RPKI off the beaten happy path

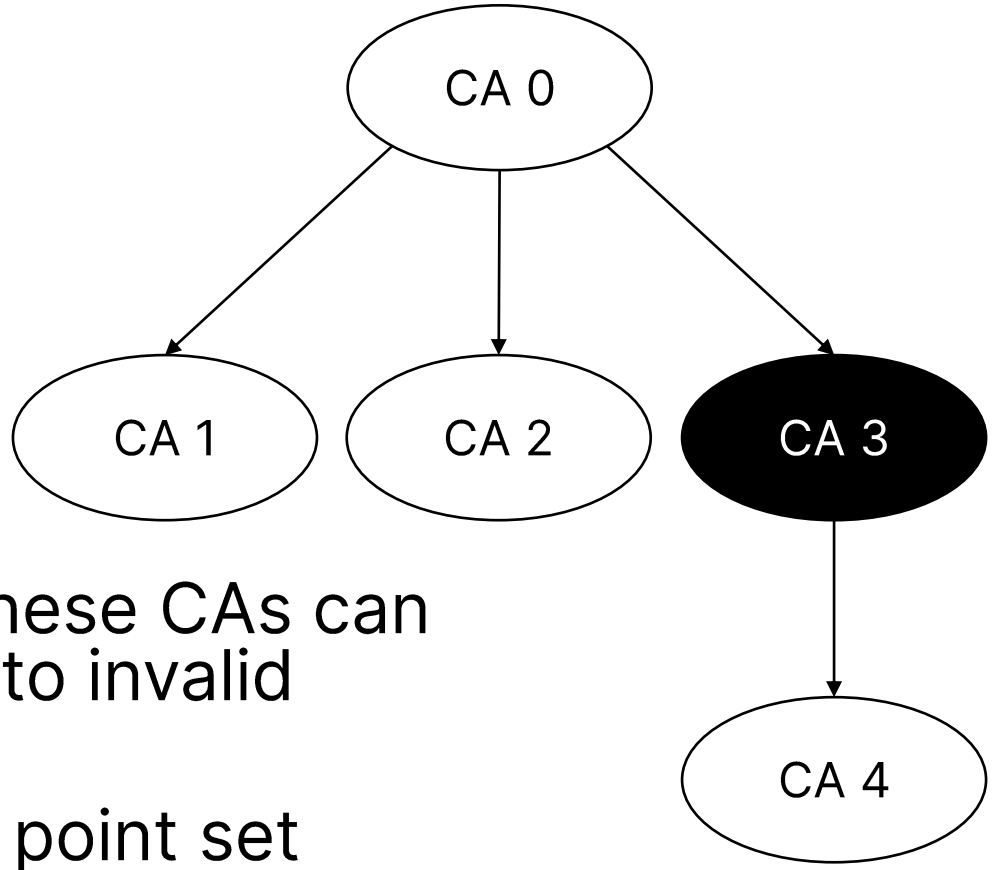
Koen van Hove
University of Twente

Ties de Kock
RIPE NCC

Tim Bruijnzeels
NLnet Labs

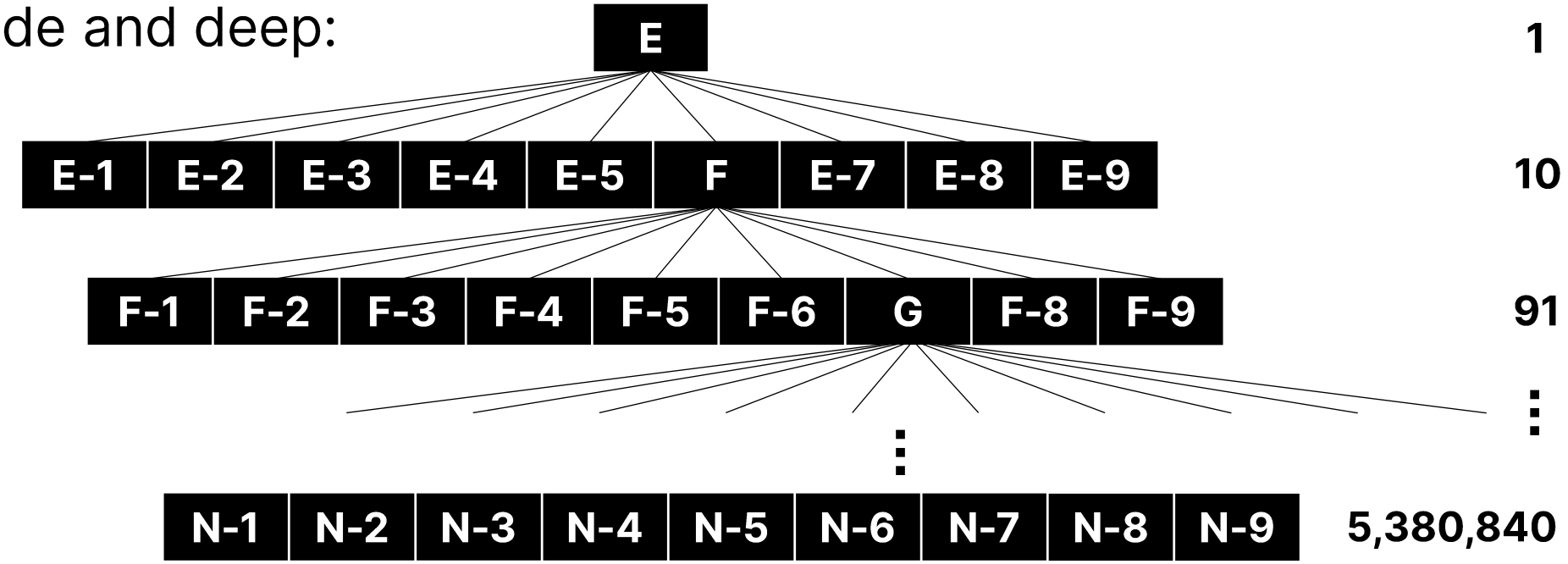
Partial RPKI data

- CA 1 has a ROA for AS1 1.1.0.0/16
- CA 2 has a ROA for AS2 1.0.0.0/8
- CA 3 has a ROA for AS3 1.2.0.0/16
- CA 4 has a ROA for AS4 1.2.3.0/24
- Not considering the data of one of these CAs can result in a route changing from valid to invalid (instead of not found)
- Case: there is no current publication point set available for CA 3 (repo down - no cache in RP, CA down and MFT/CRL expired, etc.)
  - What to do when resources are missing?
  - When should an RP report ready to RTR?



Exponential PP spread

- Several RPs limit the depth of the chain (12, 32, 100)
- One can go wide and deep:



- Questions:
  - What should the RP software/operators do?
  - What should the CAs do when it happens?
  - Should CAs prevent it from happening?
  - How should false positives be dealt with?

File system capacity

- Create many folders and overflow the amount of inodes
- rsync client will happily create all folders
  - /001/002/003/../00A/00B/../00Z/00a/../zzy/zzz/a.roa
- As folders are 0 bytes in size, it will bypass normal size restrictions
- Max path length is ~4096, above comes to ~1024
- Applying this to the RIPE NCC PP results in 17,964,612,606 folders (as of 2022-01-29)

- How should an operator prevent this?

Router capacity

- Case: a /48 has been delegated to me
- I can create $\sum_{i=0}^{80} 2^i = 2^{81} - 1$=2417851639229258349412351 prefixes
- I can pair those prefixes to 2^{32}ASNs
- This creates $2^{133} - 2^{32}$ = 10889035741470030830827987437812287799296 pairs
- RPs accept this and pass it on via the RTR protocol
- No router can handle so many entries

- At which level should this be solved? Router/RTR/RP/PP/CA?

Reporting

- Case: targeted attack based on IP address
  - In the case of rsync folders it can also be done as MITM

- Can an operator effectively stop the attack with the current tools?
- If not: how to report malicious behaviour to the (parent) CA so that they can stop it?
  - How does one prove who the perpetrator was? Is that even possible?
  - How can a CA know that their behaviour is viewed as malicious?
    - Does the publication protocol need to be extended?

Discussion

- Partial RPKI data
- Exponential PP spread
- File system capacity
- Router capacity
- Reporting

- RFC:
  - (How) should these problems be dealt with?
  - Who (CA/PP/RP software/operator/router) should solve them?
  - Proactively or reactively?