Peer-to-Peer Permissionless Consensus via Reputation

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github.com/Freechains

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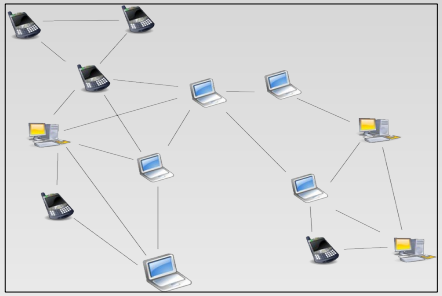

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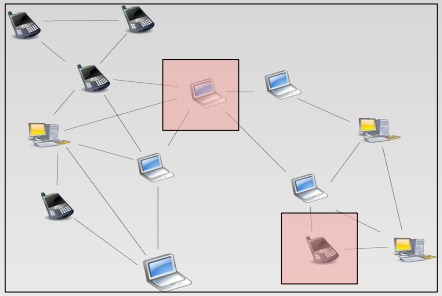

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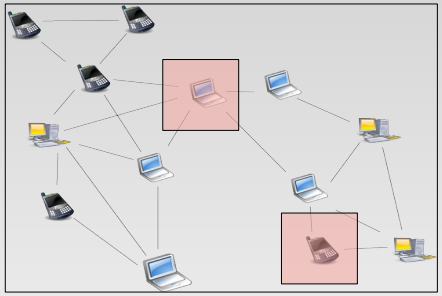

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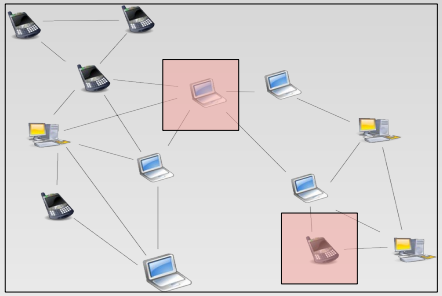

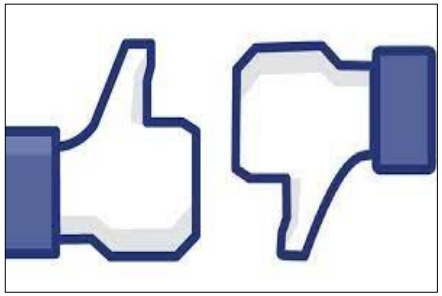

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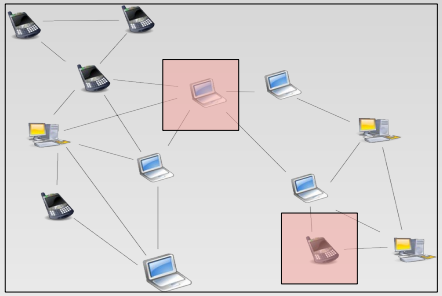

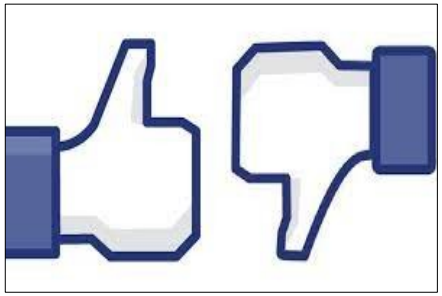

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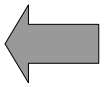

Consensus via Reputation

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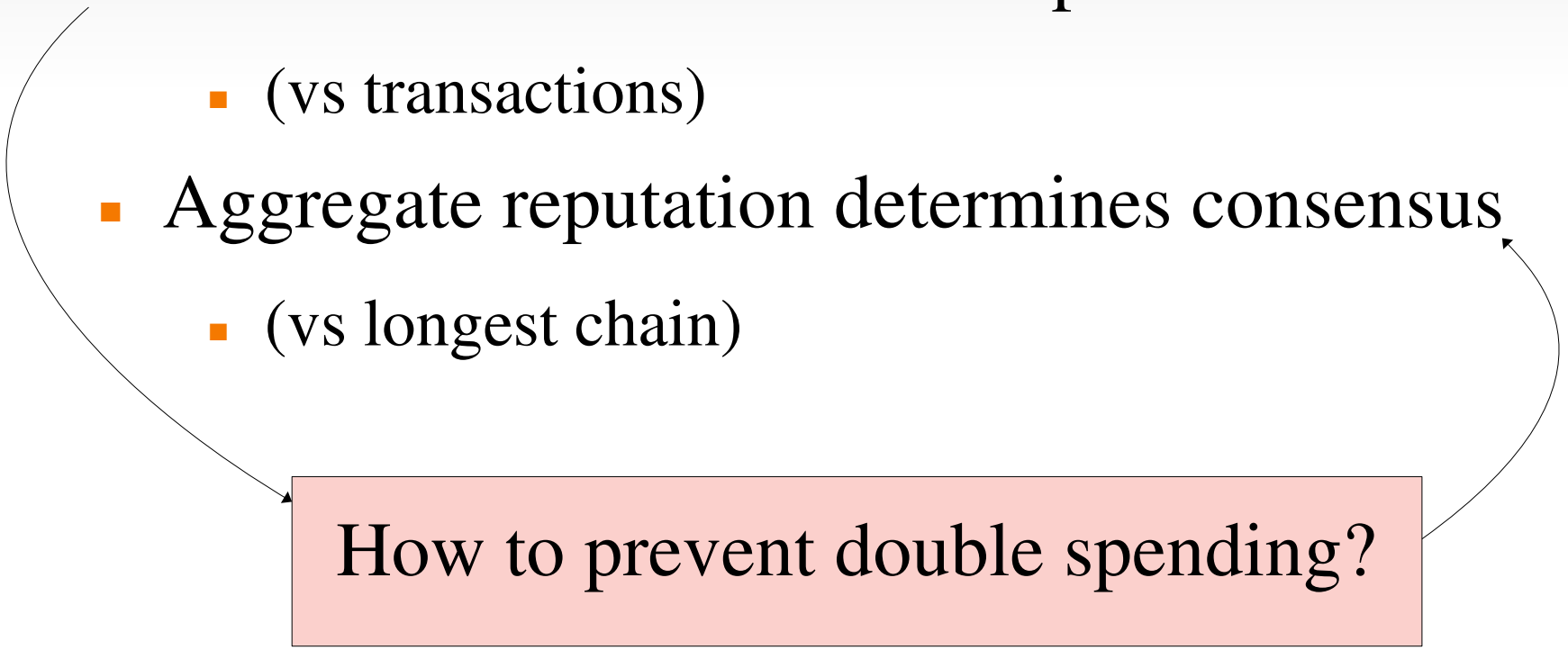

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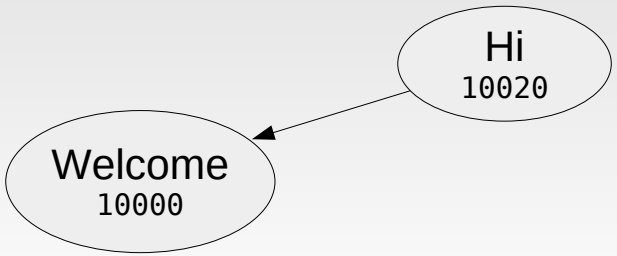

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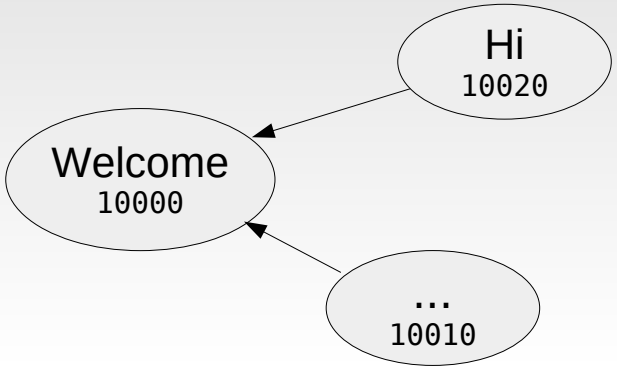

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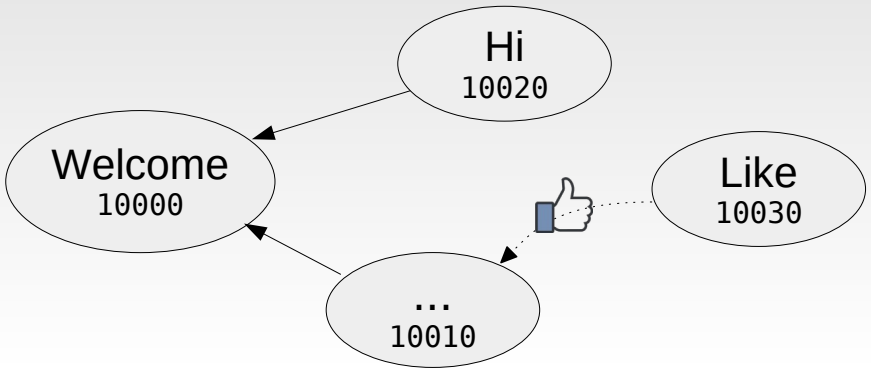

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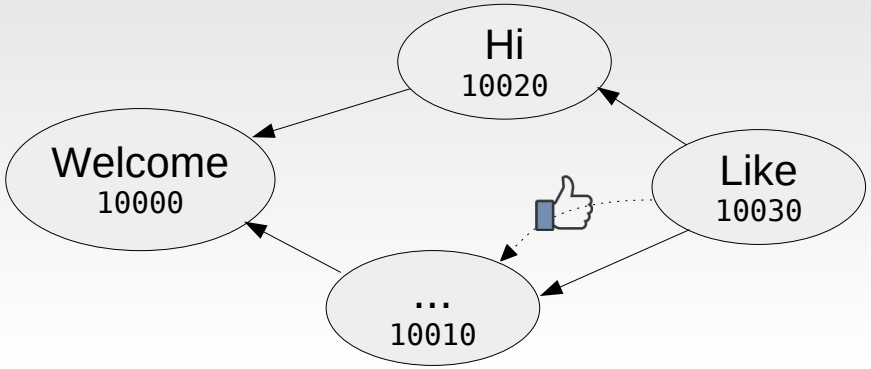

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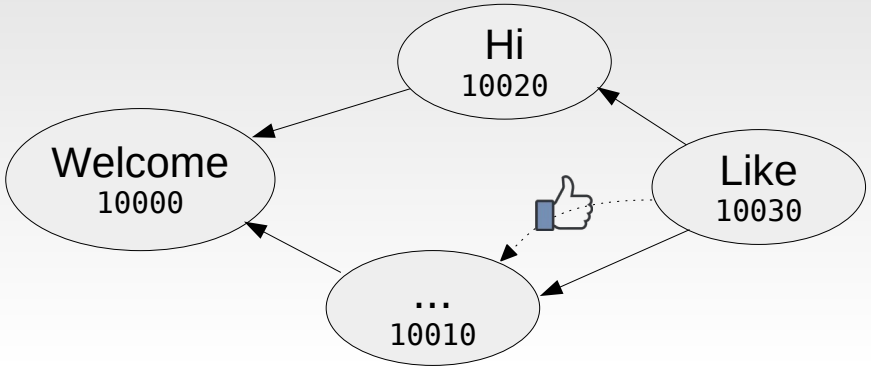

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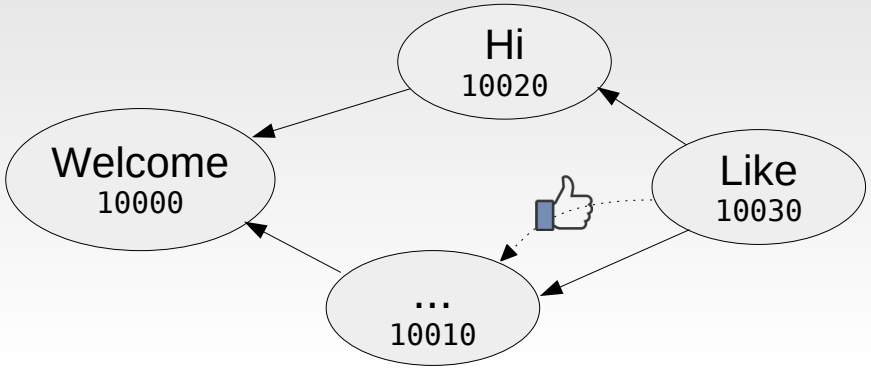

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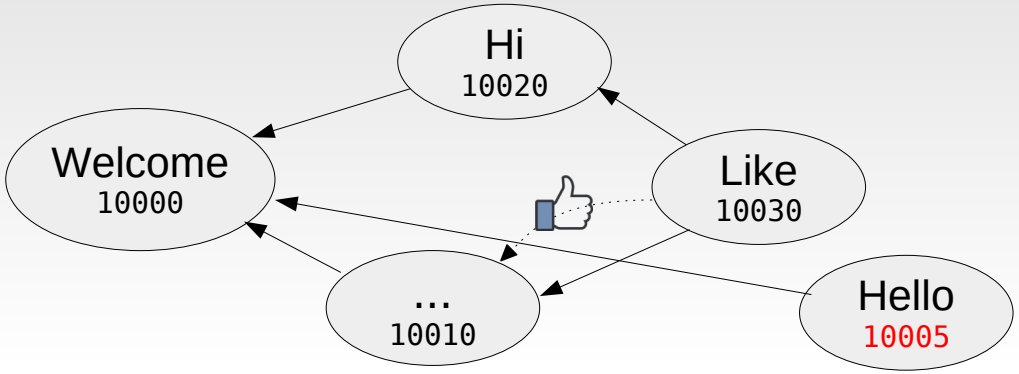

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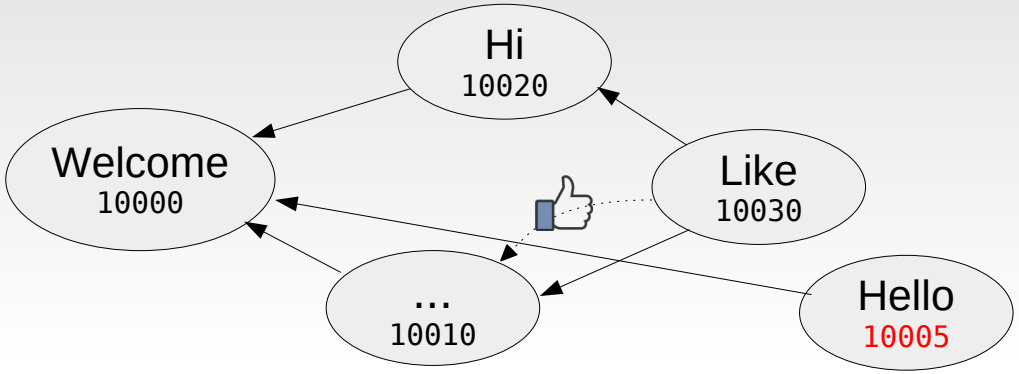

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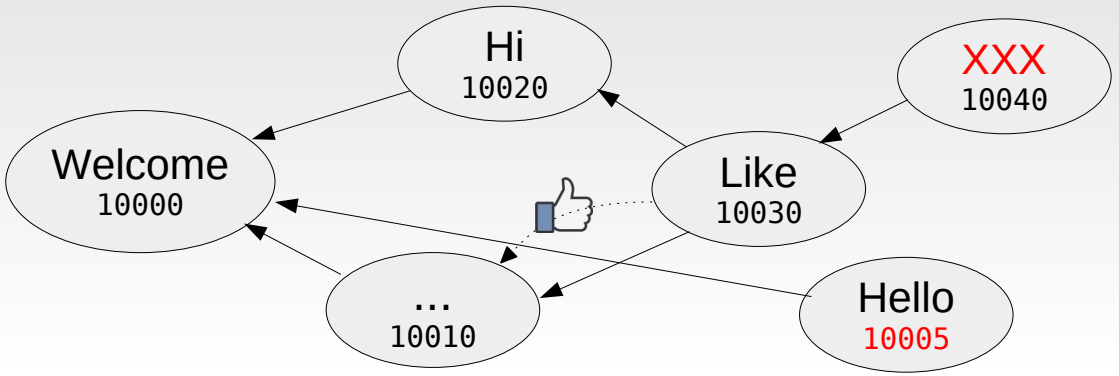

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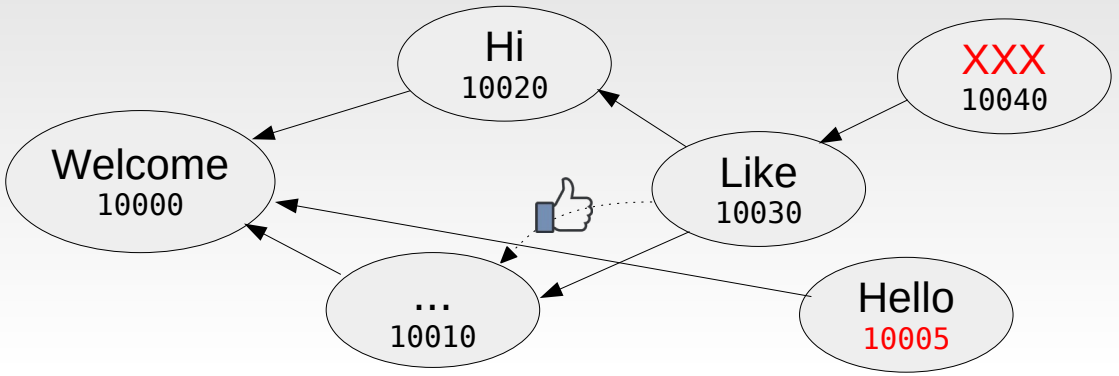

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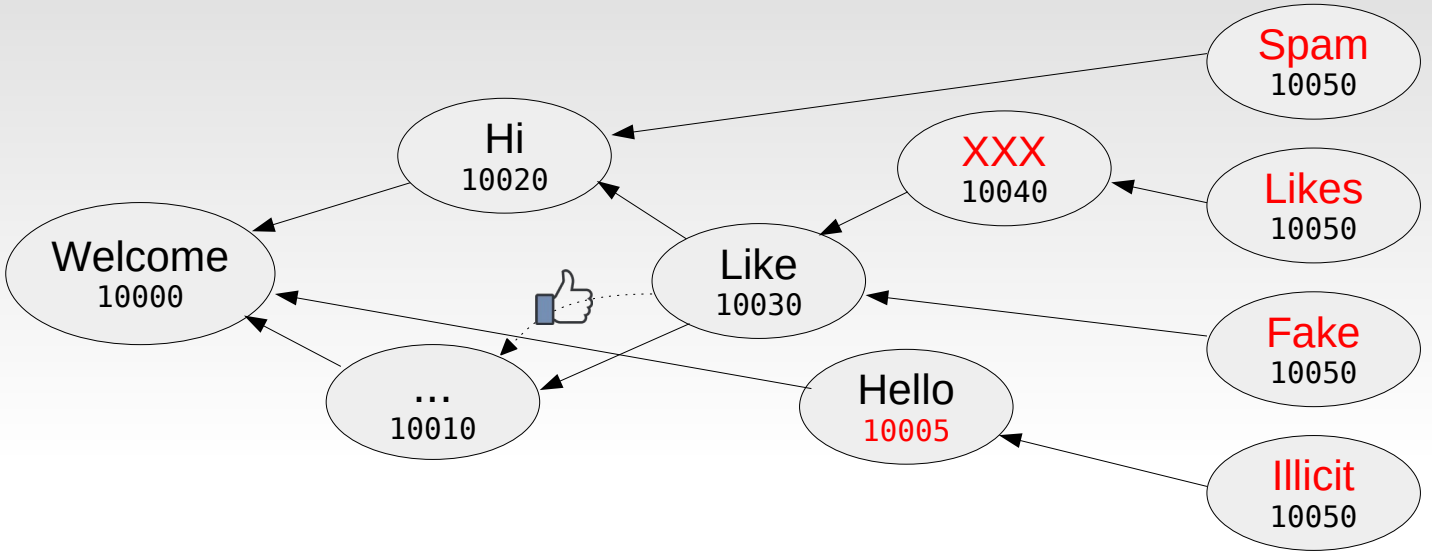

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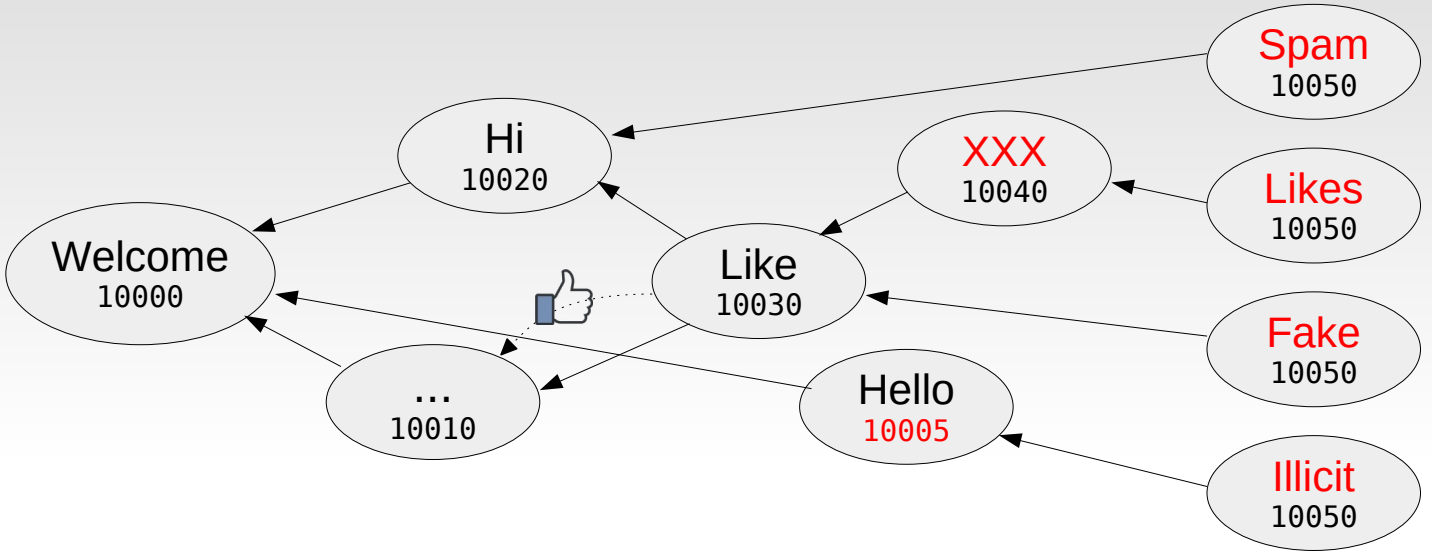

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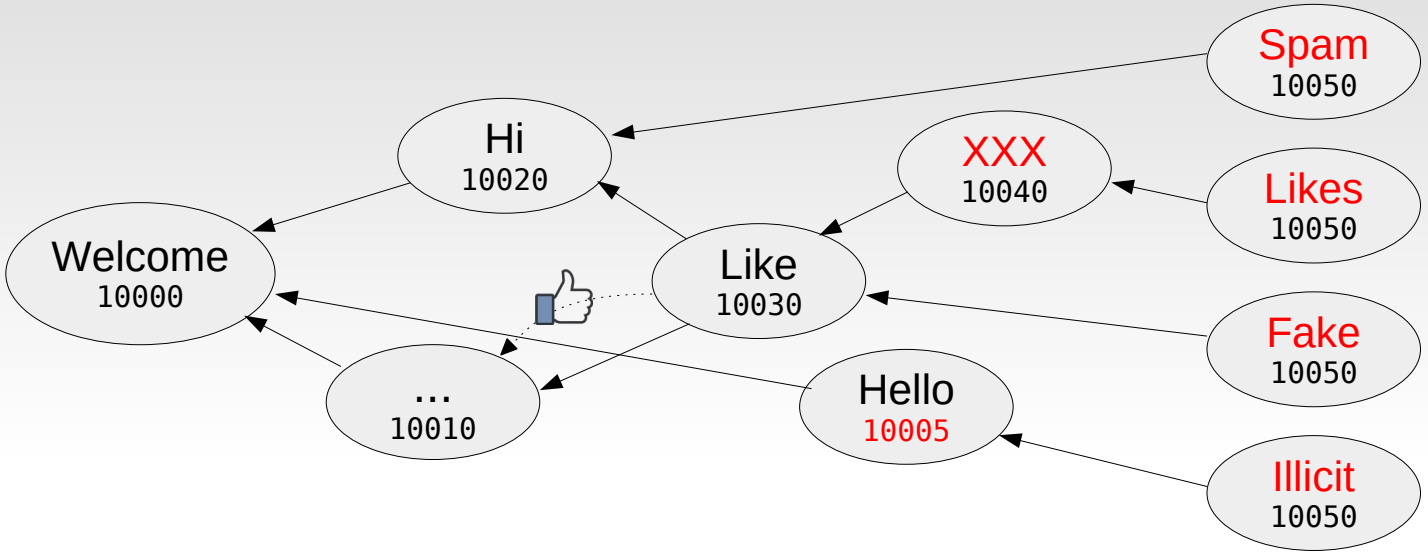

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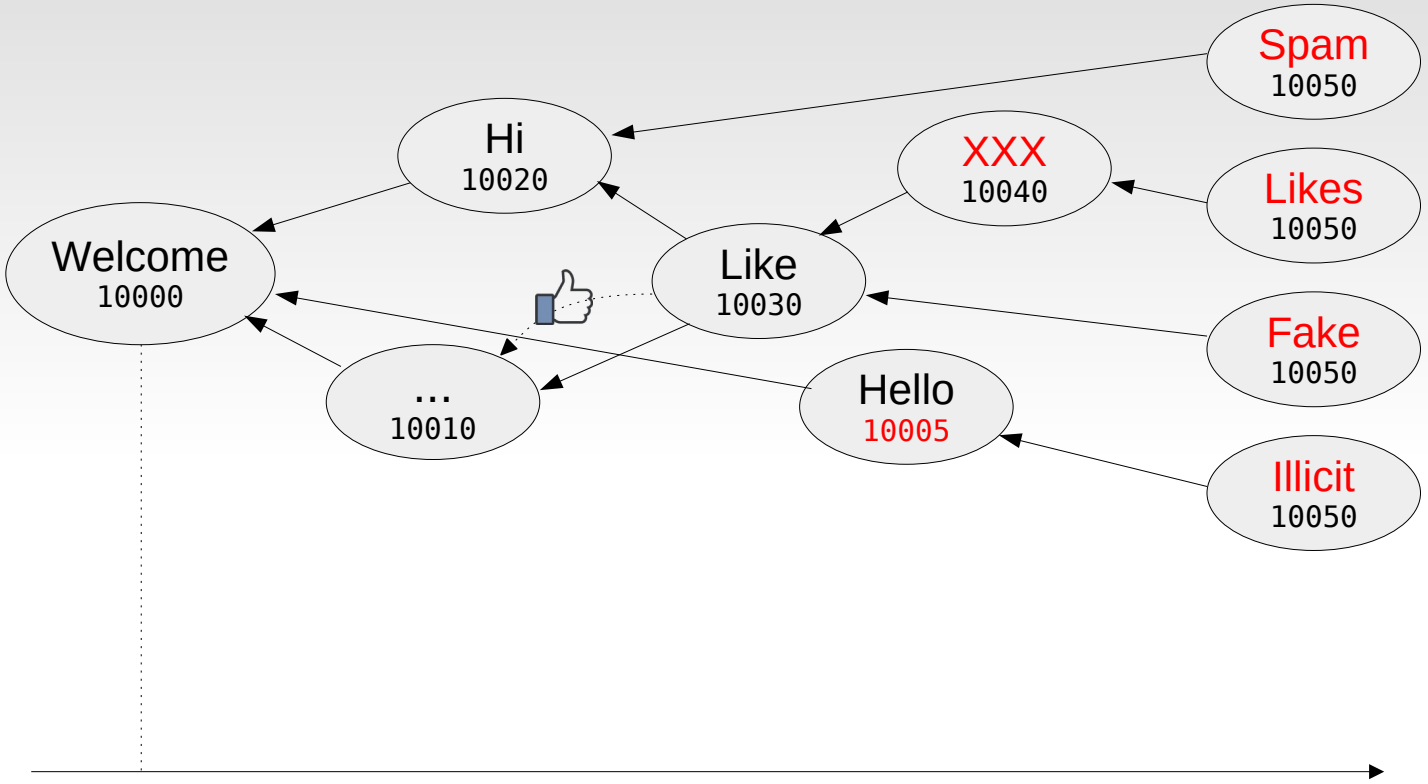

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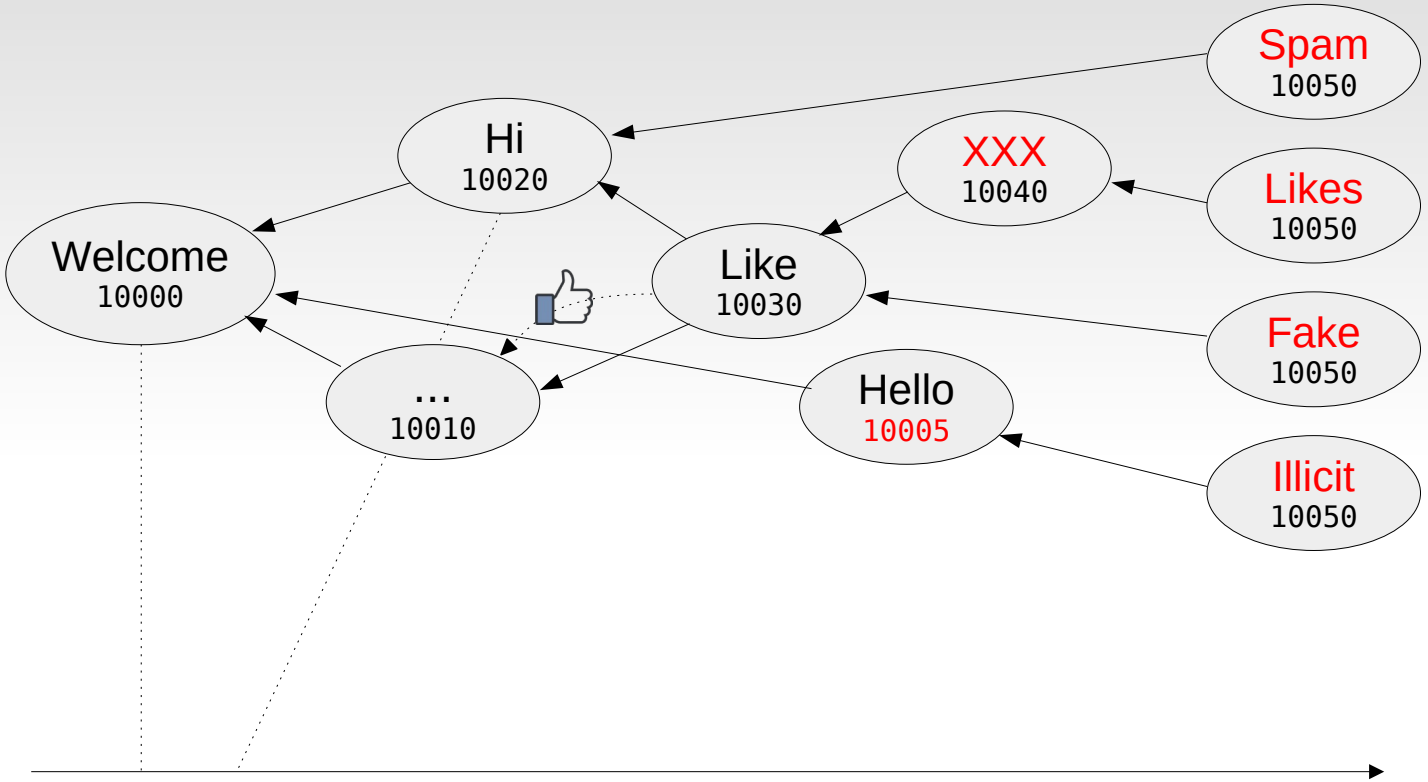

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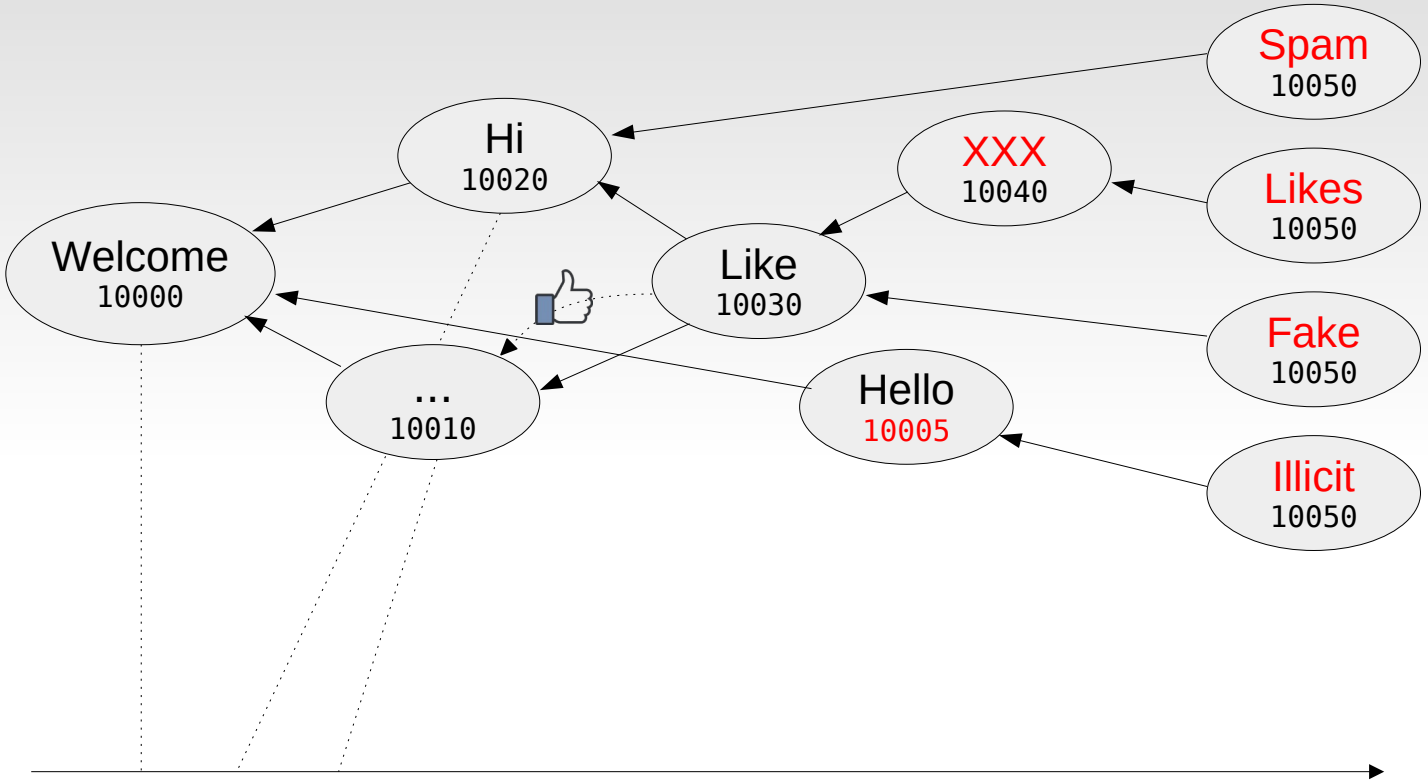

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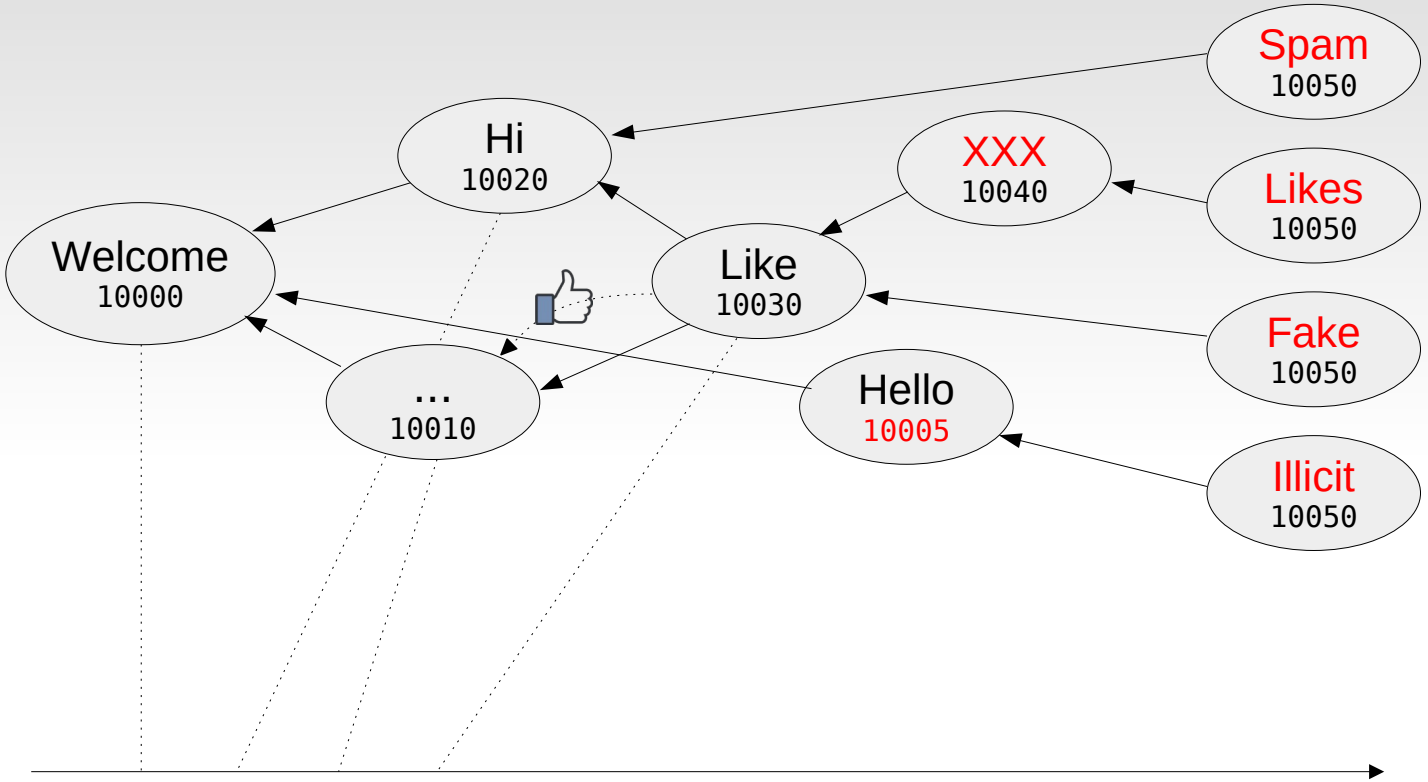

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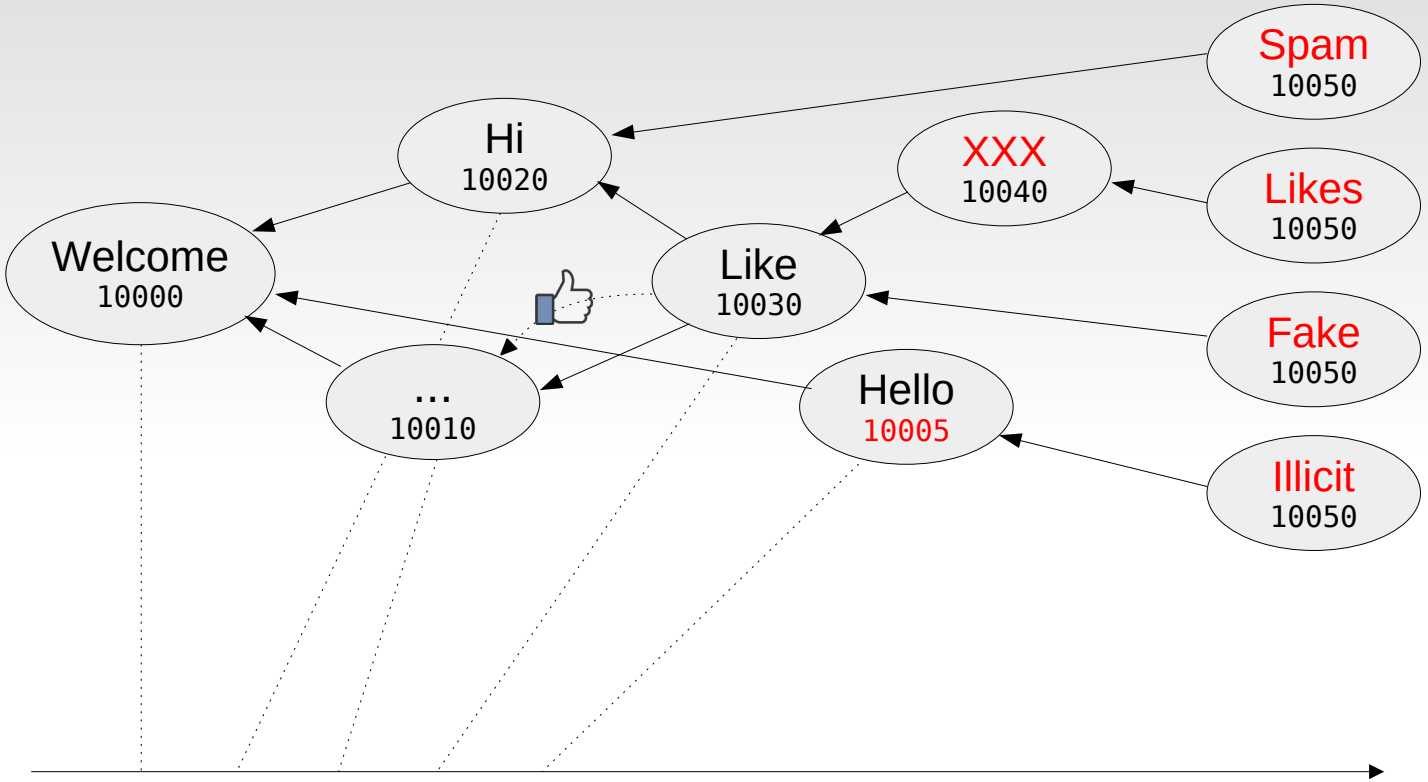

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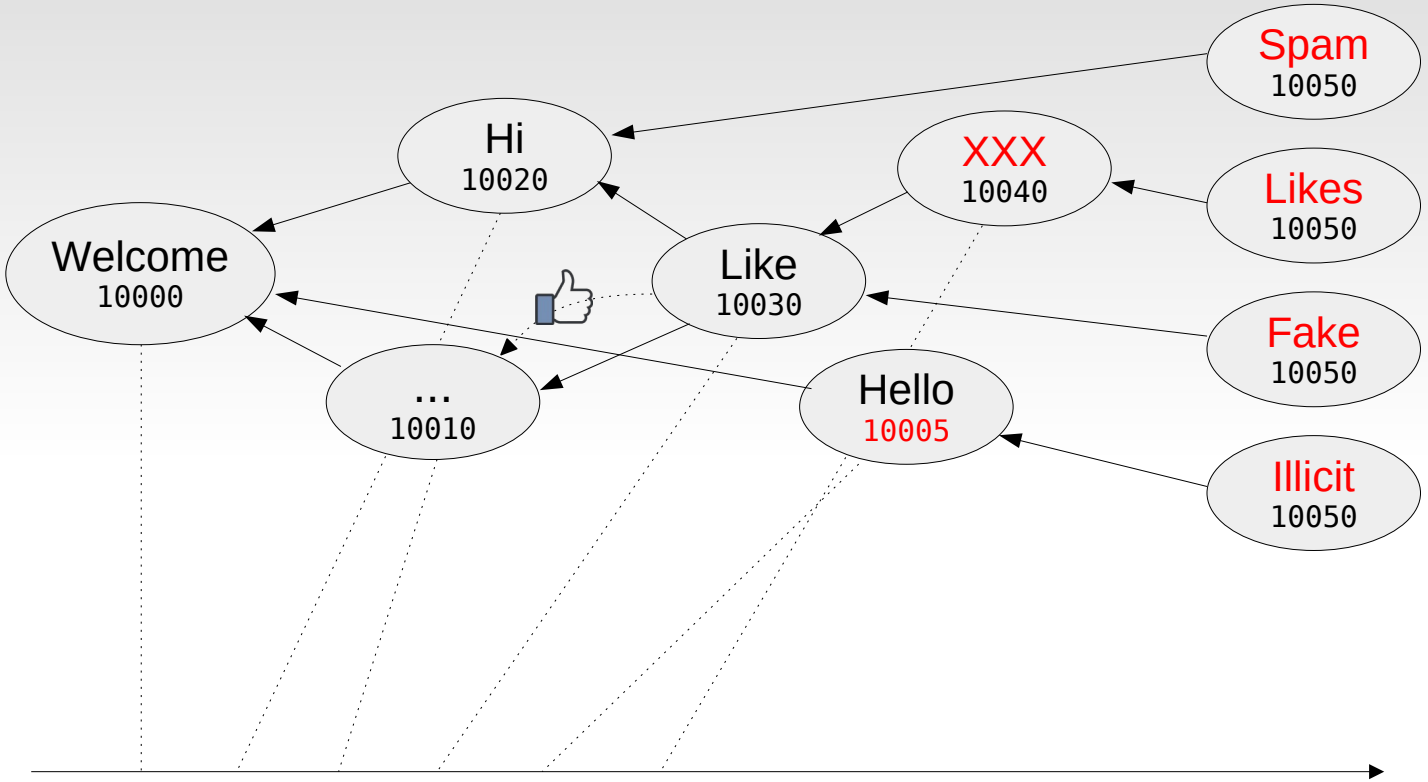

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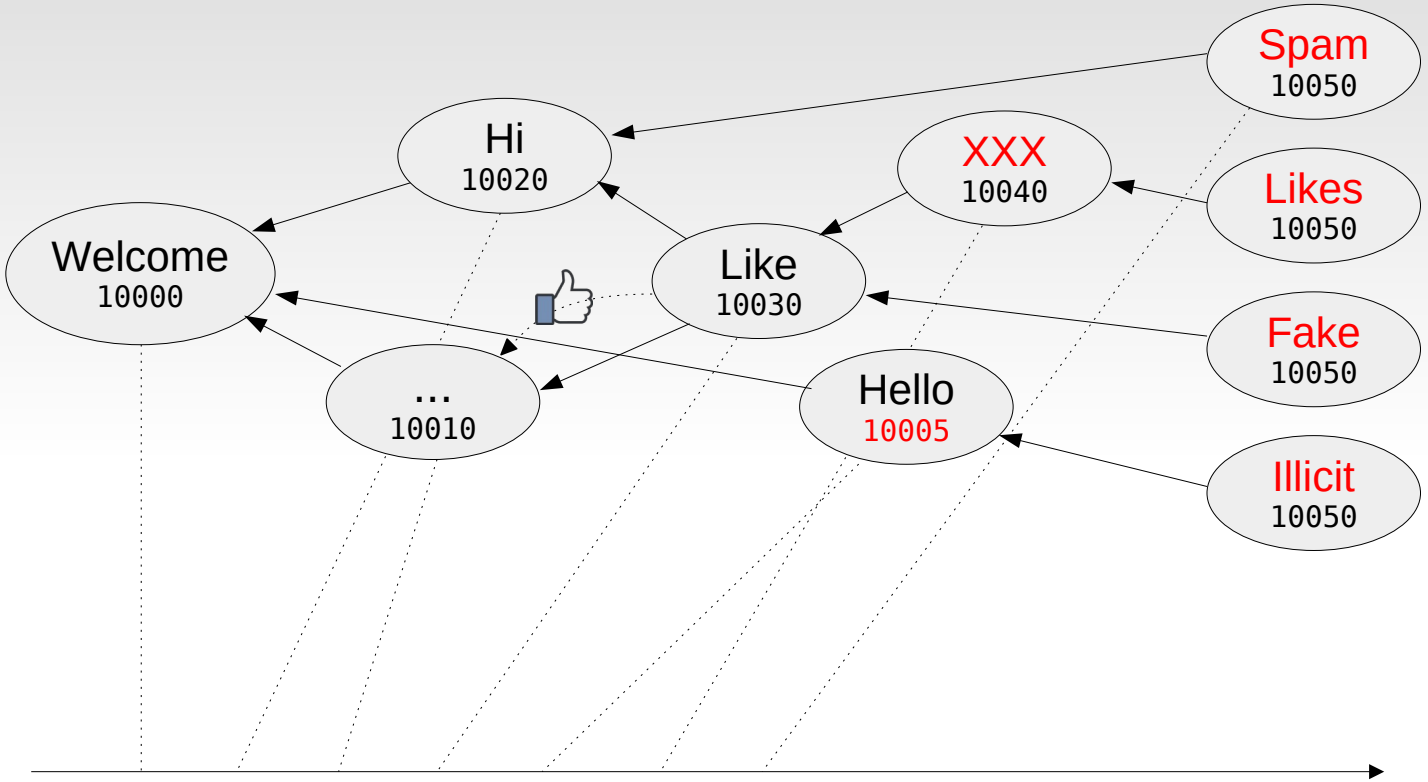

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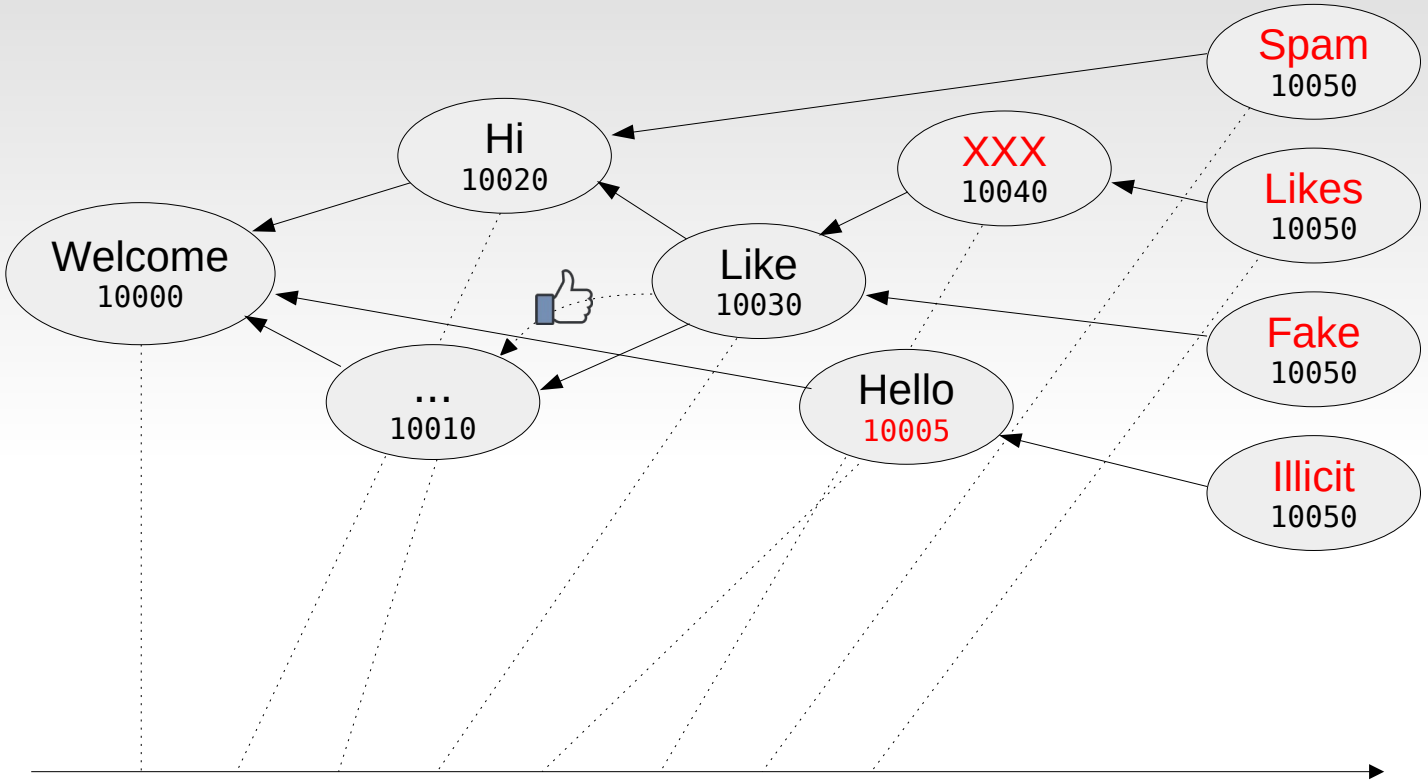

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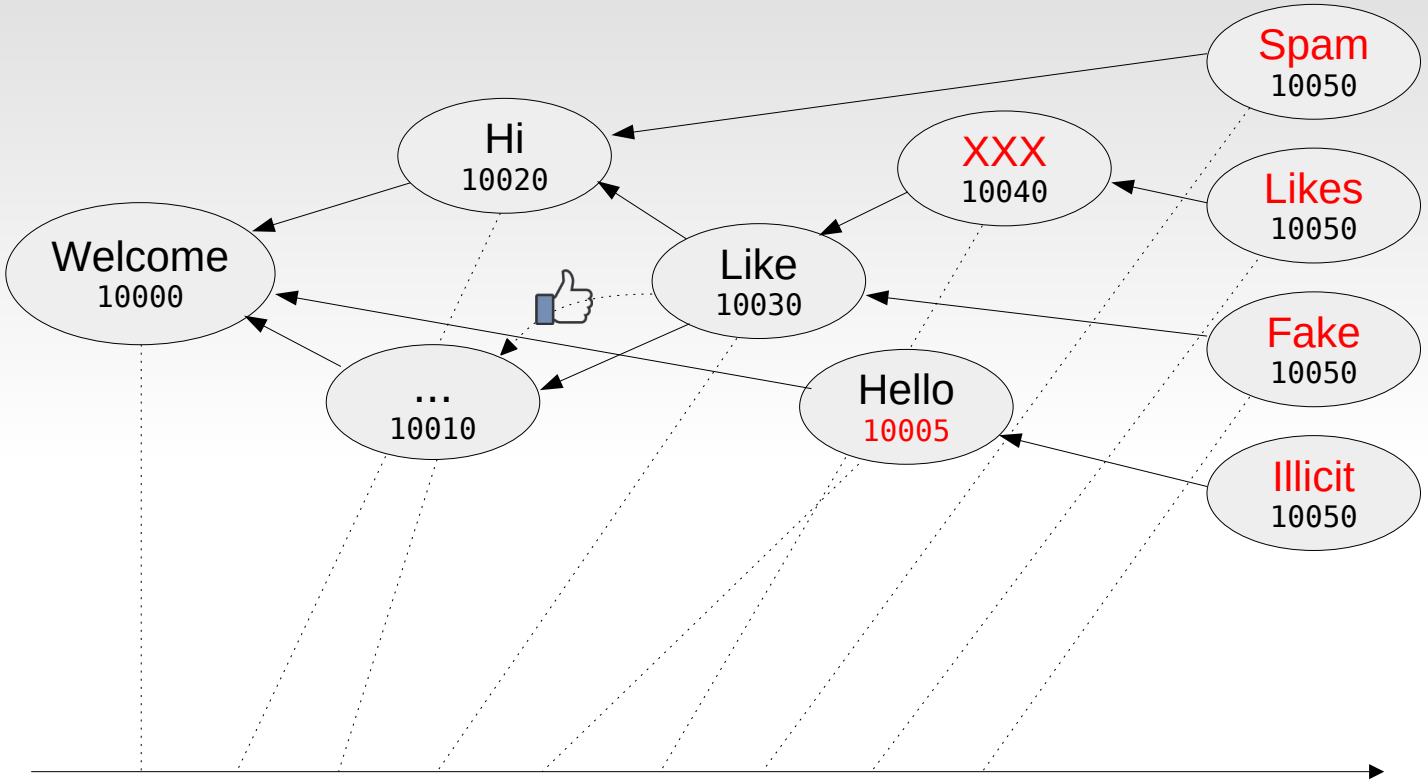

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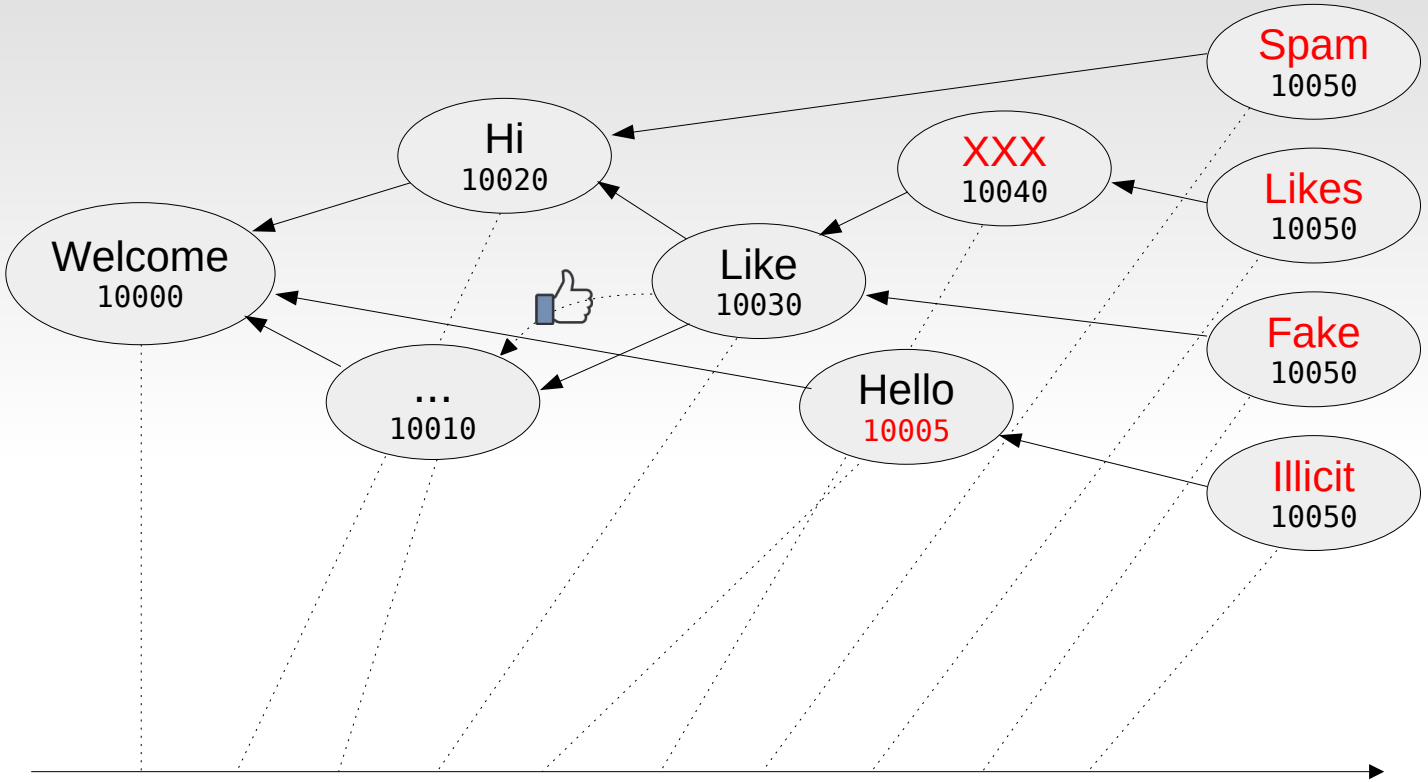

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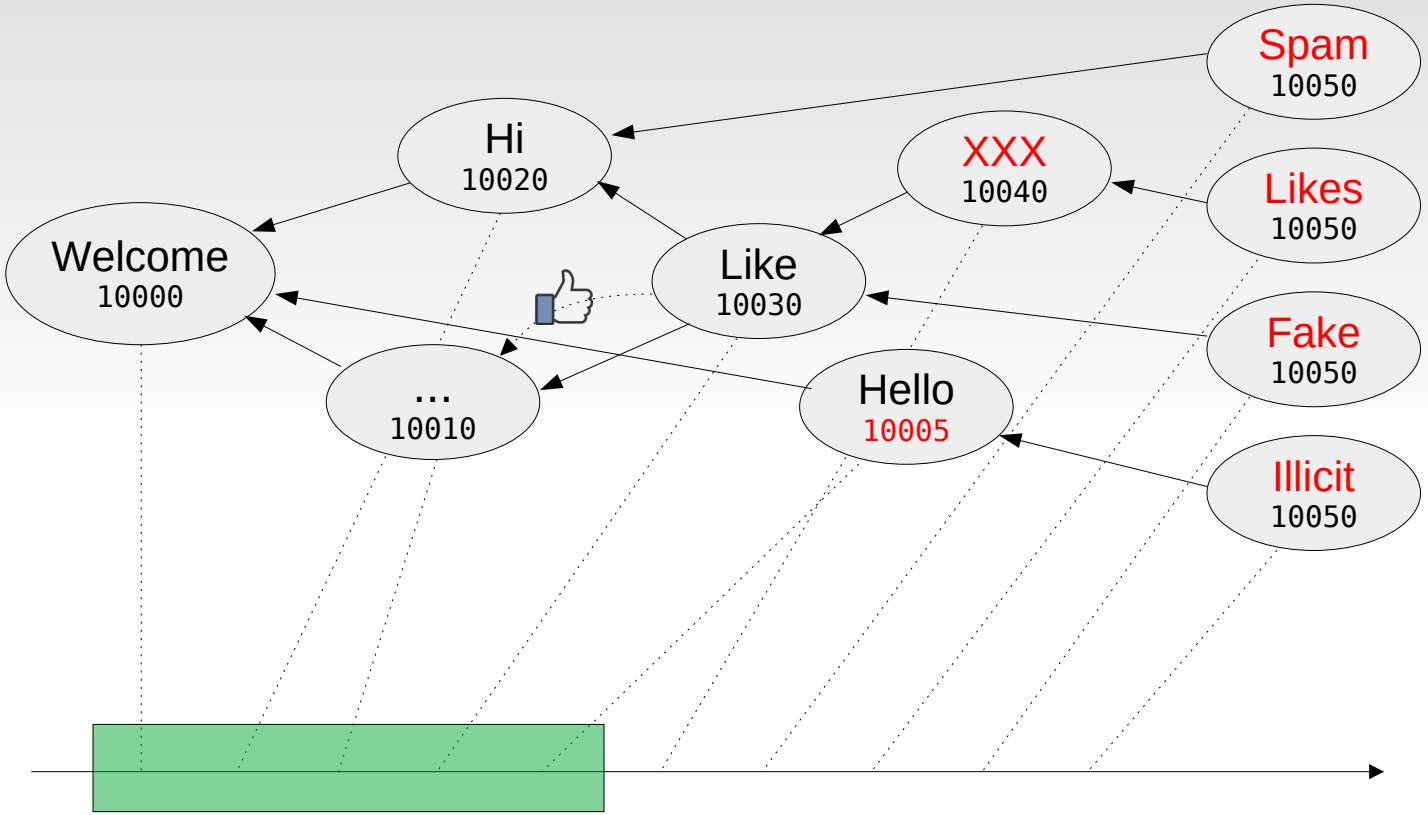

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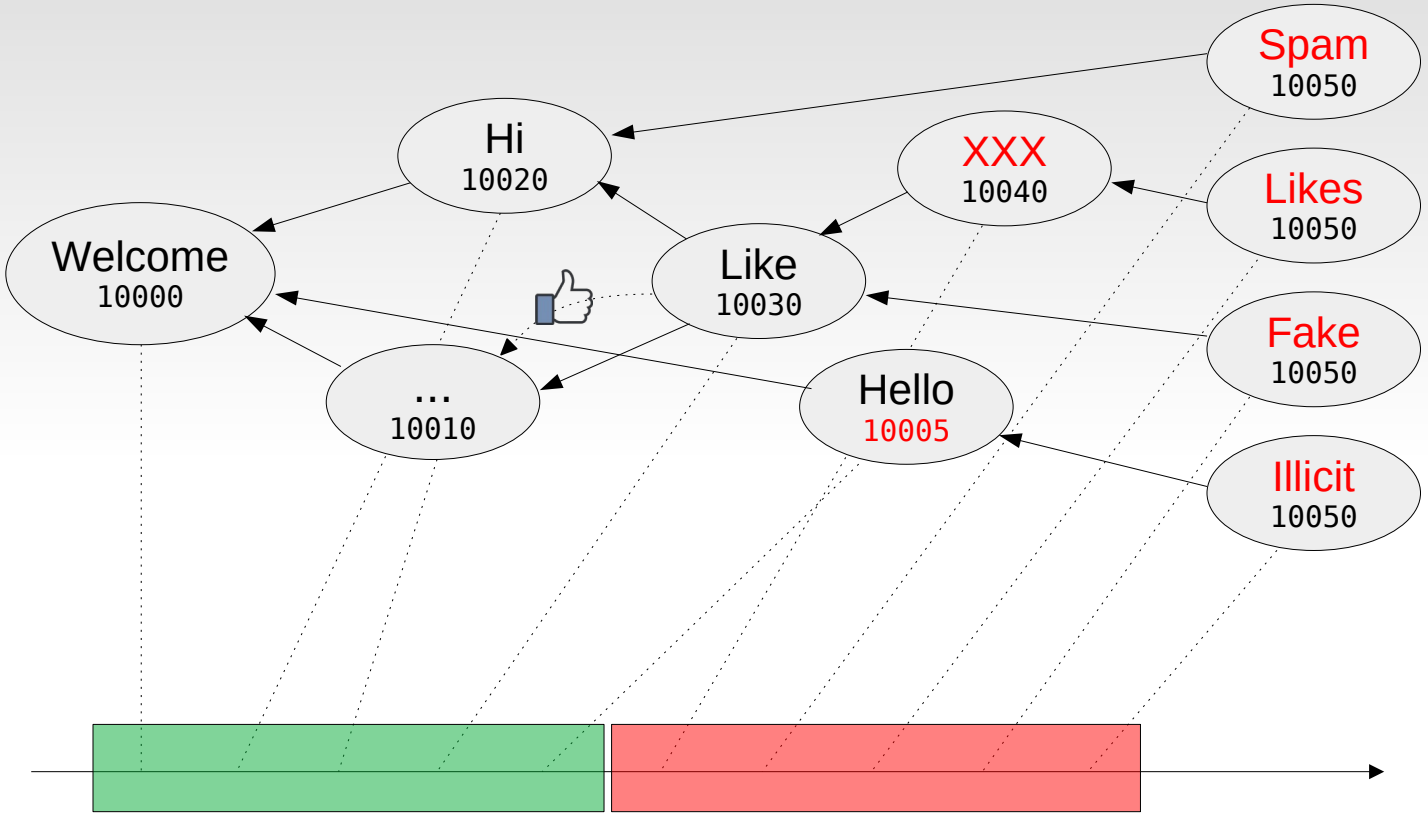

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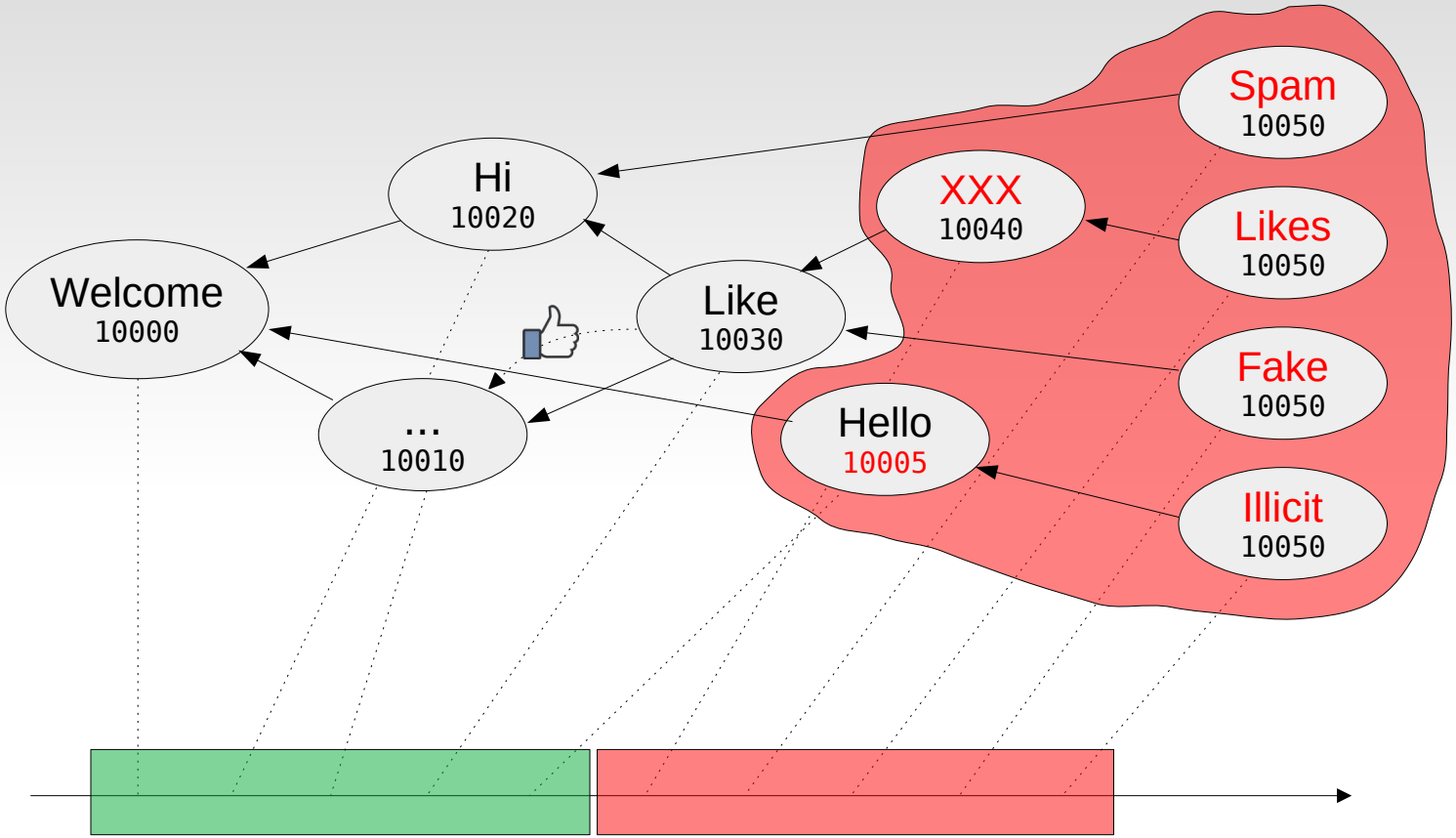

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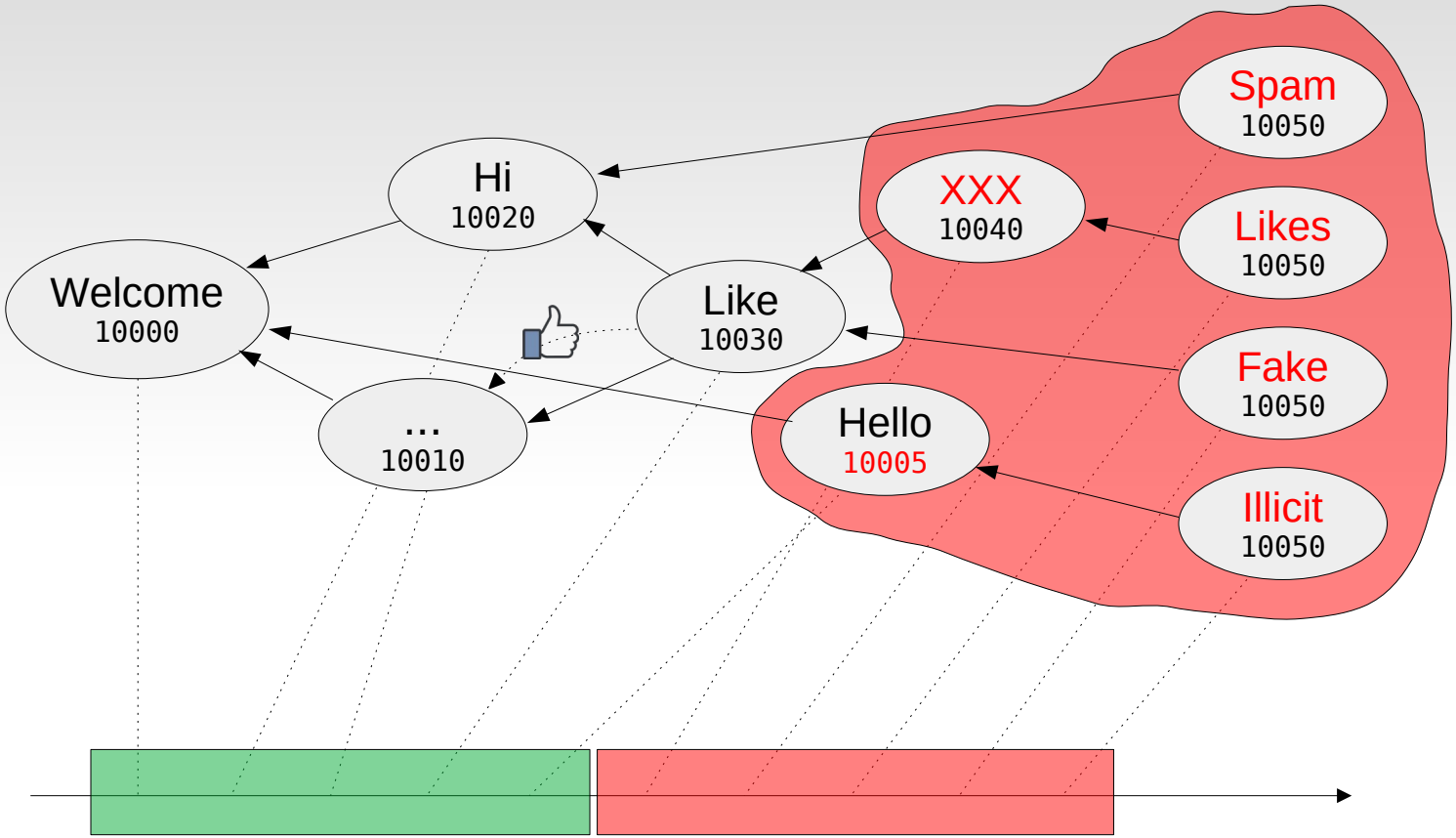

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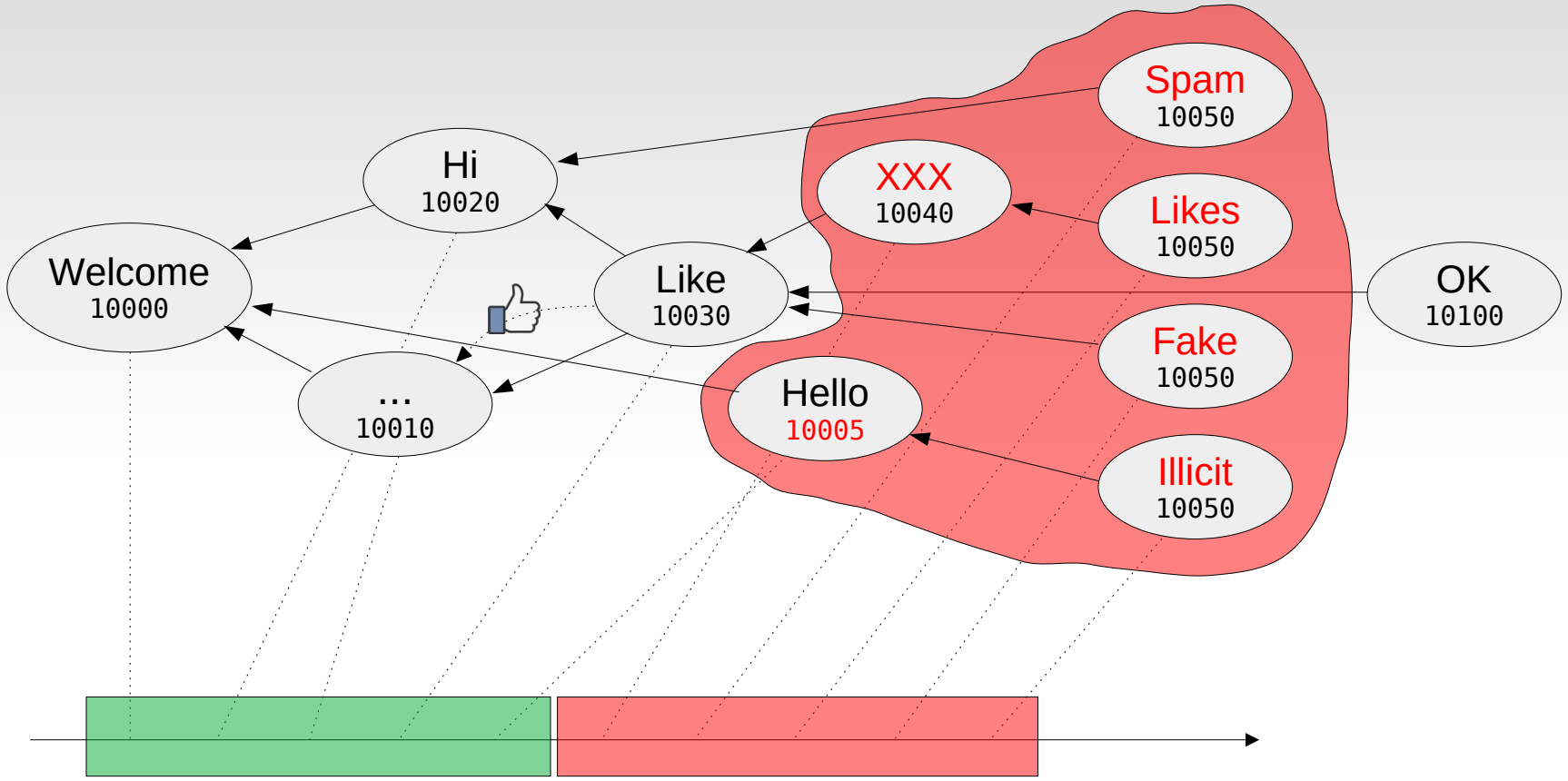

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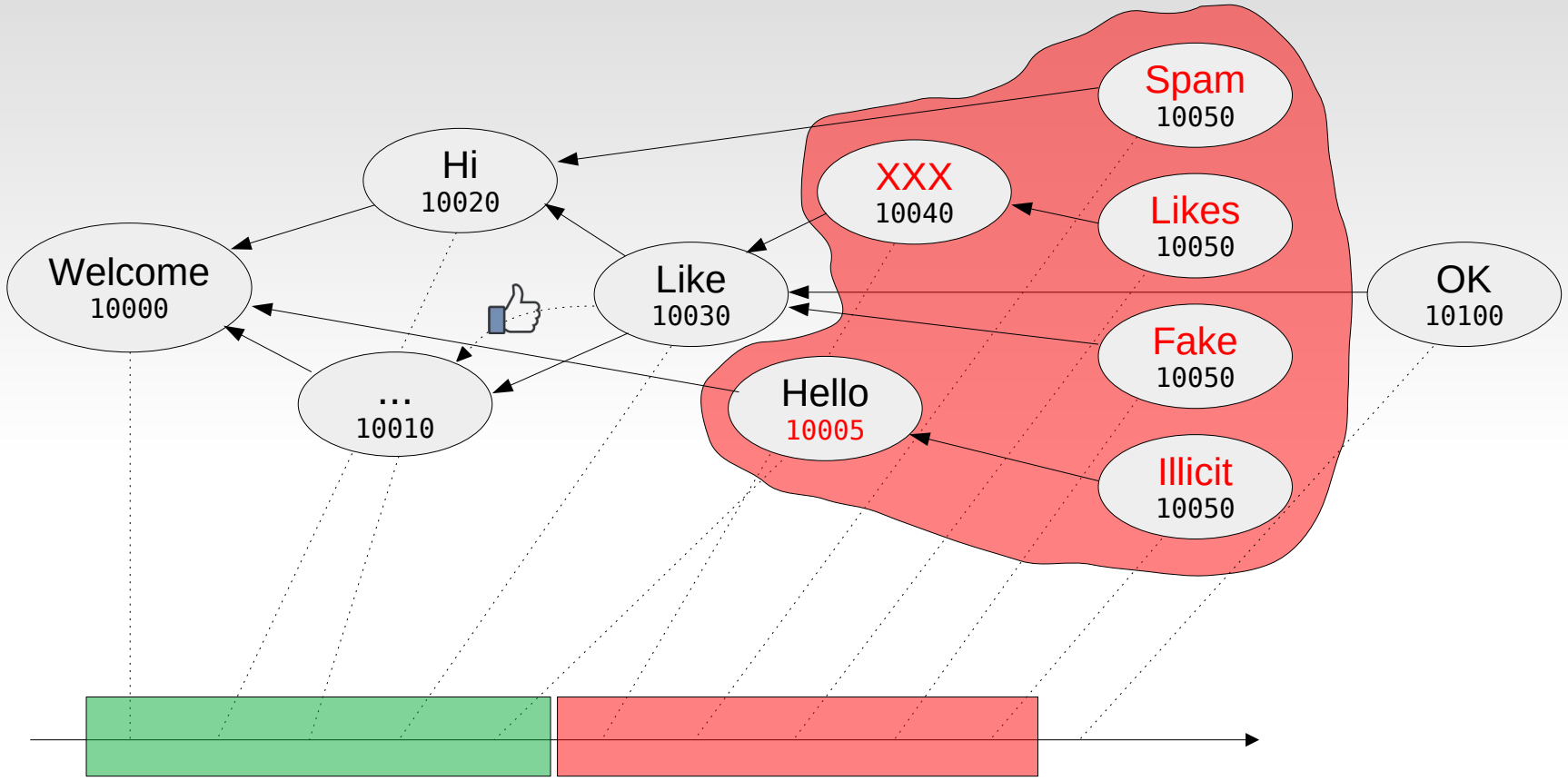

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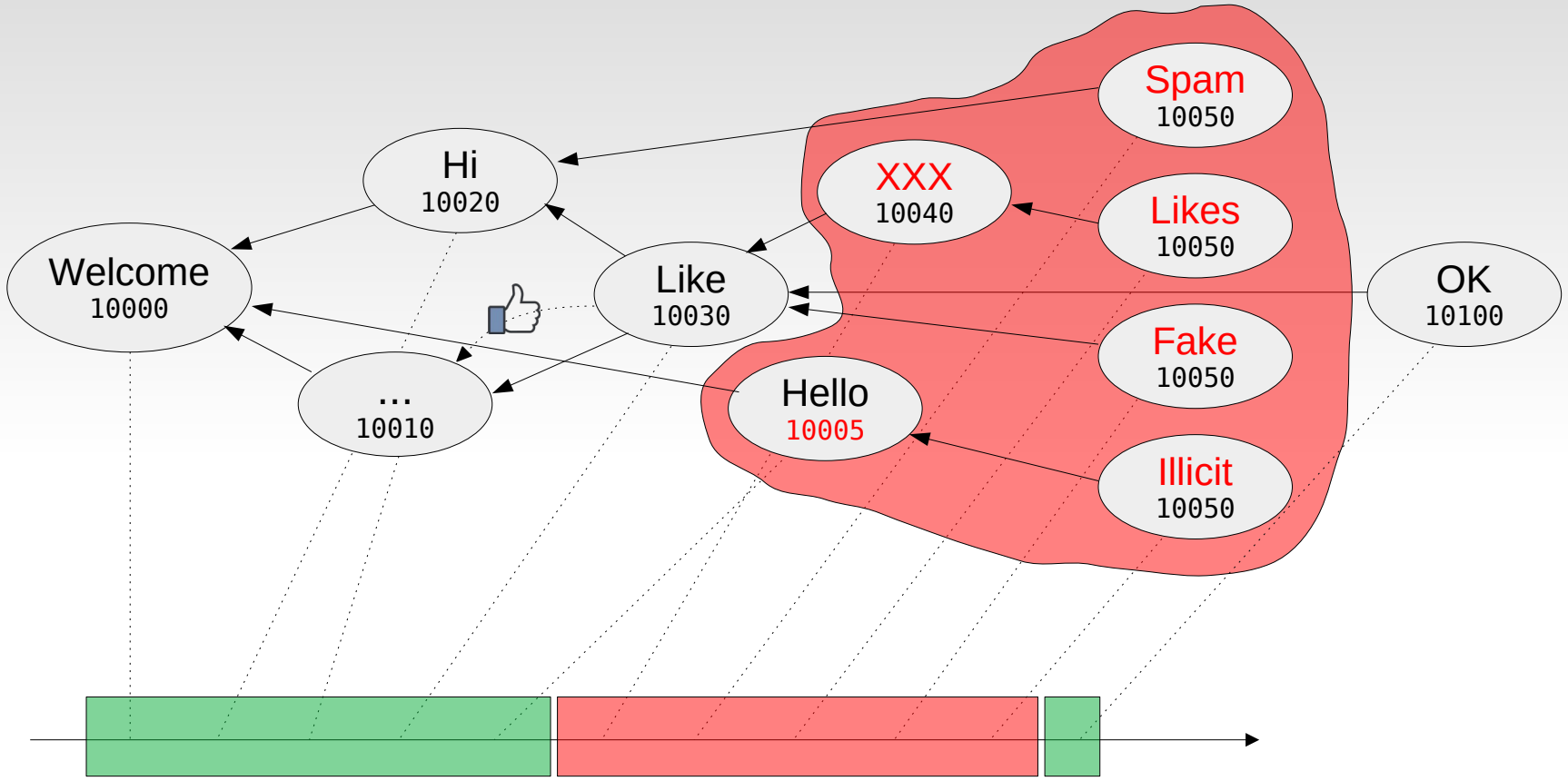

Reputation (reps)

Emission	1.a	pioneers	*+30 reps* to pioneers
	1.b	old post	*+1 rep* to author (>24h)
Expense	2	new post	*-1 rep* to author (0-12h)
Tranfer	3.a	like	*-1 rep -> +1 rep*
	3.b	dislike	*-1 rep -> -1 rep*
Constraints	4.a	min	+1 rep to post
	4.b	max	+30 reps max
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Constraints	4.a	min	+1 rep to post
	4.b	max	+30 reps max
	4.c	size	128Kb max

Reputation (reps)

- Forum pioneer → + reps
- New content → - reps
- Consolidated content → + reps
- Likes & Dislikes → +/- reps

Sybil Resistance

Emission	1.a	pioneers	*+30 reps* to pioneers
	1.b	old post	*+1 rep* to author (>24h)
Expense	2	new post	*-1 rep* to author (0-12h)
Tranfer	3.a	like	*-1 rep -> +1 rep*
	3.b	dislike	*-1 rep -> -1 rep*
Constraints	4.a	min	+1 rep to post
	4.b	max	+30 reps max
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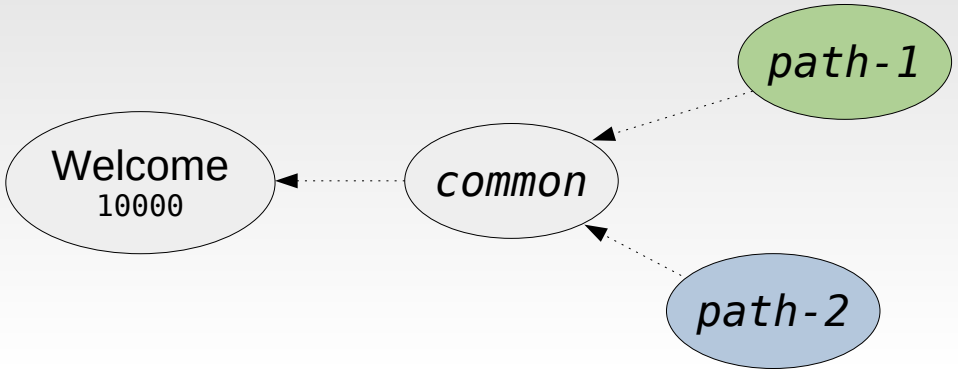
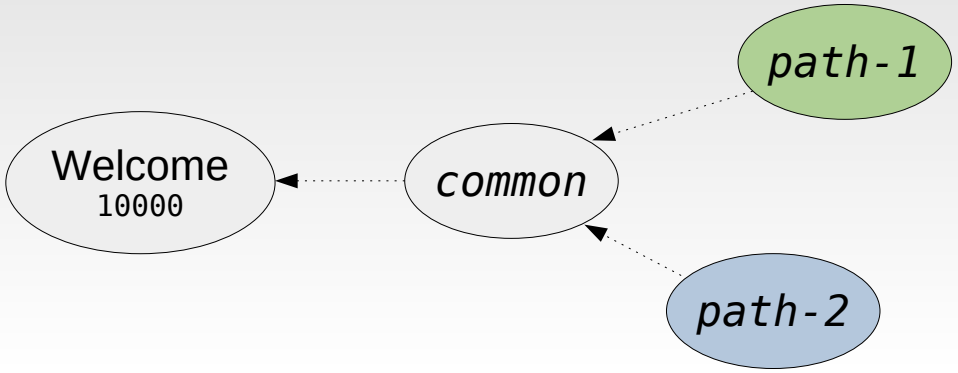
Reputation → Consensus



Reputation → Consensus



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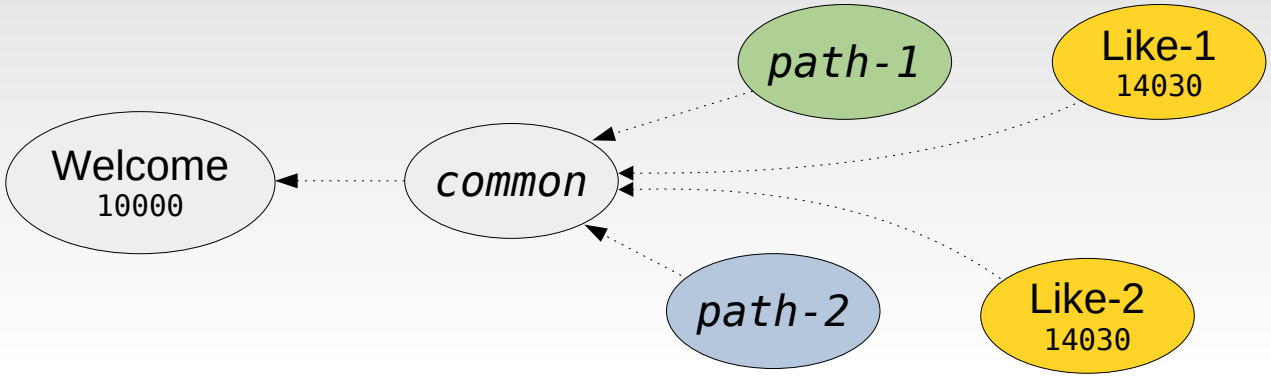

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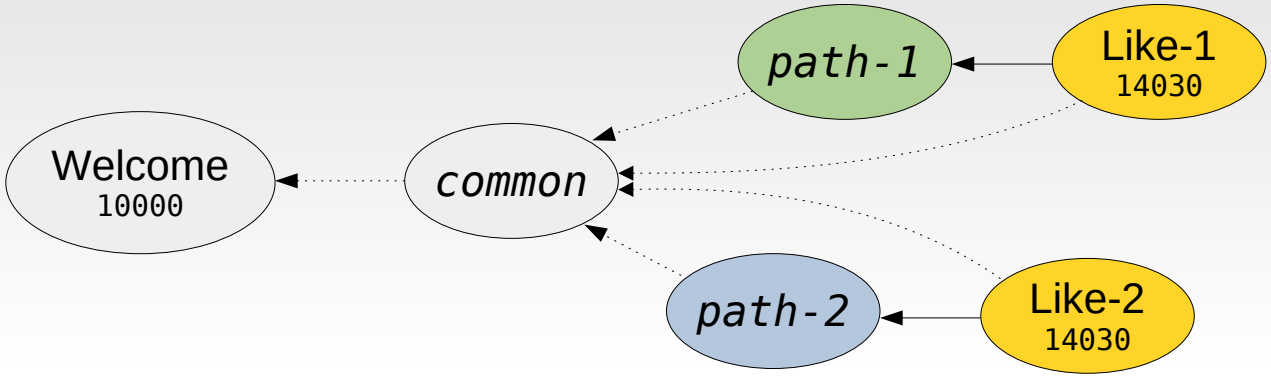

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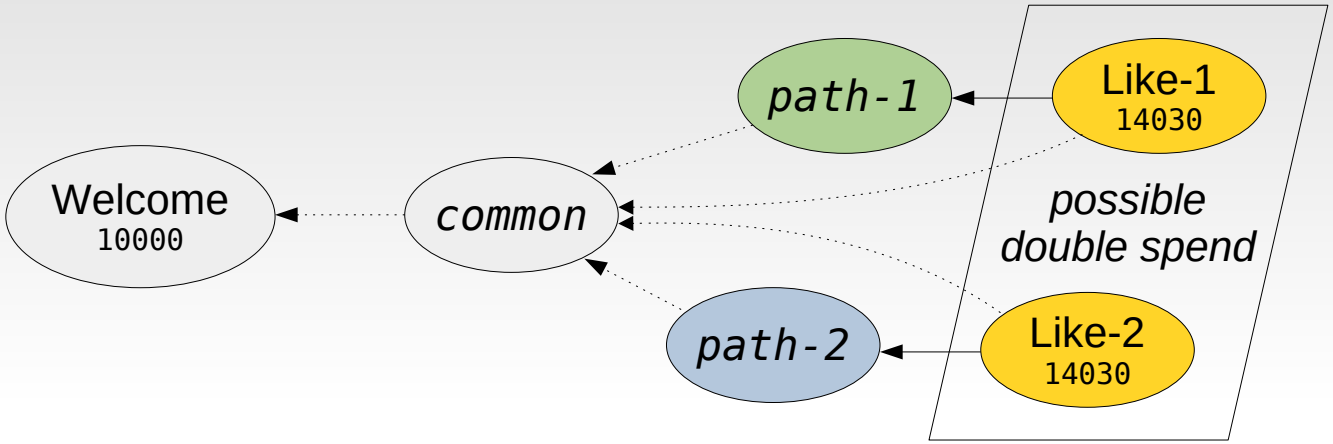

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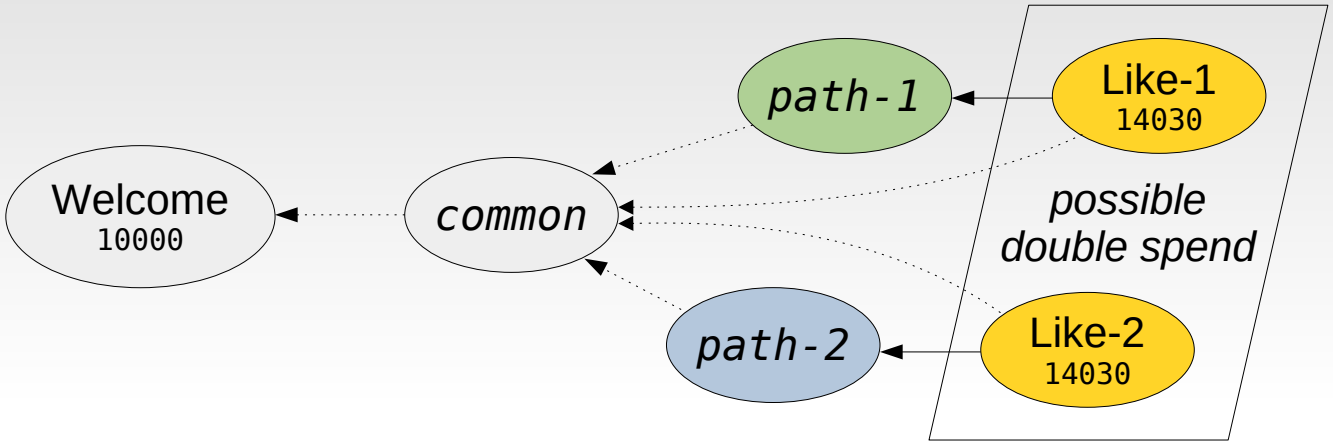

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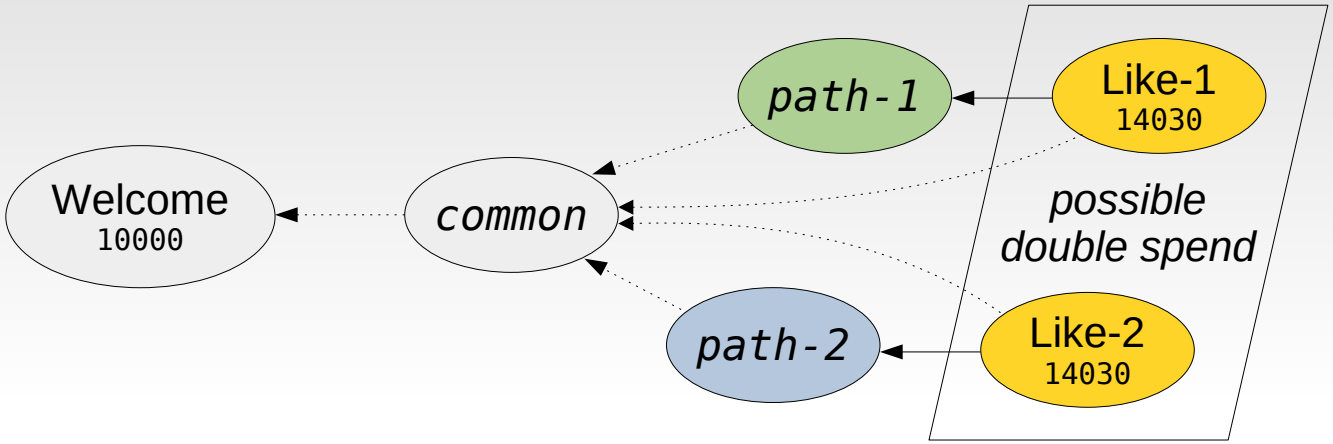

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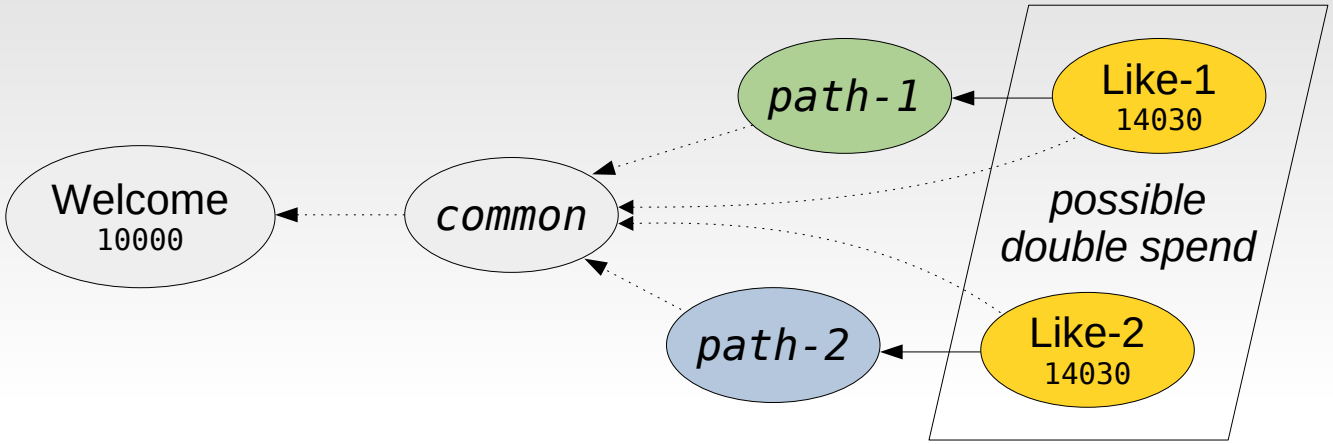

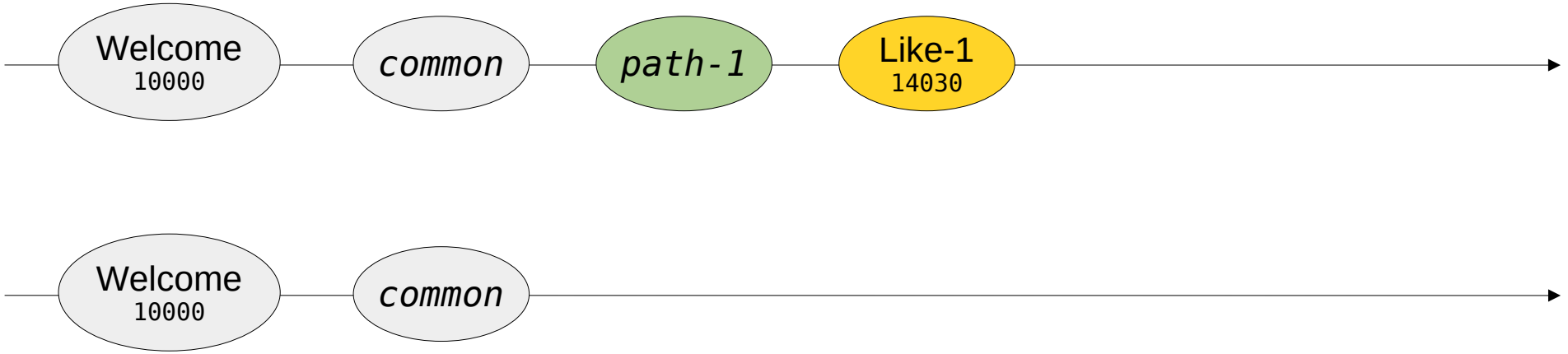

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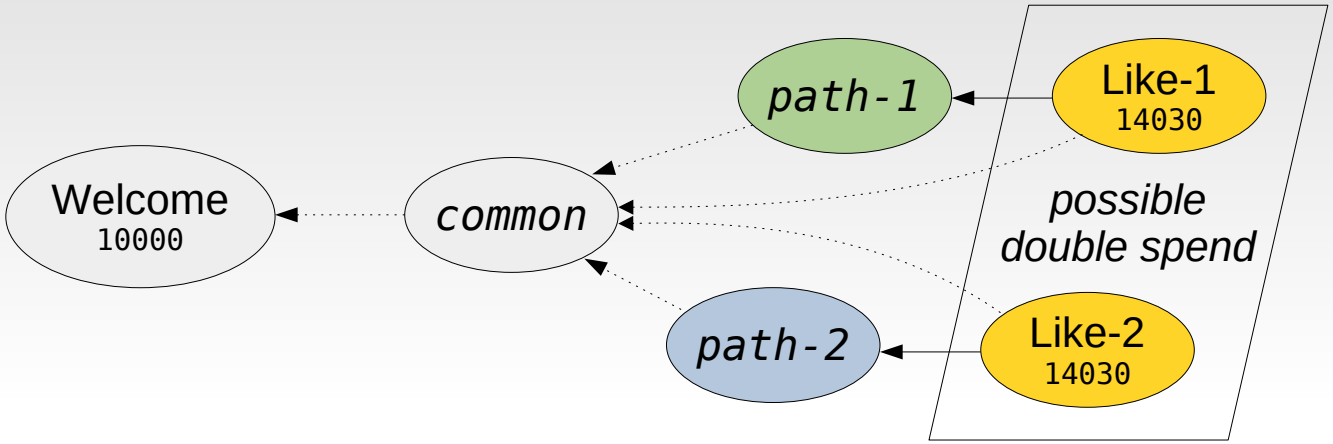

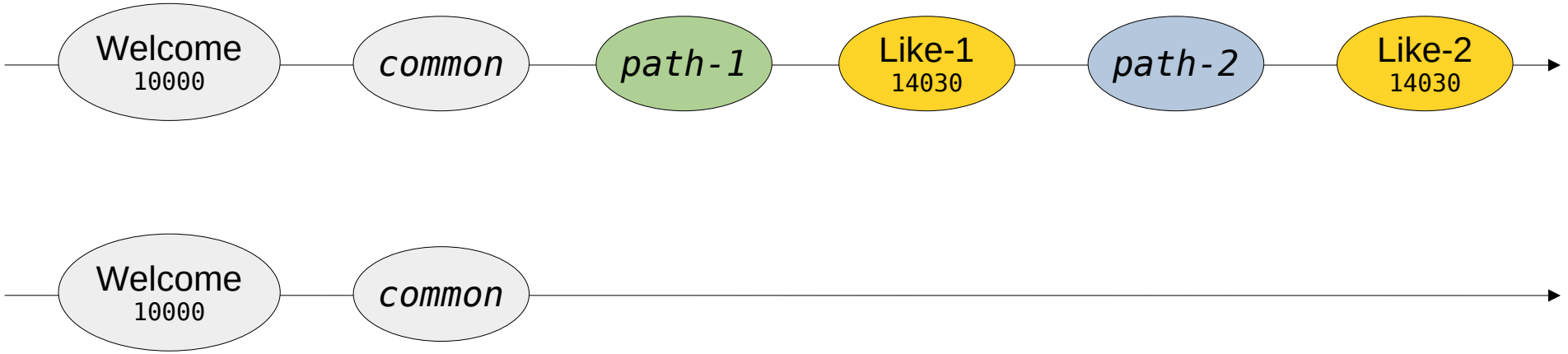

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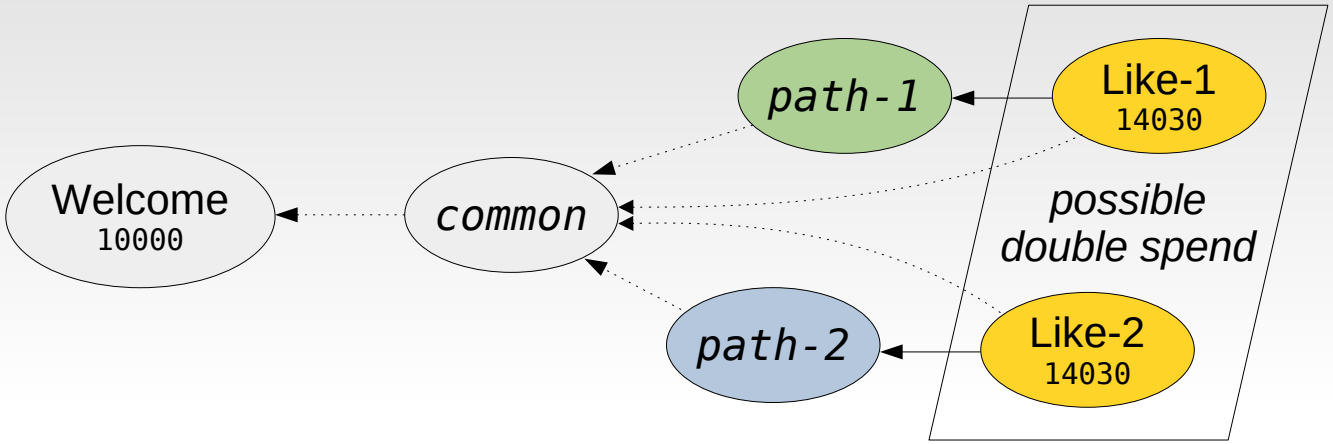

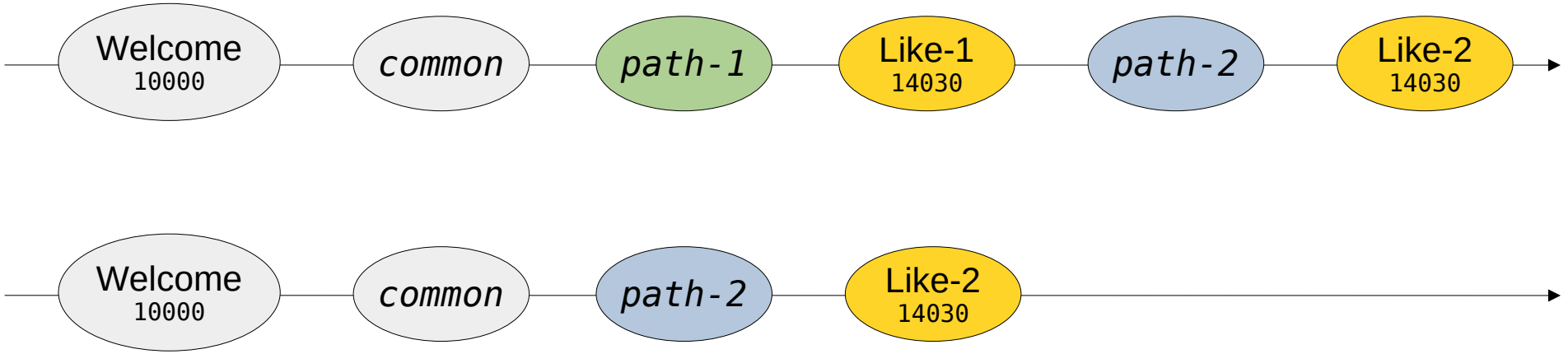

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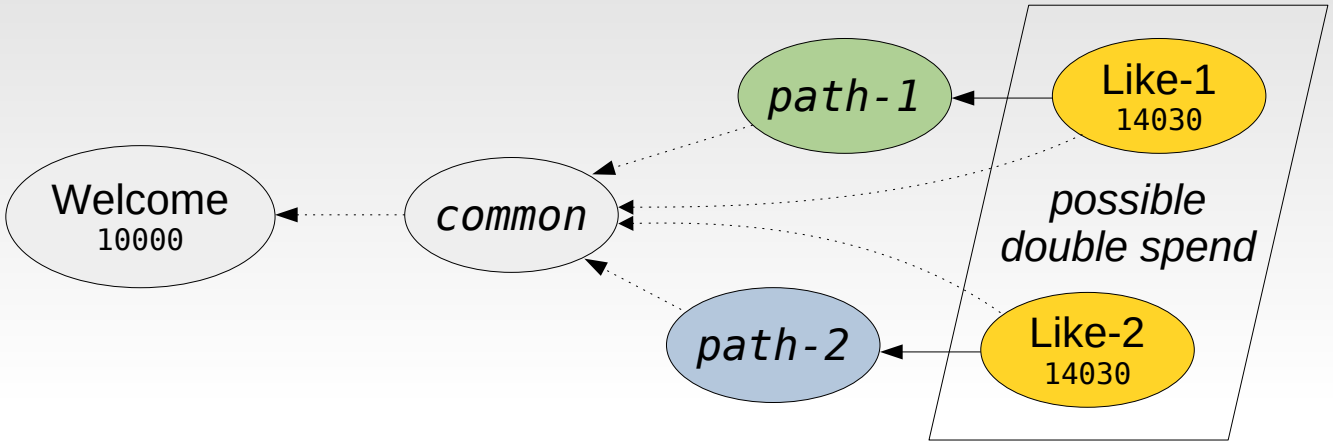

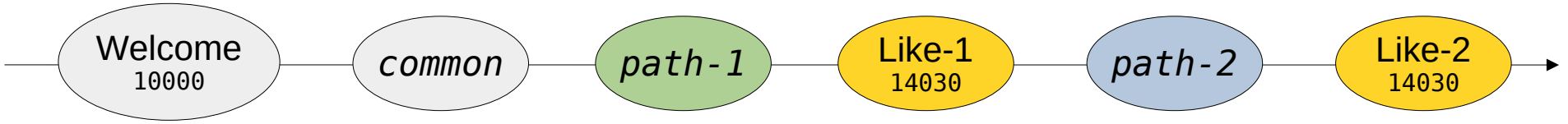

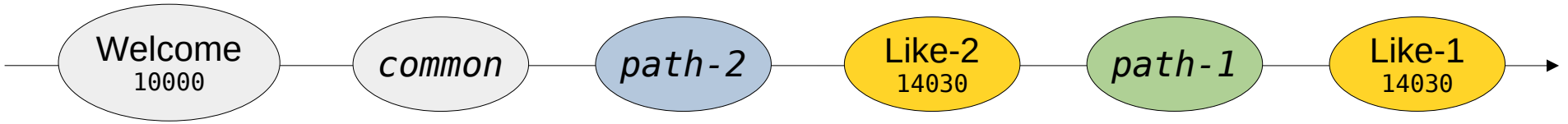

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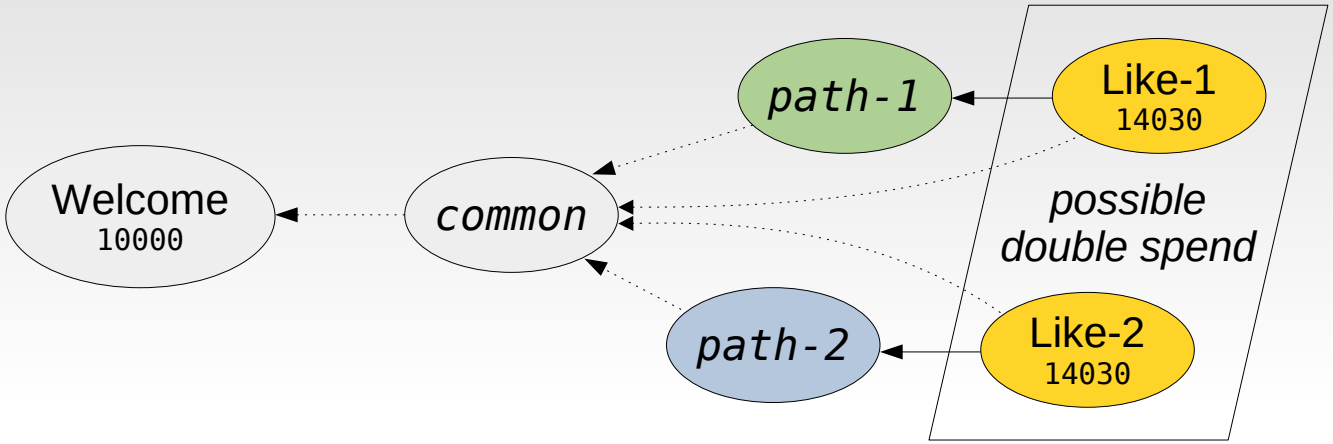

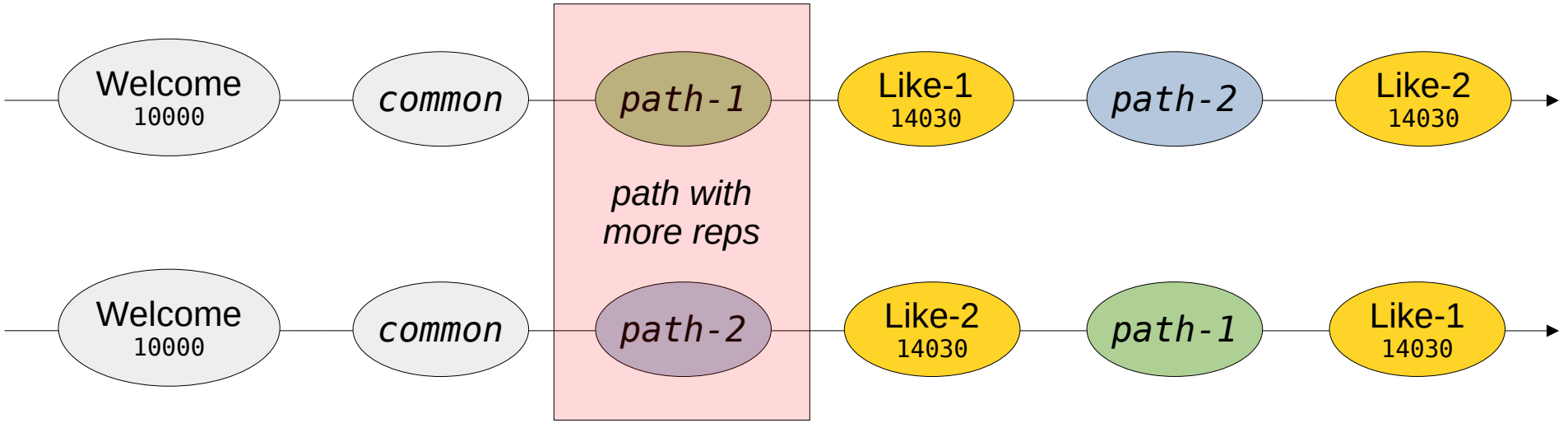

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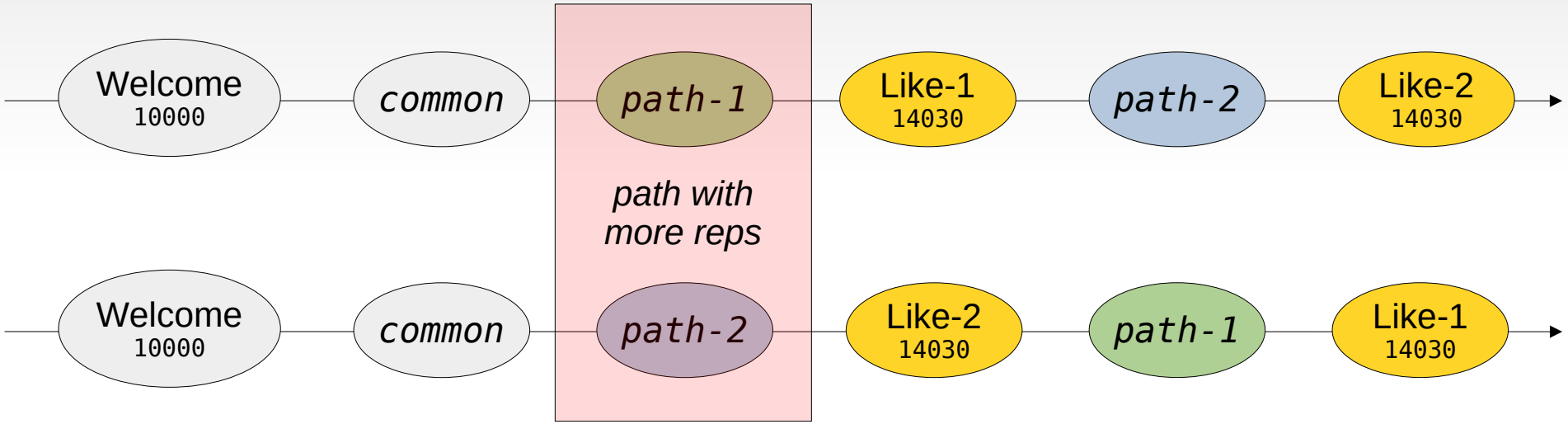

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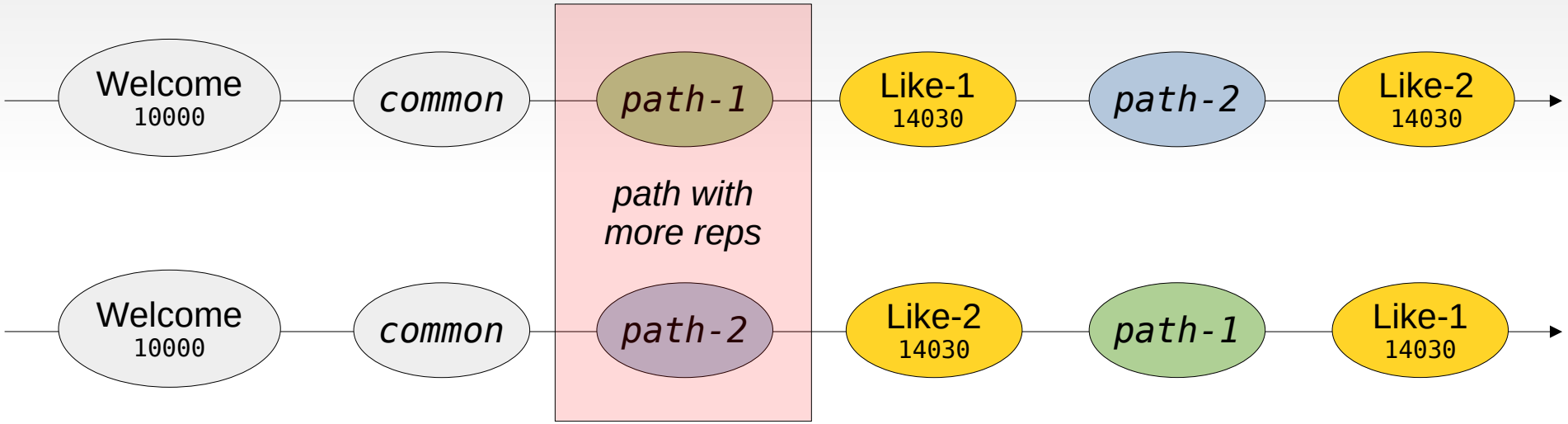

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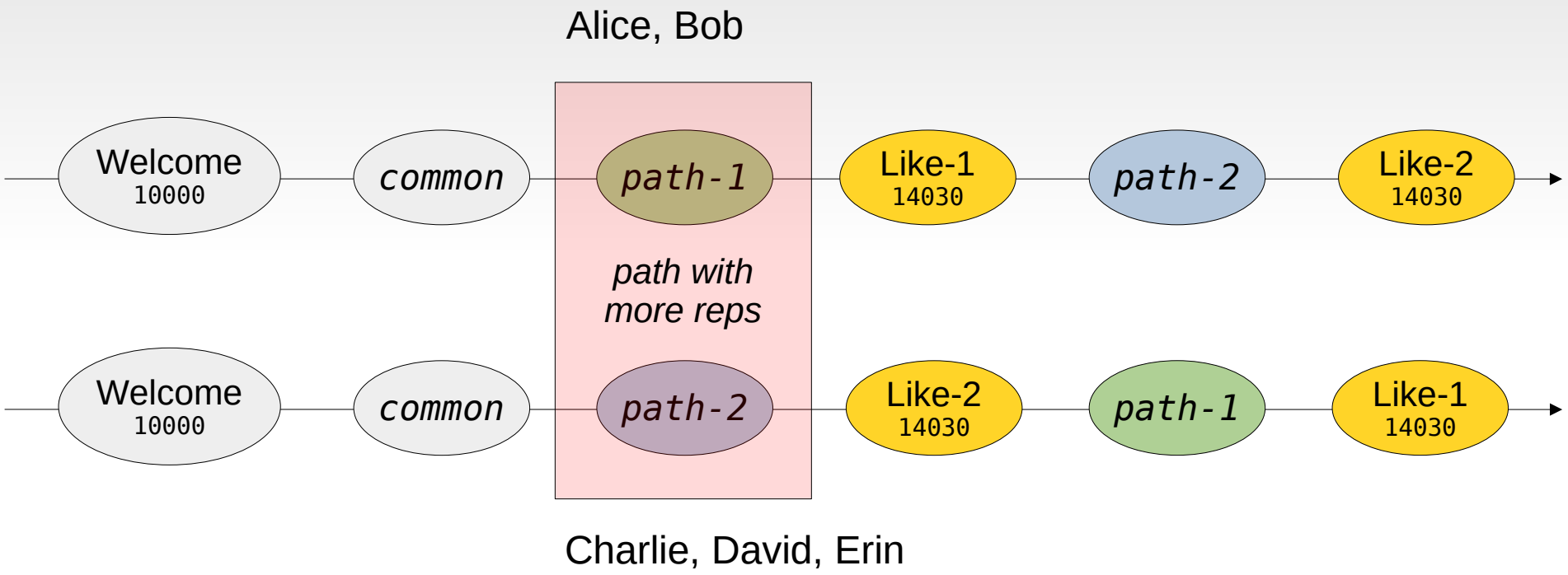

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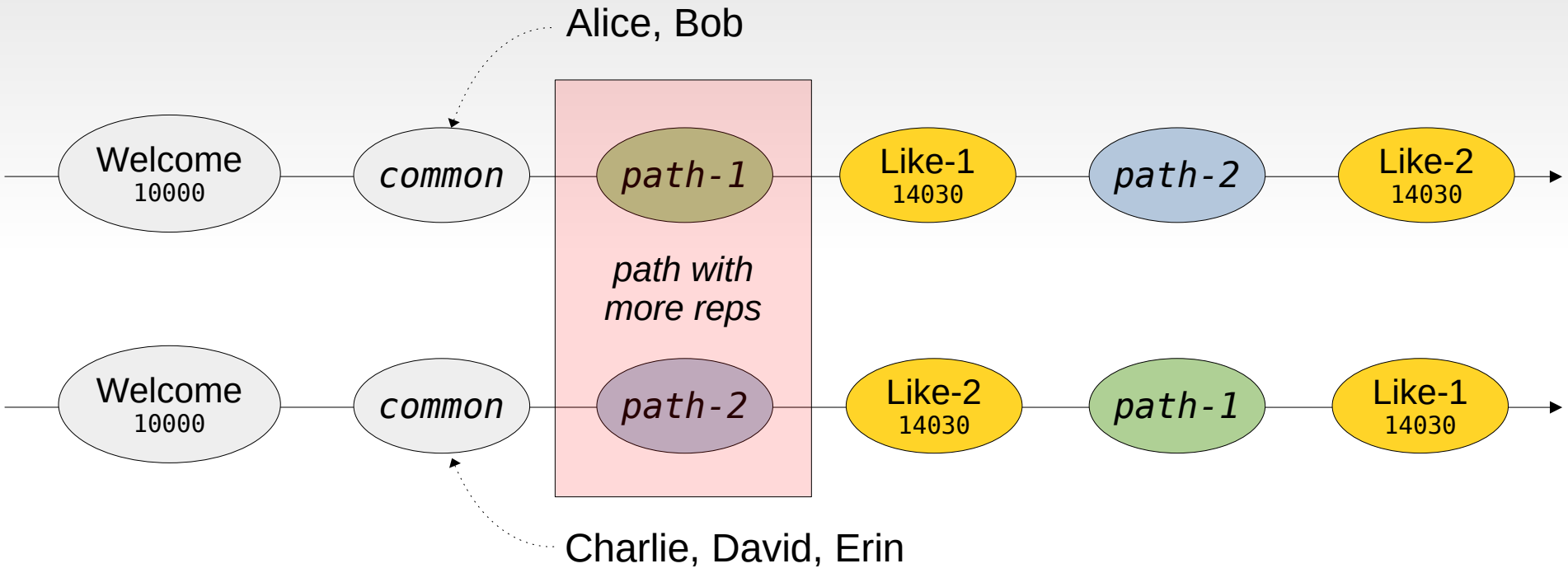

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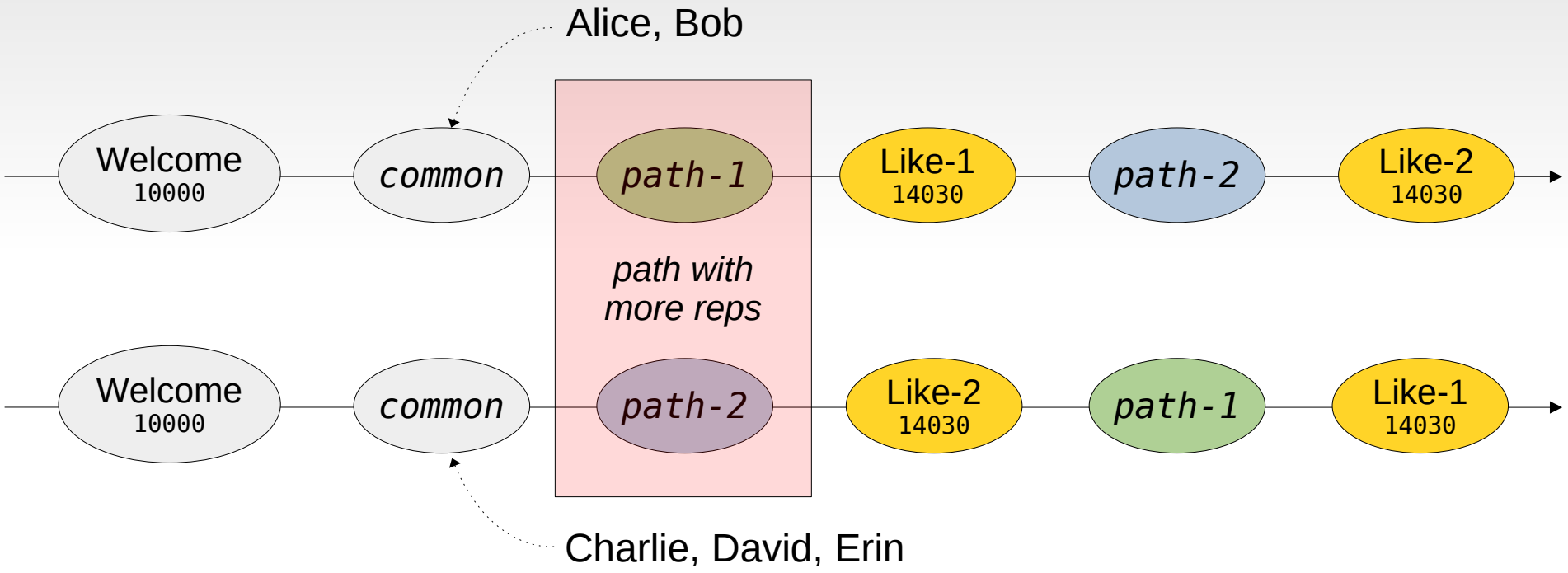
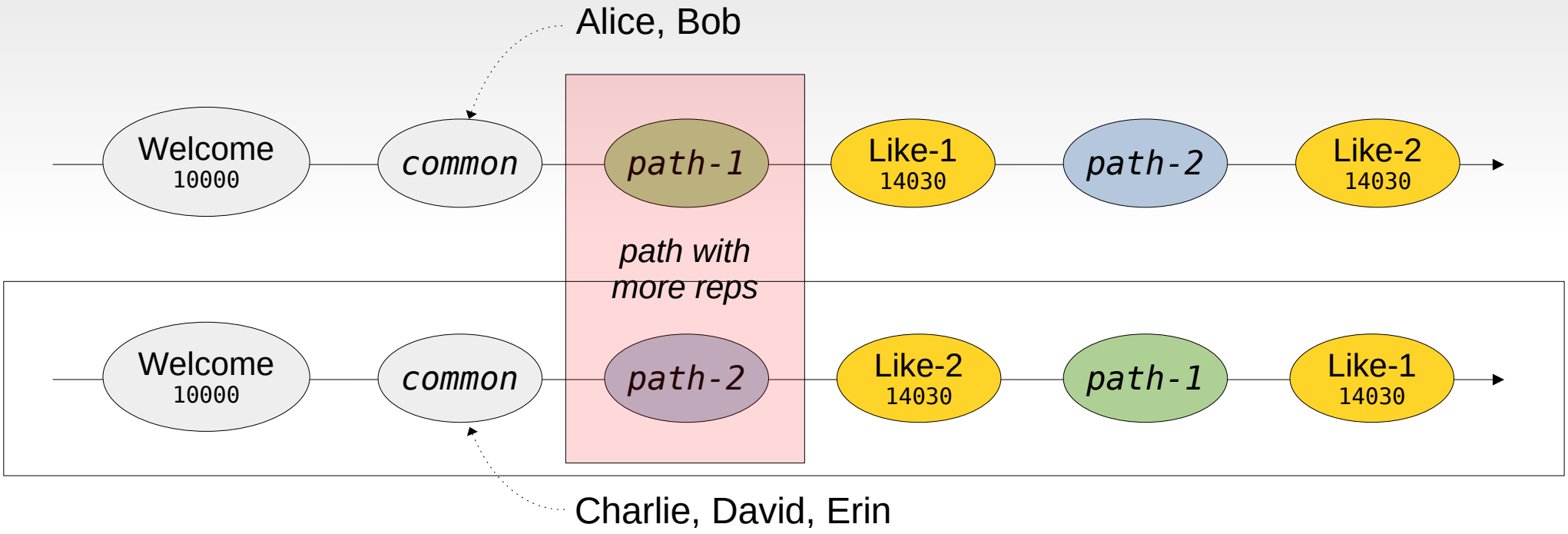


$$R(A)+R(B) < R(C)+R(D)+R(E)$$

Reputation → Consensus



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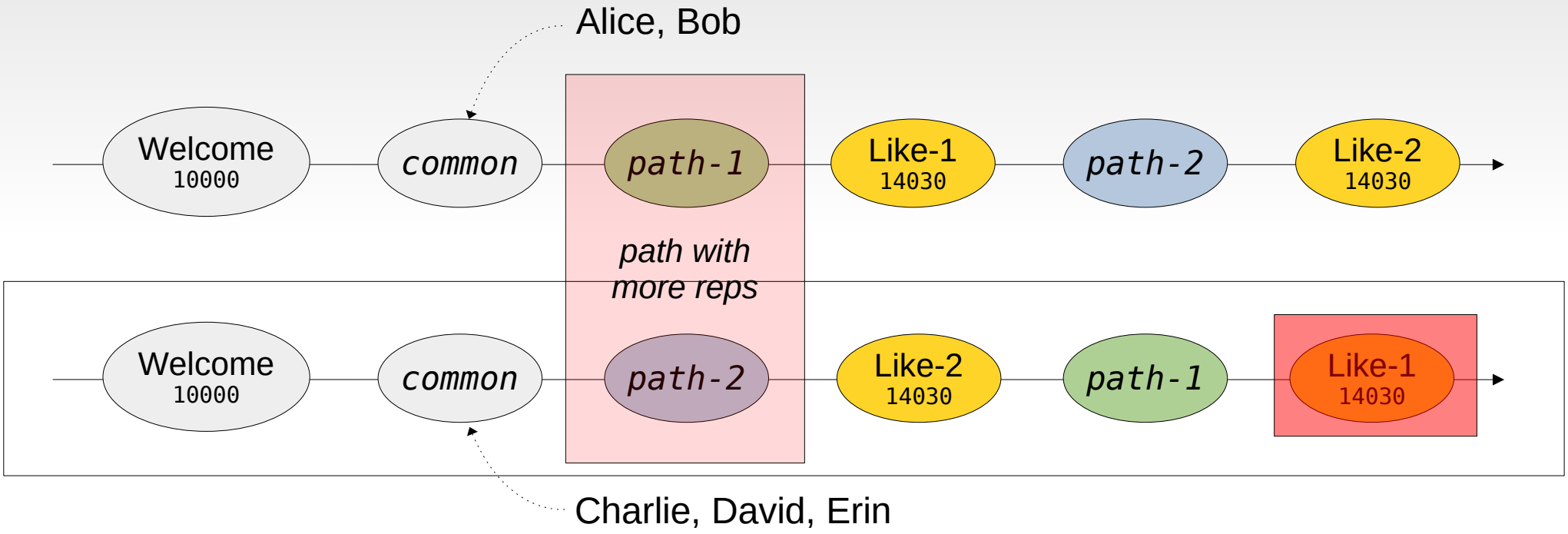

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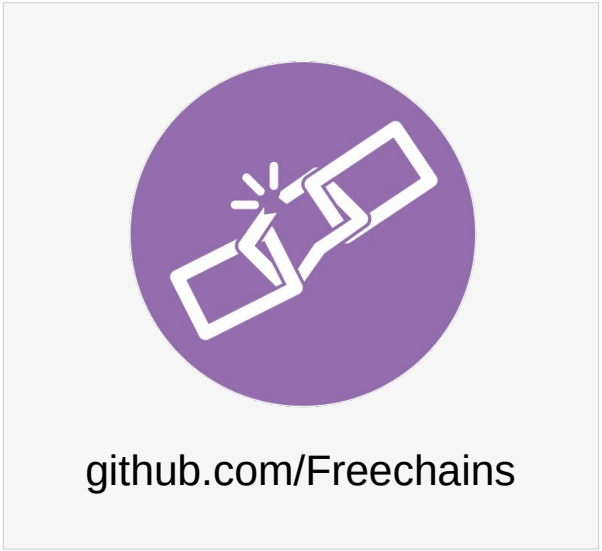
Freechains

github.com/Freechains

Freechains

- Permissionless consensus protocol



Freechains

- Permissionless consensus protocol
- Consensus via reputation (*proof-of-authoring*)

github.com/Freechains

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- Subjective judgment (likes & dislikes)

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Freechains

- Permissionless consensus protocol
- Consensus via reputation (*proof-of-authoring*)
- Subjective judgment (likes & dislikes)
- Solves the *double-spending* problem

github.com/Freechains

Main Contributions

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- Recognizing published contents as scarce resources

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- Allowing users to create diversified forums of interest
- Allowing users to work offline
- Supporting content removal without compromising the integrity of the blockchain

Peer-to-Peer Permissionless Consensus via Reputation

Francisco Sant'Anna, Fabio Bosisio, Lucas Pires

github.com/Freechains

Francisco Sant'Anna
francisco@ime.uerj.br
@_fsantanna

Extra Slides

Problems with Crypto

- They enforce a unique timeline to preserve value and immunity to attacks
- They lean towards concentration of power due to scaling effects
- They impose an external economic cost to use the protocol
- They rely exclusively on objective rules to reach consensus
- They require peers to be permanently online.

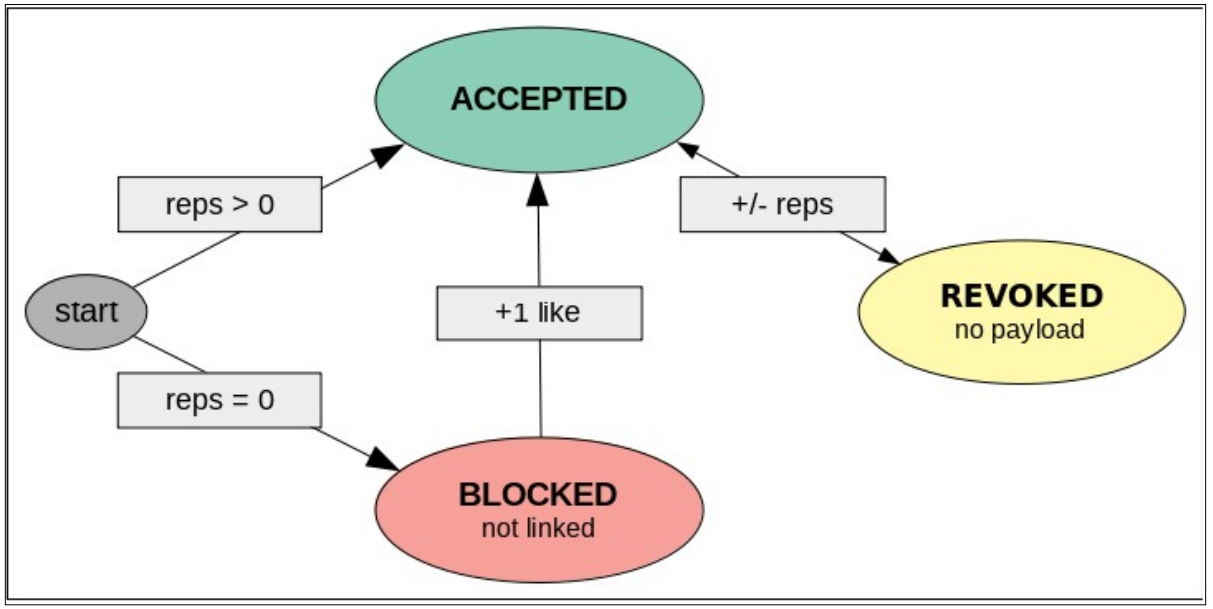
Local-First Software (*)

- Users can work offline
- Forks are not only permitted but encouraged
- Blocks are individual posts
  - (intrinsic vs extrinsic value)
- Primary blockchain is a DAG not a list
- But...
  - the longer disconnected, the more conflicts
  - posts reordering when rejoining

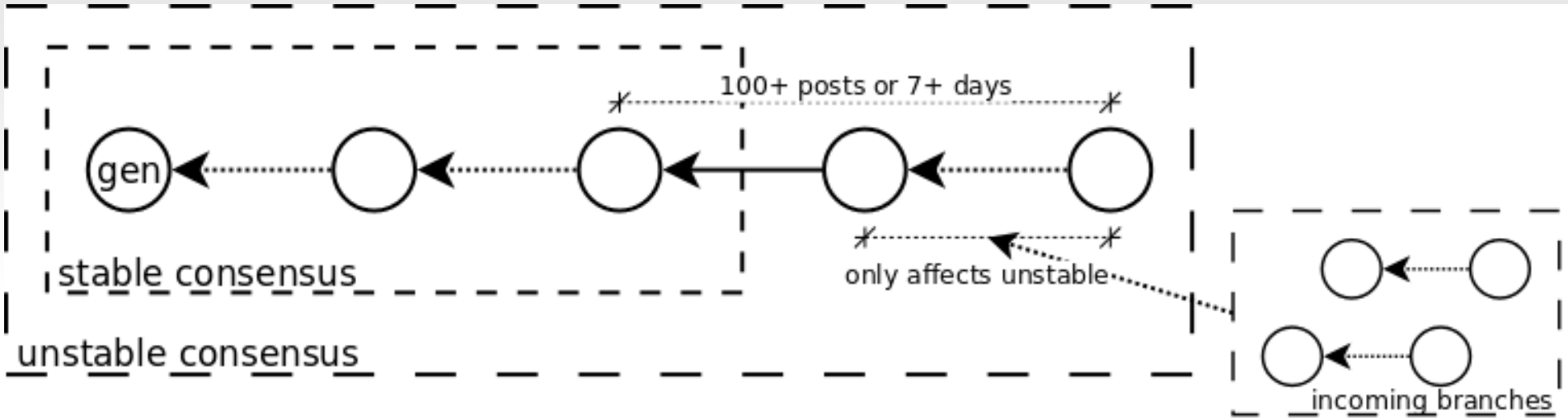
(*) M. Kleppmann et al. Local-first software: you own your data, in spite of the cloud. In Onward'19, pages 154–178, 2019.

Content Removal

- Users can revoke posts with dislikes.
- Peers are forced to remove payloads, only forwarding associated blockchain metadata.
- Does not compromise the integrity of the blockchain.



Stable Consensus



- Freezes the order of posts once they cross the threshold
- Prevents long-lasting local branches to merge
- Creates a hard fork
- Reconciling branches is no longer possible

Evaluation

- Internet Archives
  - 10k messages
  - chat channel, 3 months, *Wikimedia Foundation*
  - newsgroup forum, 9 years, *comp.compilers*
- Evaluate
  - metadata overhead
  - consensus runtime
  - graph forks (asynchronicity)
  - blocked messages (bookkeeping)

Evaluation

- Metadata overhead
  - Chat: 10x
  - Newsgroup: 50%
- Consensus runtime
  - Chat: 125s and **50ms**
  - Newsgroup: 100s and **70ms**
- Graph forks (asynchronicity)
  - Chat: 18%
  - Newsgroup: 14%
- Blocked messages (bookkeeping)
  - Chat: 3.7%
  - Newsgroup: 3.5%

Conclusion

Finally, we do not claim that the proposed reputation system enforces "good" human behavior in any way. Instead, it provides a transparent and quantitative mechanism to help users understand the evolution of forums and act accordingly. Human creativity contrasts with plain economic resources (e.g., proof-of-work), which do not appraise social interactions and also tend to concentrate power over the time.