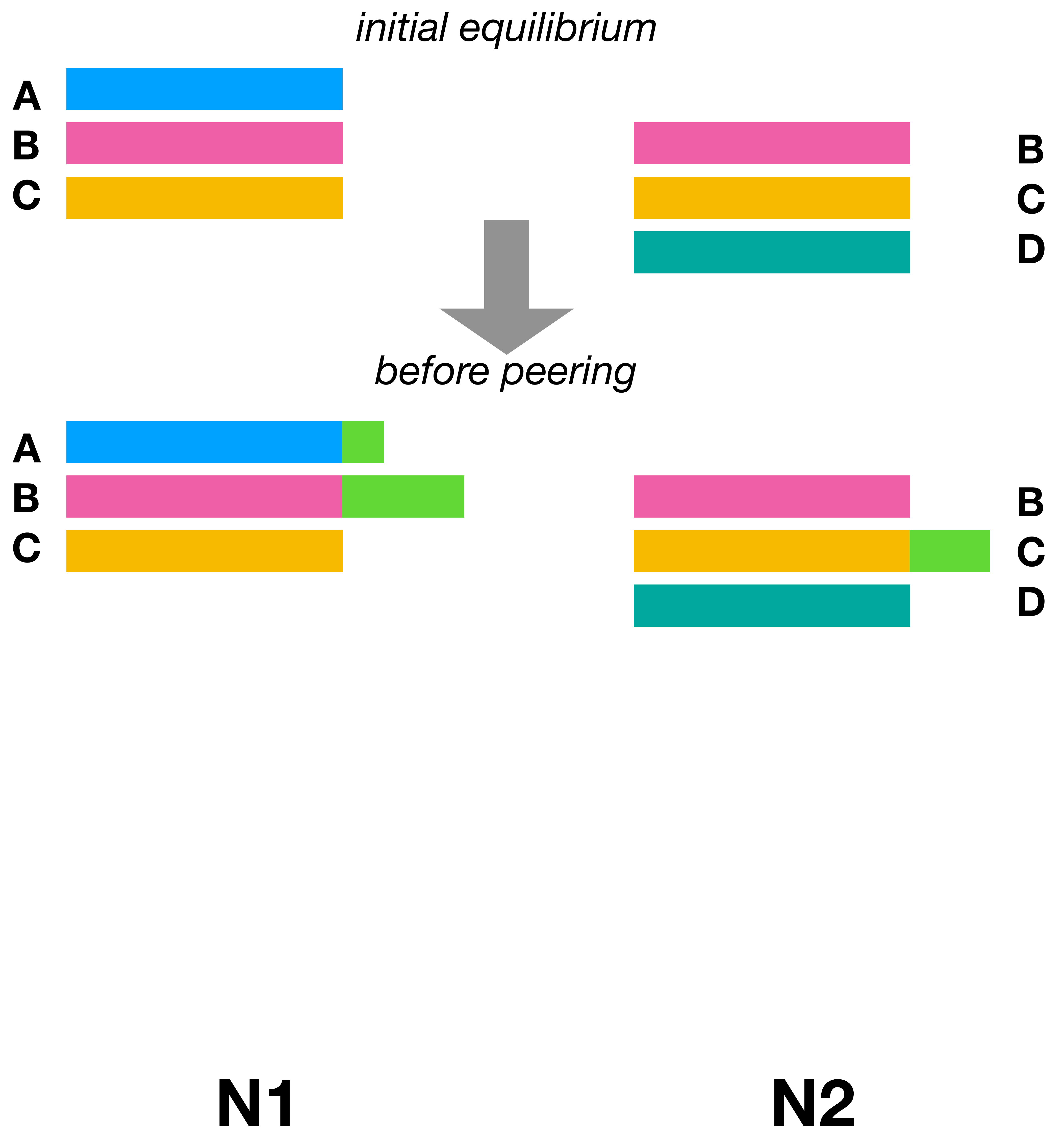

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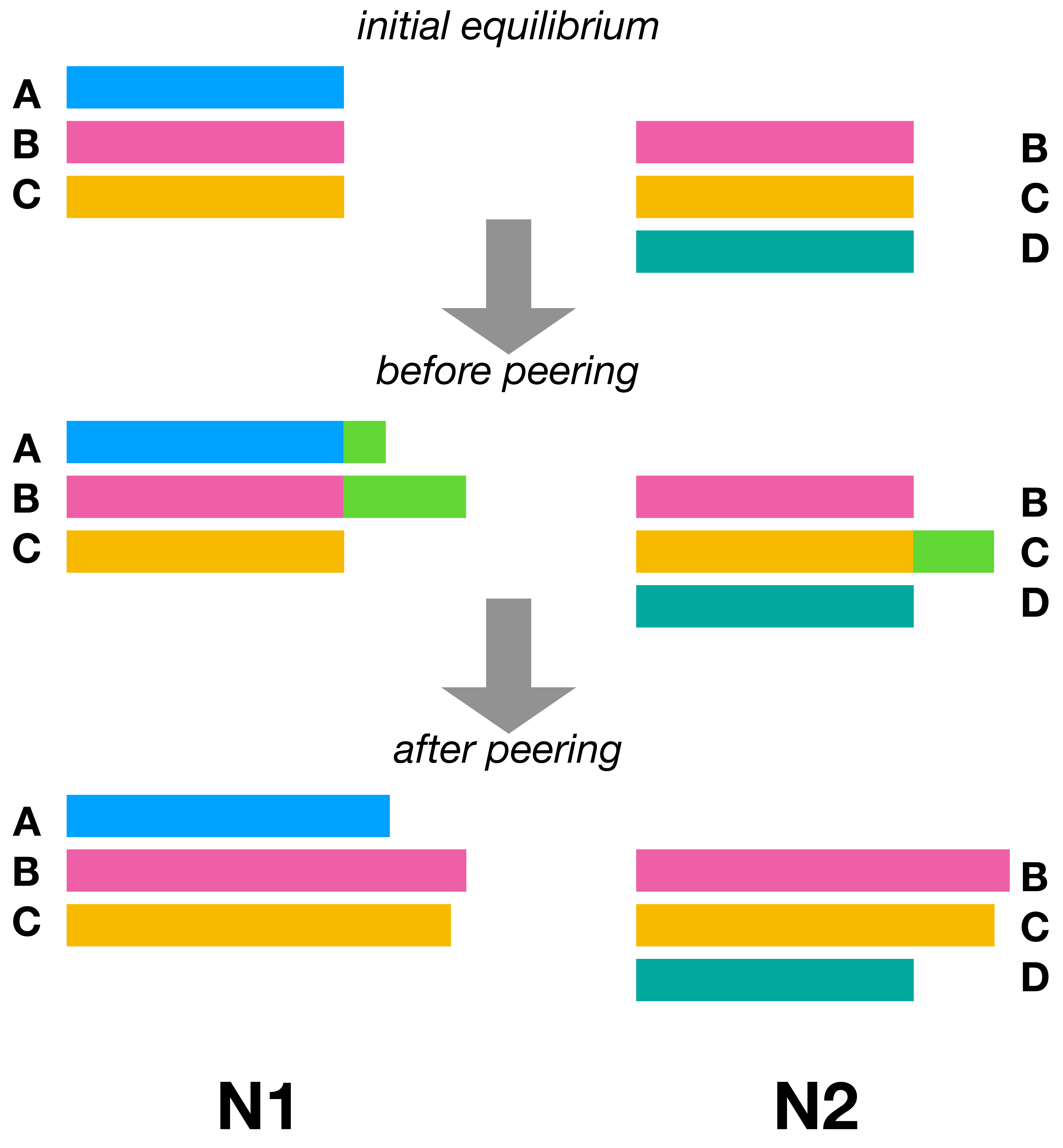

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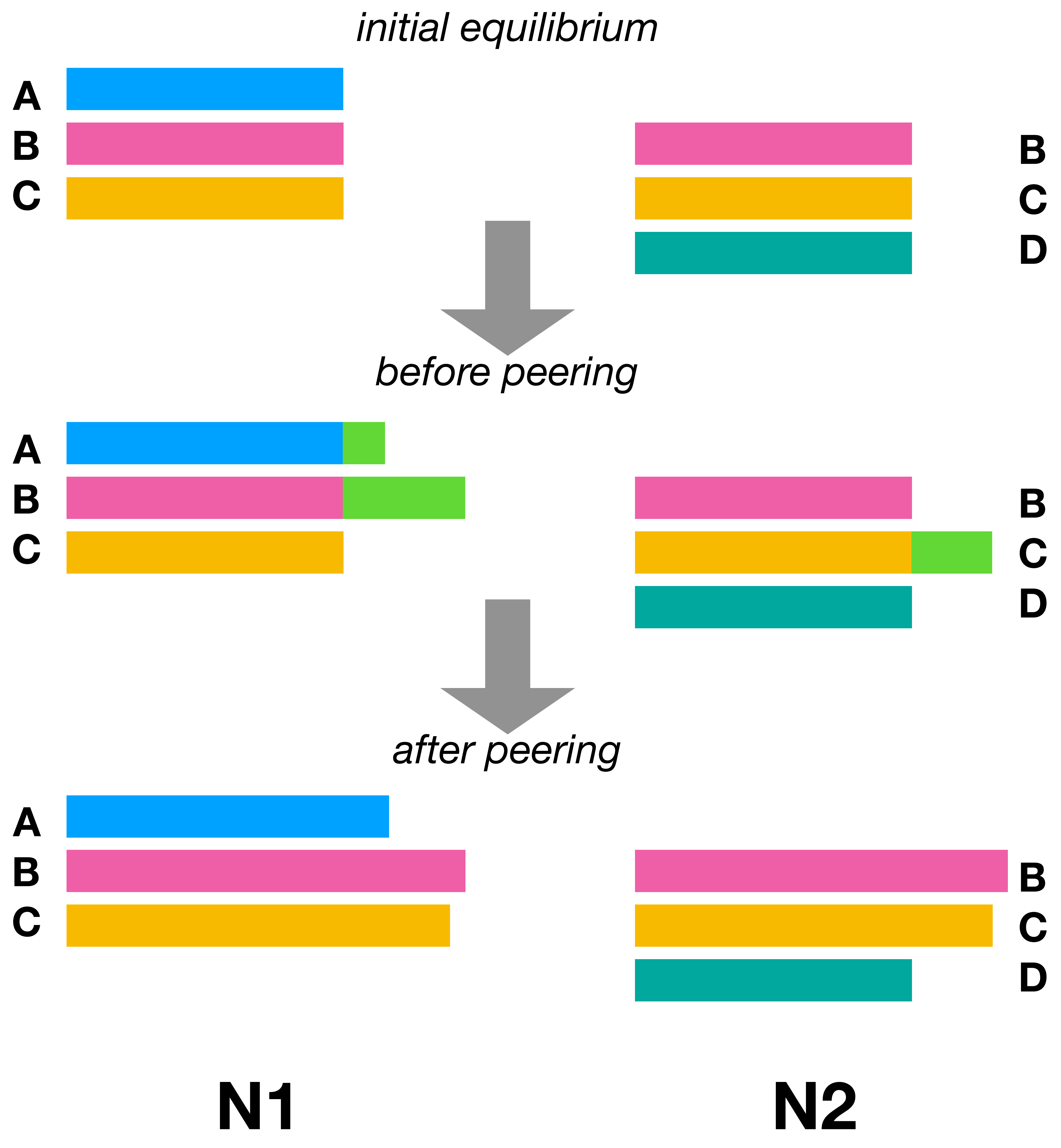
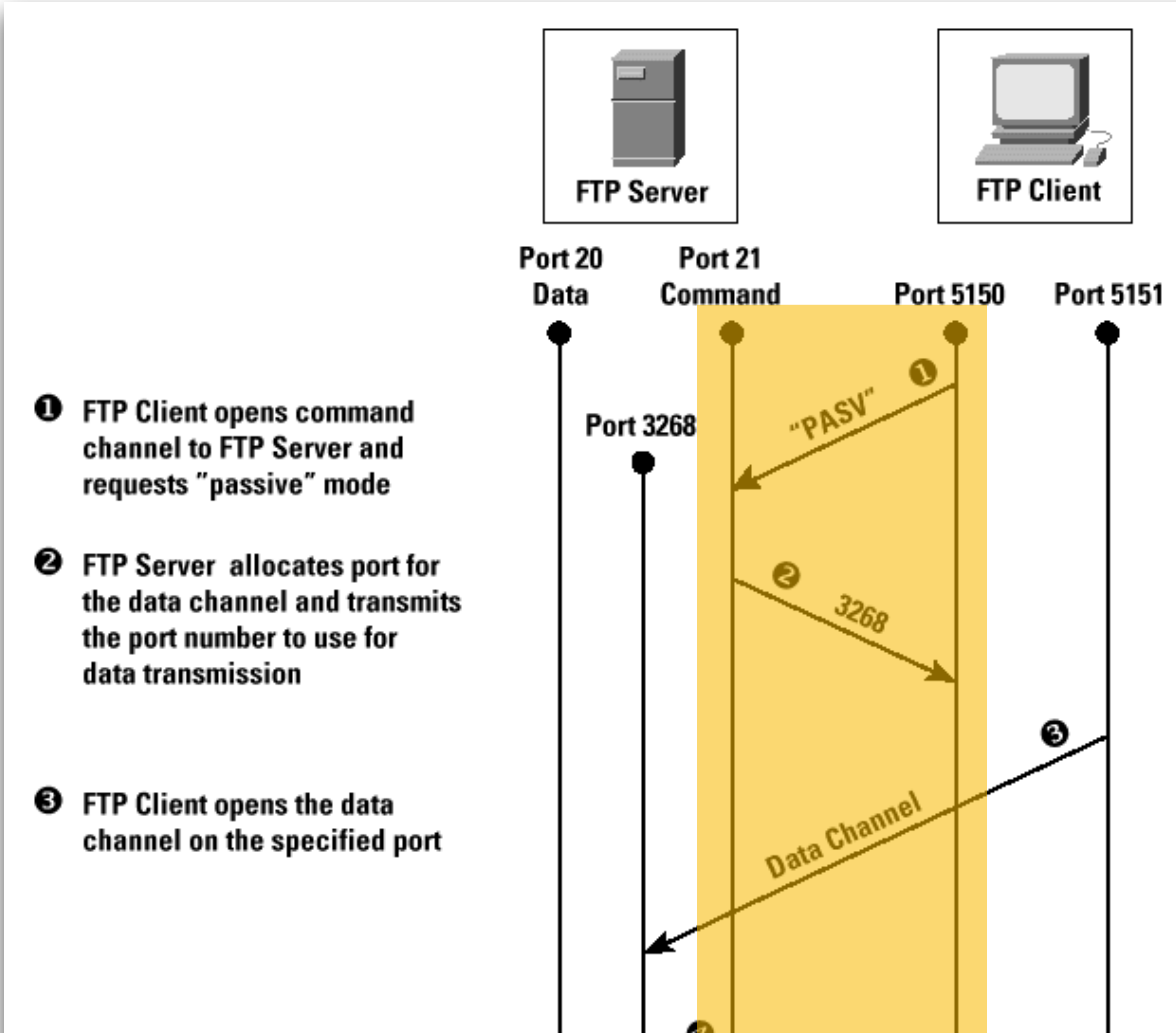
- Applies to the intersection of the log sets



2) AOP - logical design

à la FTP (a replication protocol):
separate control and data channels:



❶ FTP Client opens command channel to FTP Server and requests "passive" mode

❷ FTP Server allocates port for the data channel and transmits the port number to use for data transmission

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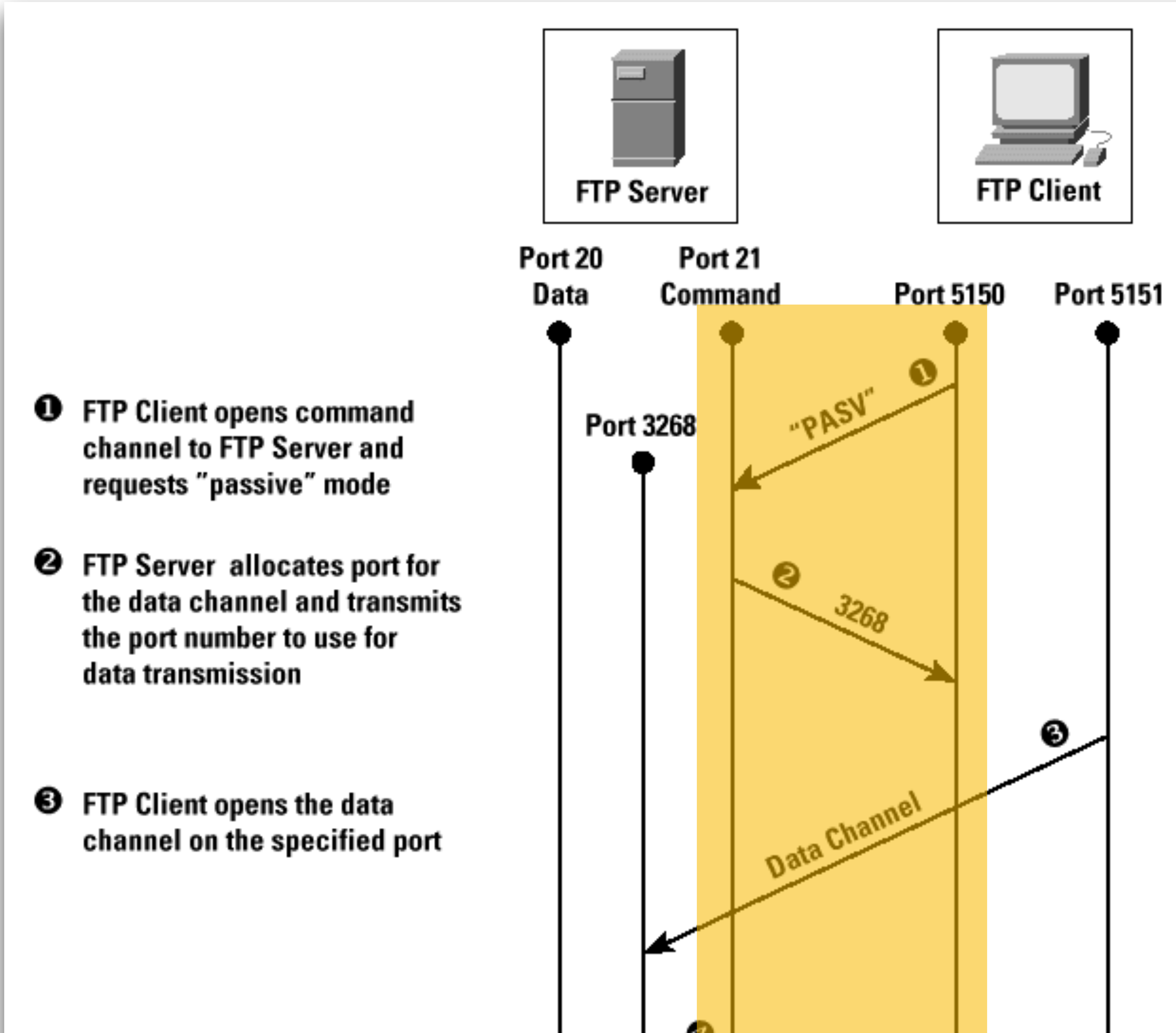

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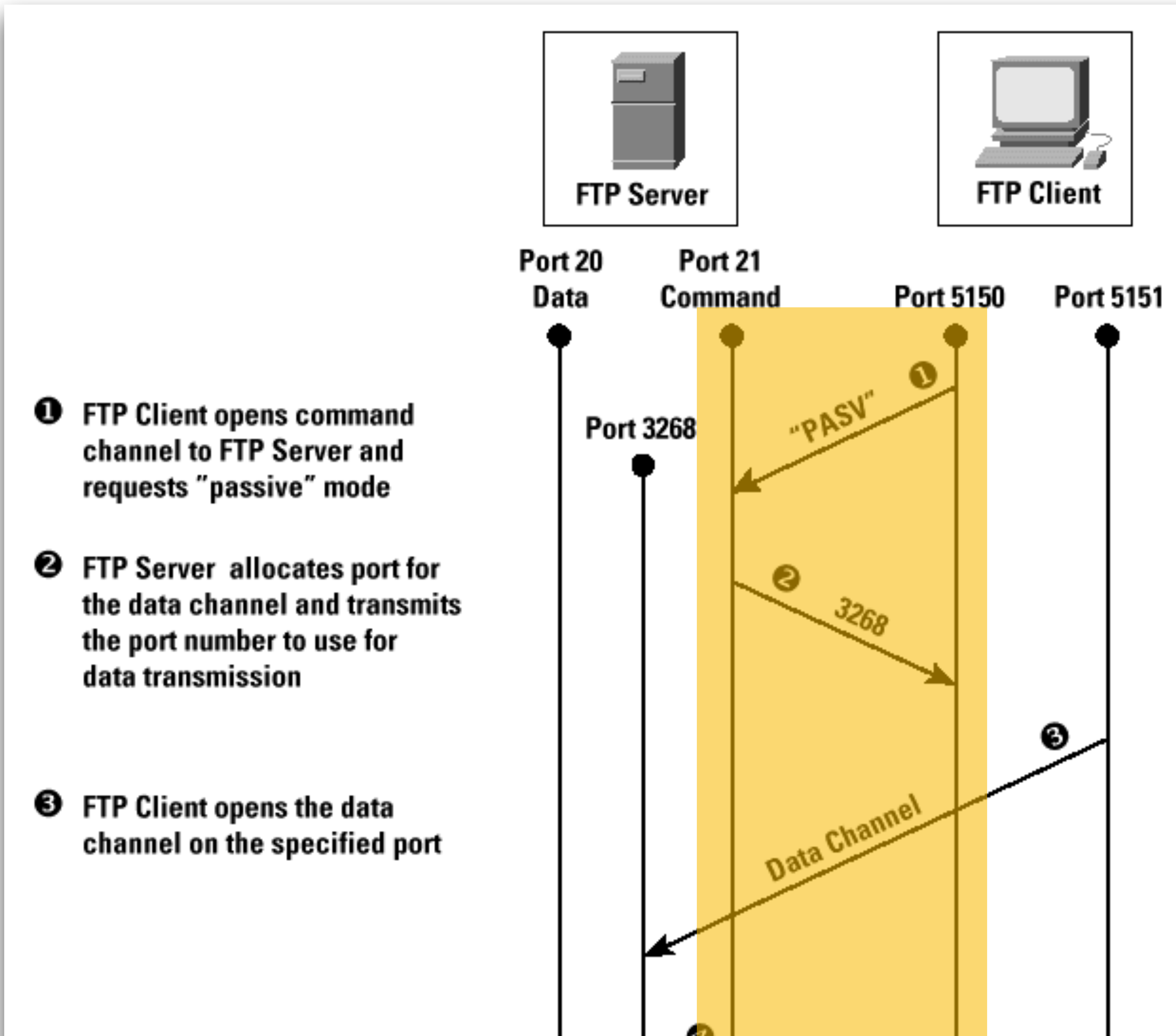
- Data
  actual transfer of information



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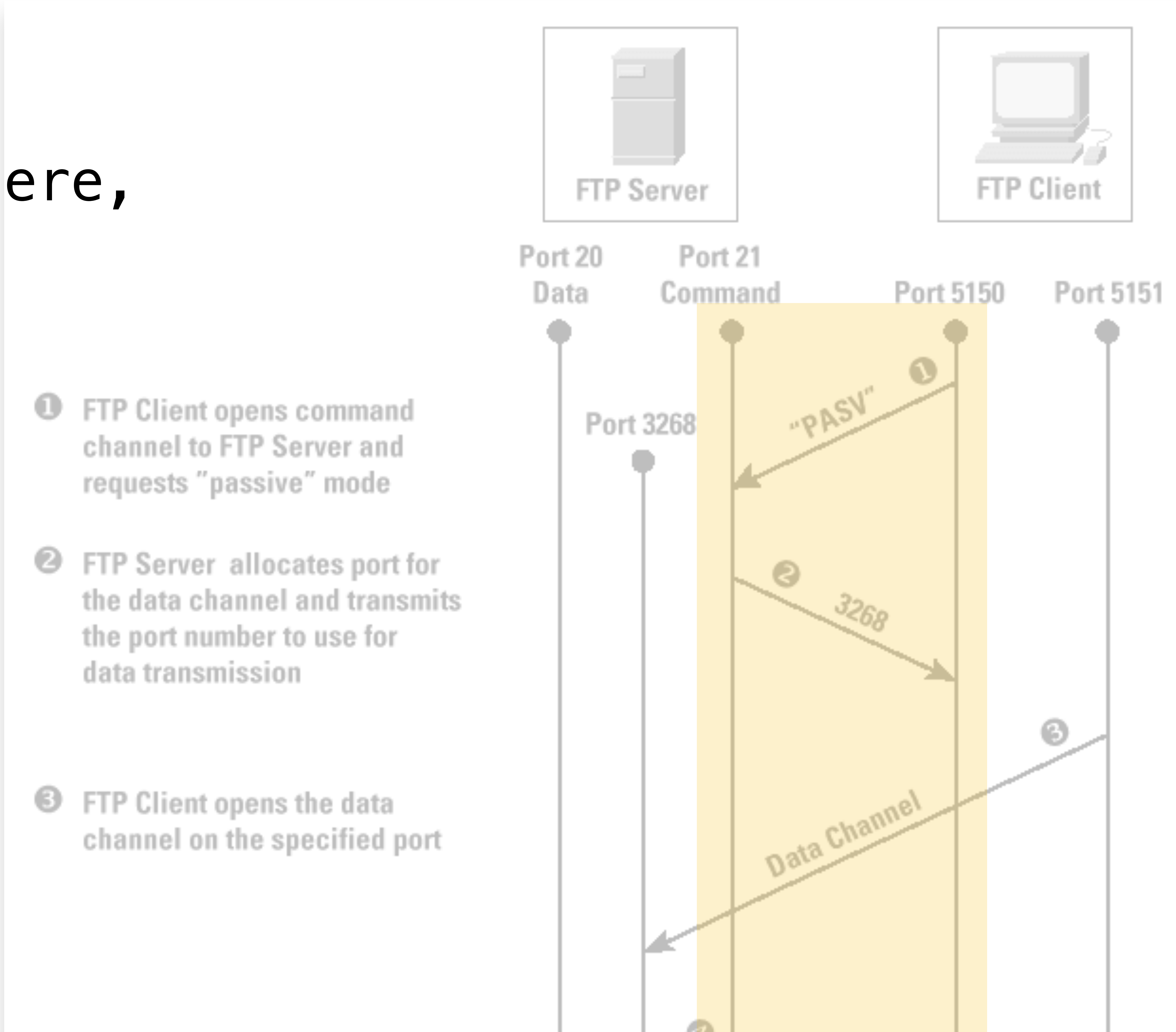
also called “subscribe” in pub/sub

2”) AOP - logical design

Show time–sequence diagram here,
and ports …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FTP Client
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Data
Port 21
Command
Port 5150
Port 5151
Port 3268
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“PASV”
3268
Data Channel

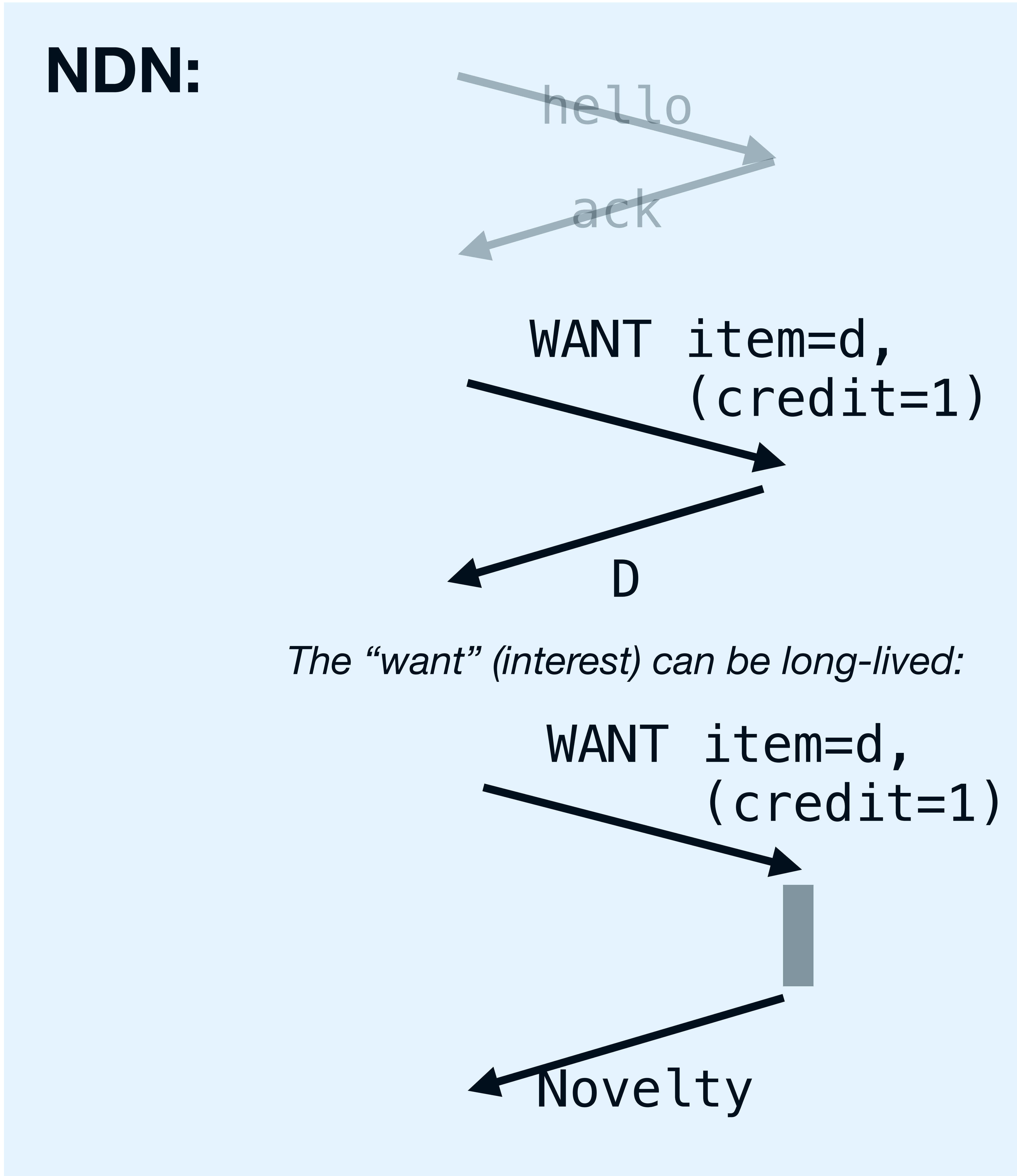
3) Pullified vs Pushified replication

Pullified implementation style:

- “mainstream”, client/server mindset, RPC
- chosen by NDN, SSB (!)

Pushified style:

- See **later** in this slide set.
- Note: AOP is **not** SSB (yet)



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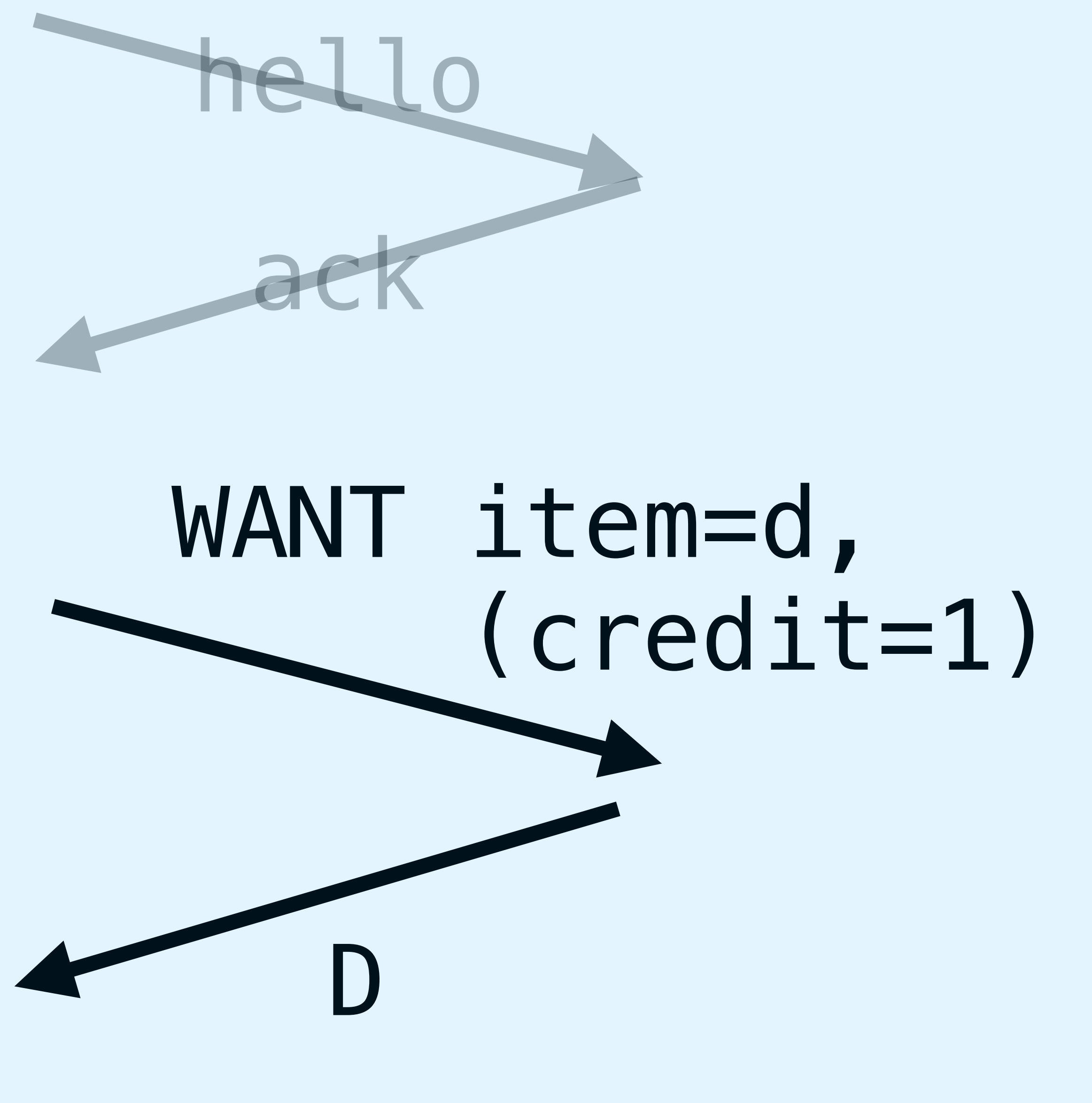
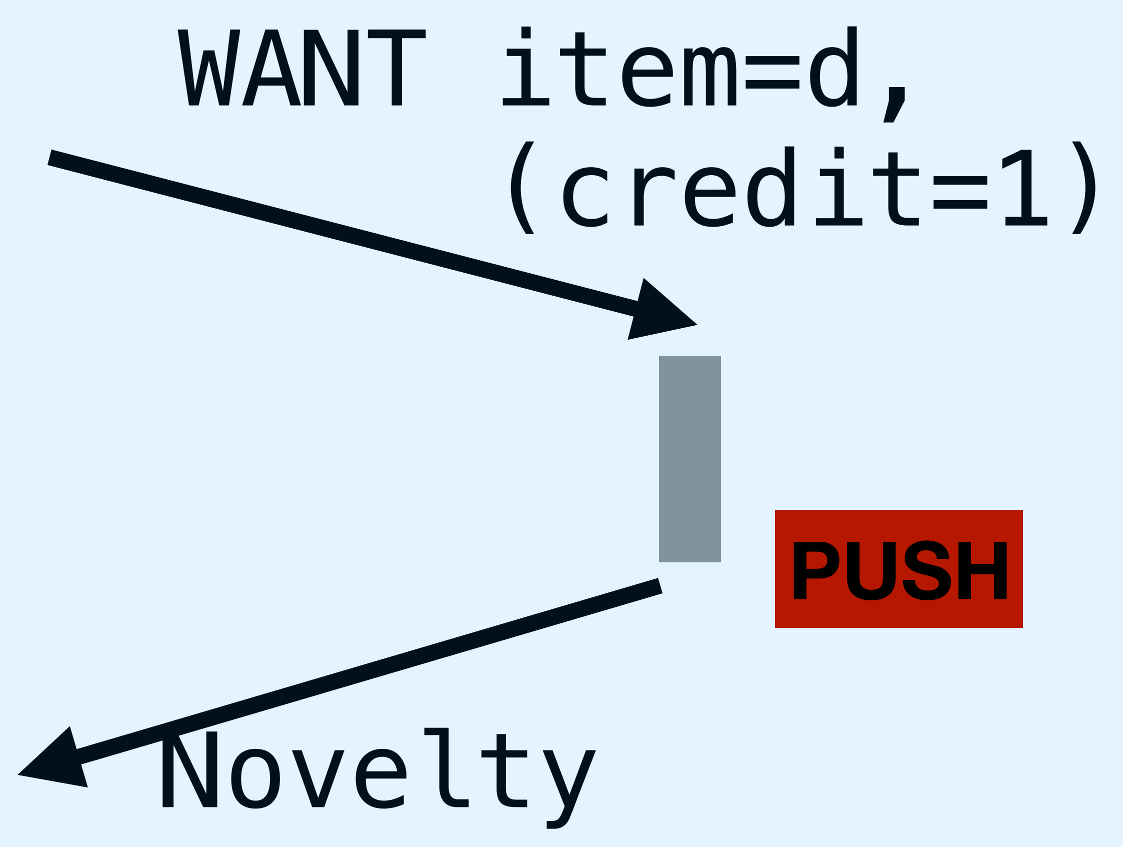
NDN:



The “want” (interest) can be long-lived:



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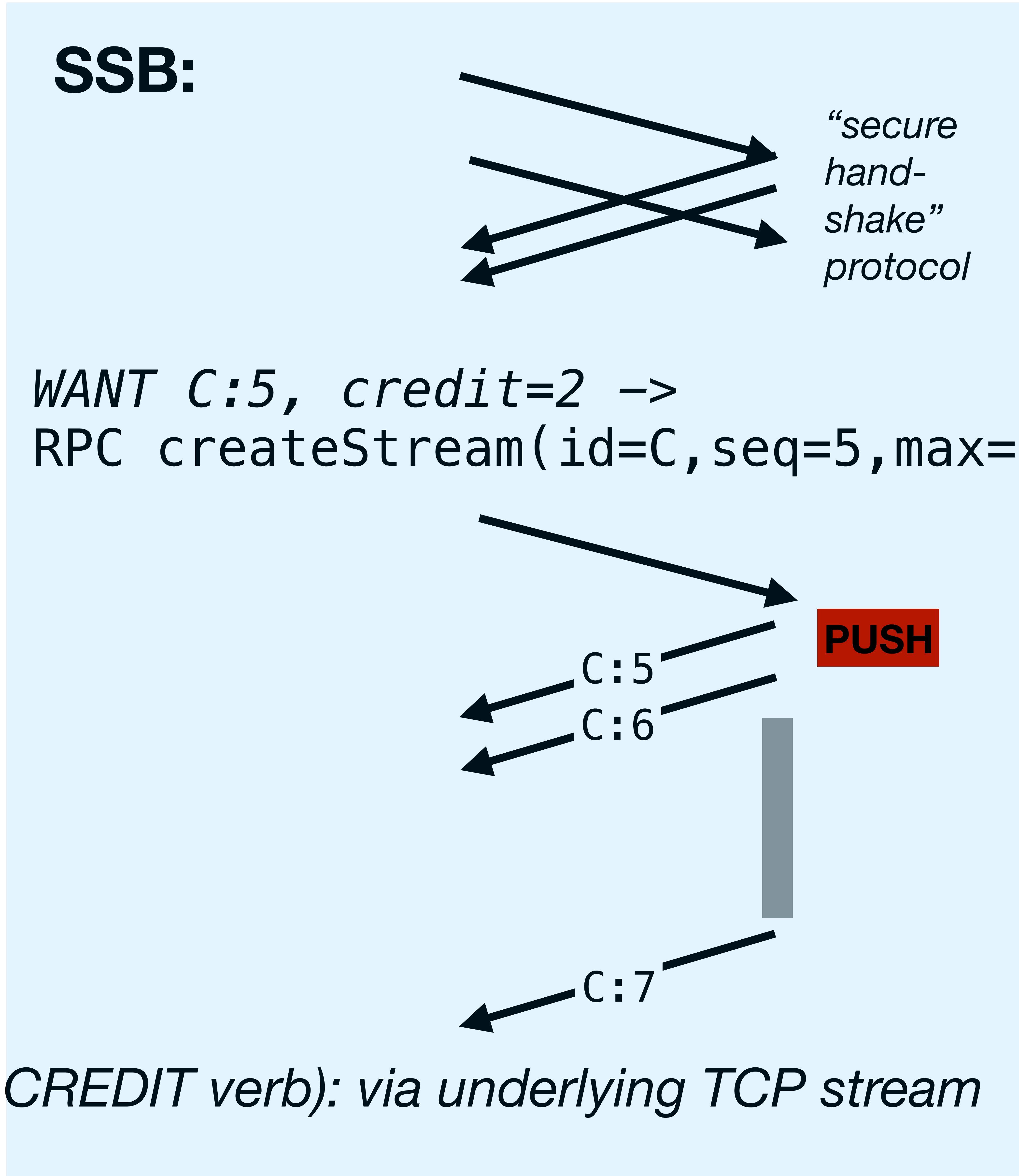

```
WANT C:5, credit=2 ->
RPC createStream(id=C,seq=5,max=
```

overall backpressure (the CREDIT verb): via underlying TCP stream

3”) One Problem of Pullification

In SSB:

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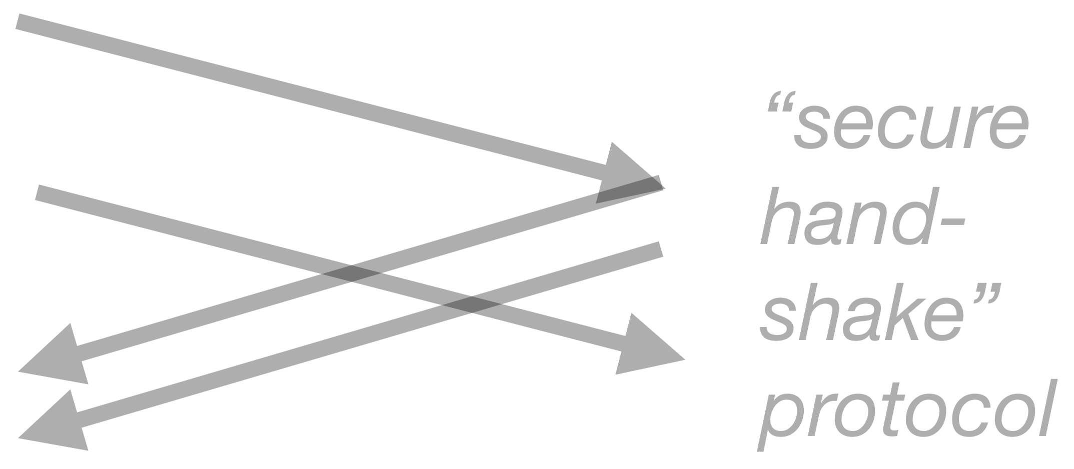

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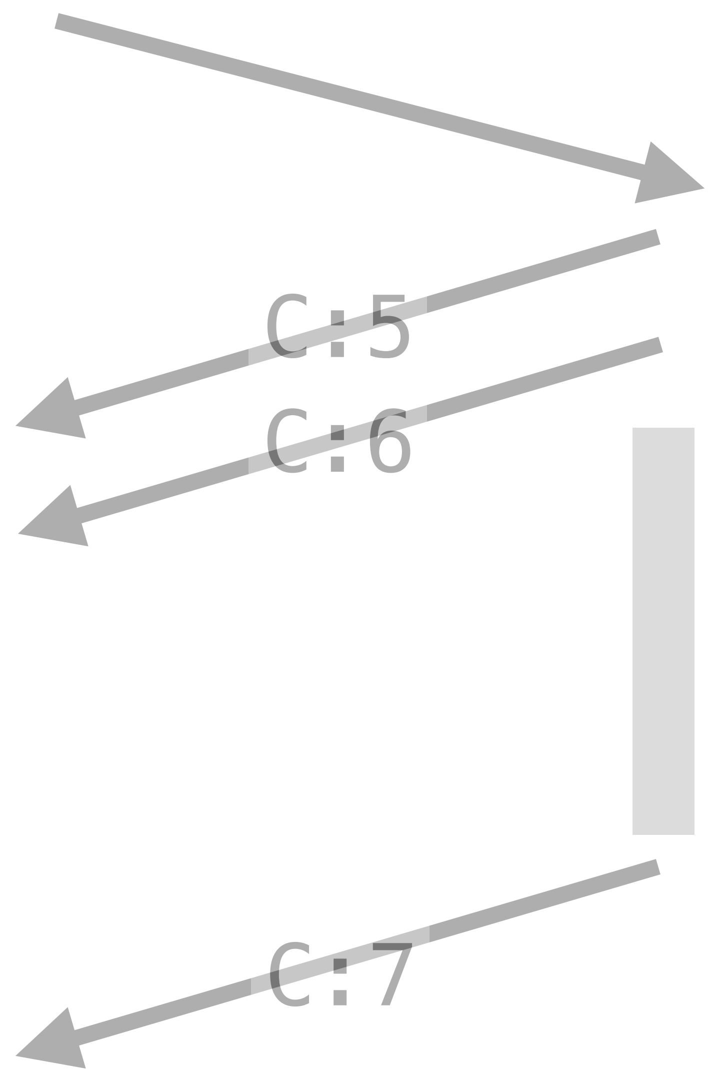

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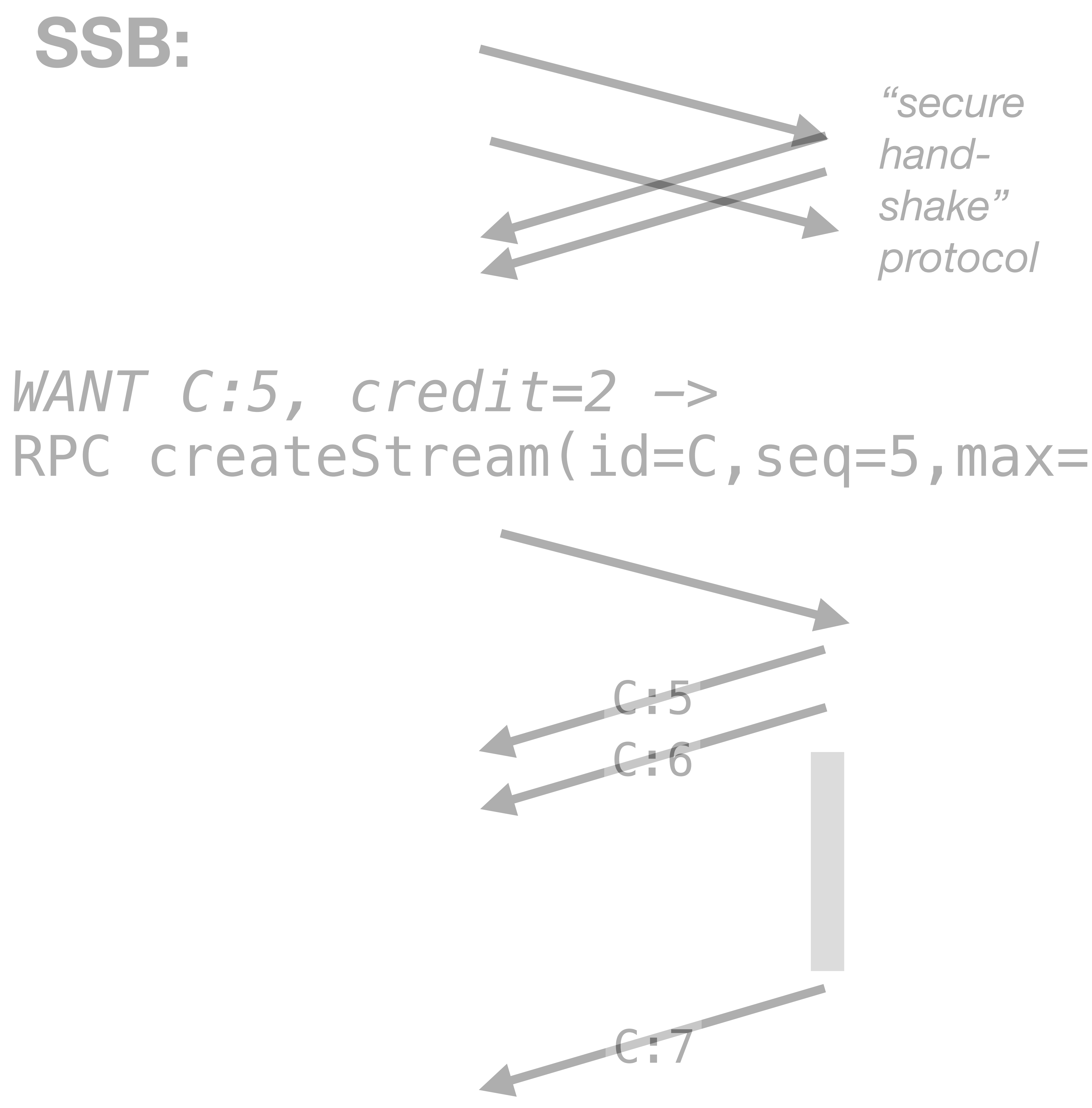

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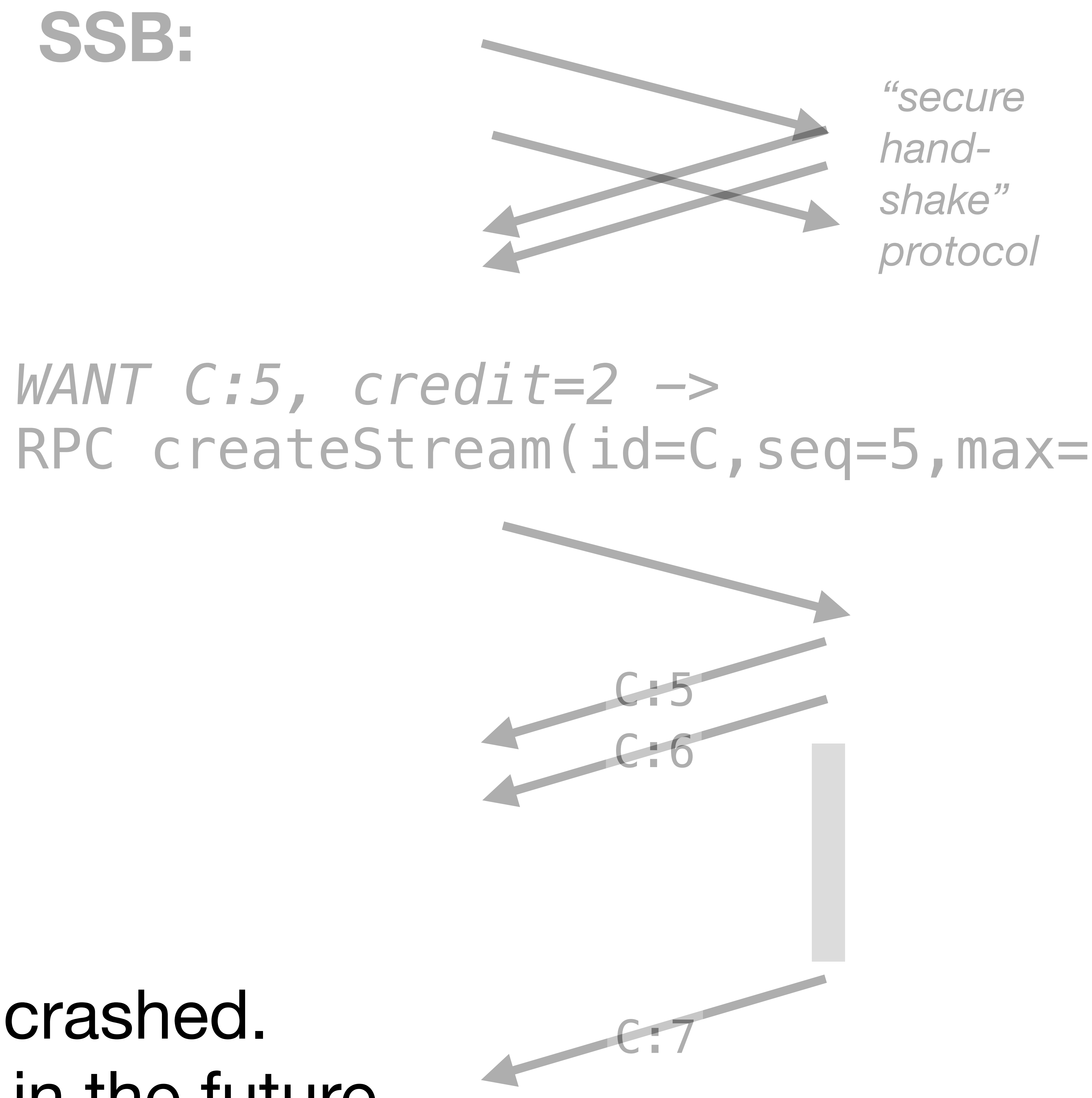
In NDN:

- Must ***repeatedly re-issue*** the WANT LLI (long-lived interest) because peer could have crashed. This will also be hundreds or thousands LLIs, in the future


SSB:
“secure hand-shake” protocol
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Main idea:

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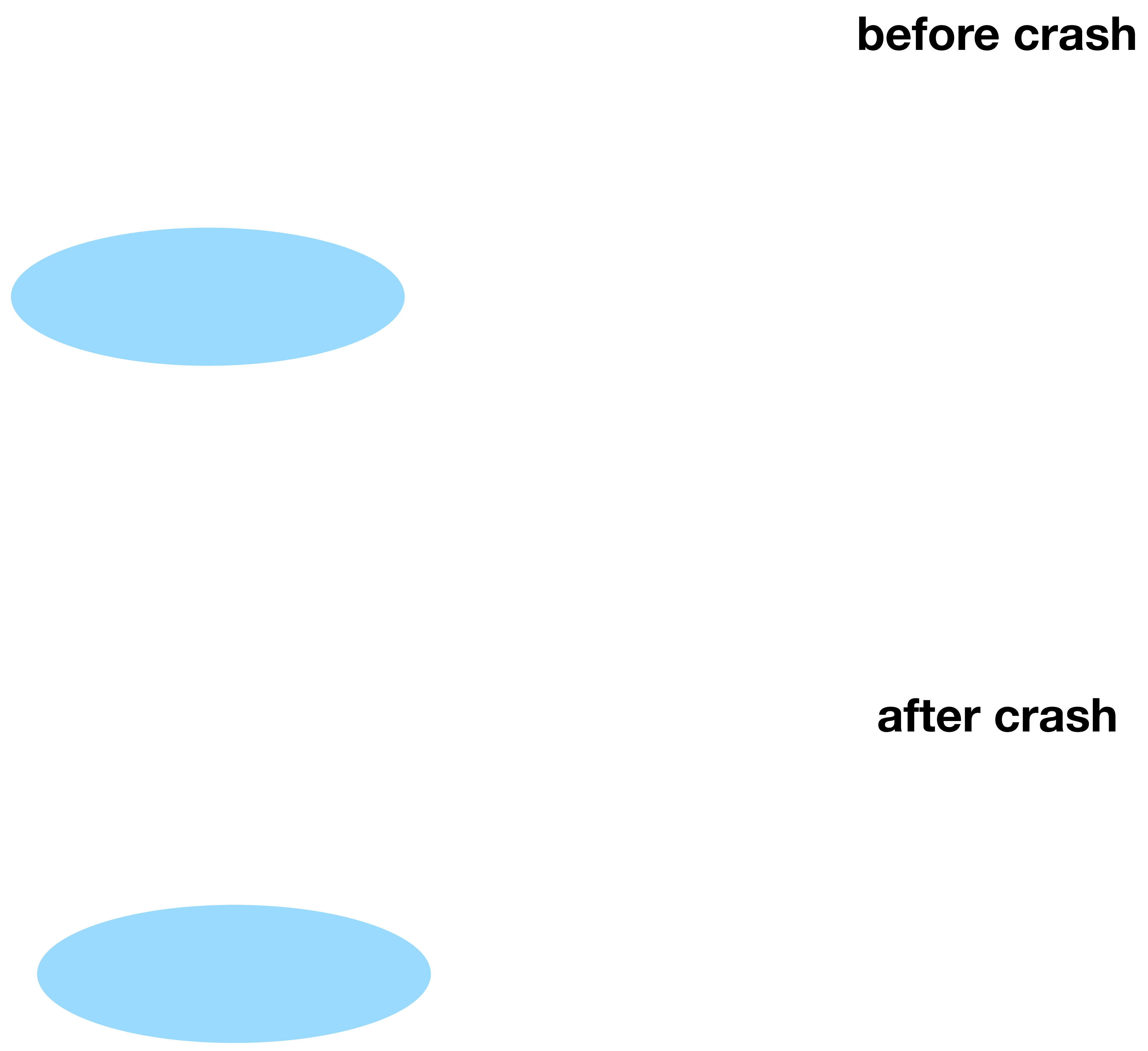
- but not replicated beyond the peer



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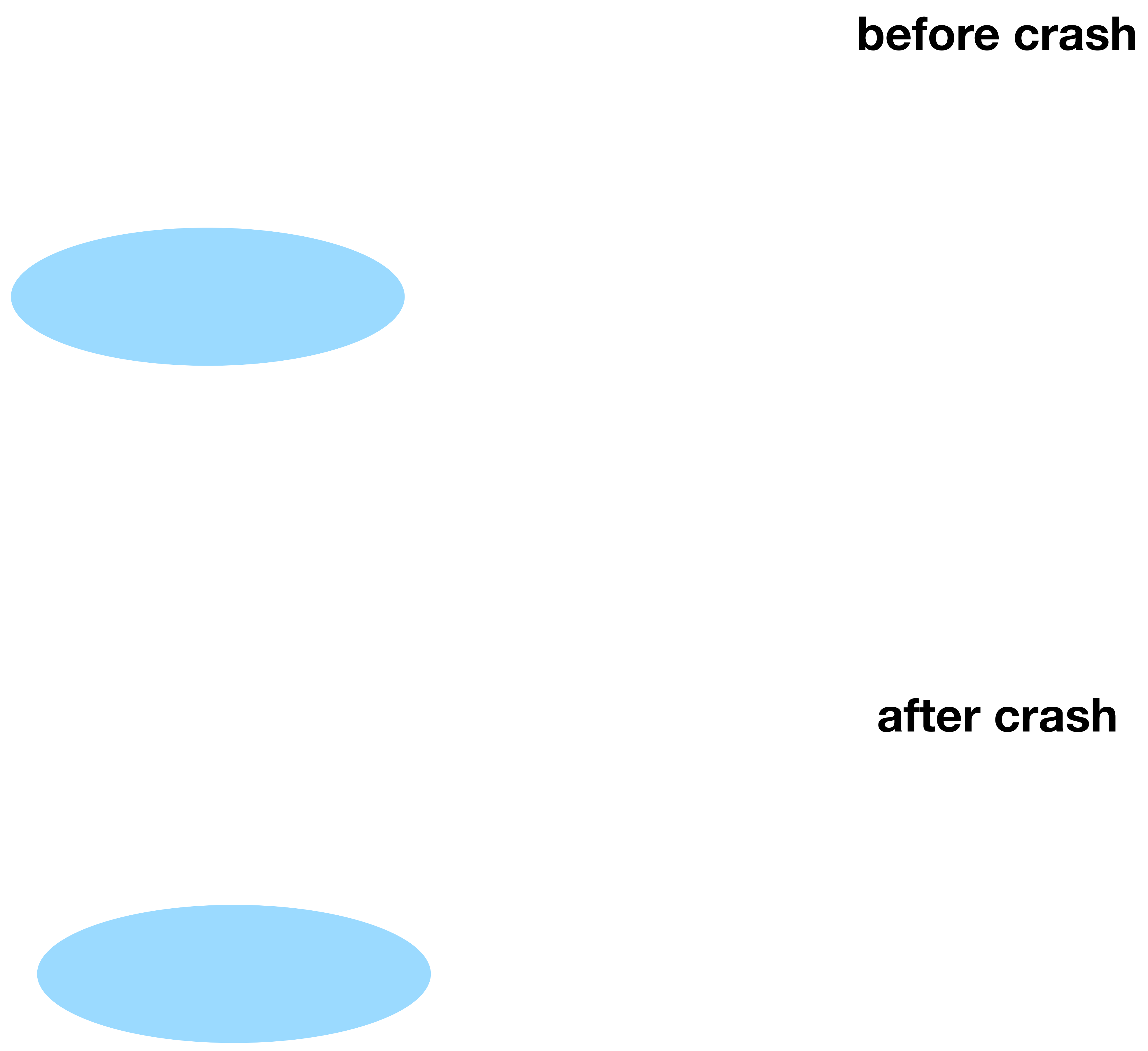
Reminder: log W2 contains all log IDs that node N2 wants



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after crash

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-> HELLO id=N1, want_id=W1
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-> WANT W2:15
              <- W2:15 (~ WANT M:1)
              <- W2:16 (~ UNWANT B)
                                 ...
```

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  ```
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Not a suprise, really: TCP *is* a "replication protocol", can also be called a "controlled push" (=sender driven, flow-controlled)

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TCP … in comparison to NDN and AOP

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  - have to use parallel Interests to fill the pipeline

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    (together this feature is called "flow balance")
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- AOP more like TCP
  - "stream" thinking, cumulative ack
  - both remember information frontier (packet loss)
  - difference to TCP: AOP supports *multiple* streams,
    AOP can *resume* its streaming after a node crash, hides "Internet weather"

6) Status and Conclusions

AOP is a pushified version of a replication protocol for event streams

- AOP is *not* SSB: perhaps SSB will adopt it?
- AOP is *not* a general pub/sub:
  - strict (crypto-enforced) log discipline
  - reliable
  - producer-centric (e.g., no N:1 sending to a “topic channel”)
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AOP: running Python Proof-of-Concept
for connection-less settings (UDP, ethernet)