

Decentralized Collaborative Version Control

DICG'21



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TU Delft

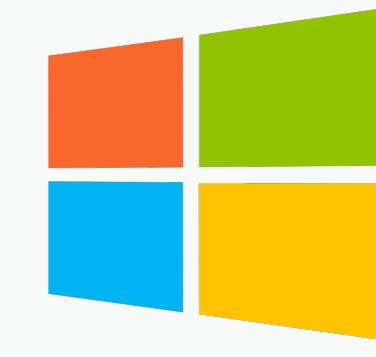
Centralised Services Dominate the Market

5 Largest Corporations by Market Capitalisation



Apple

2254



Microsoft

1682



Amazon

1634



Google

1185



Facebook

777

*Asset evaluation in billions of dollars

Decentralized Services as an Alternative

Decentralized Services as an Alternative



All Crypto

2450

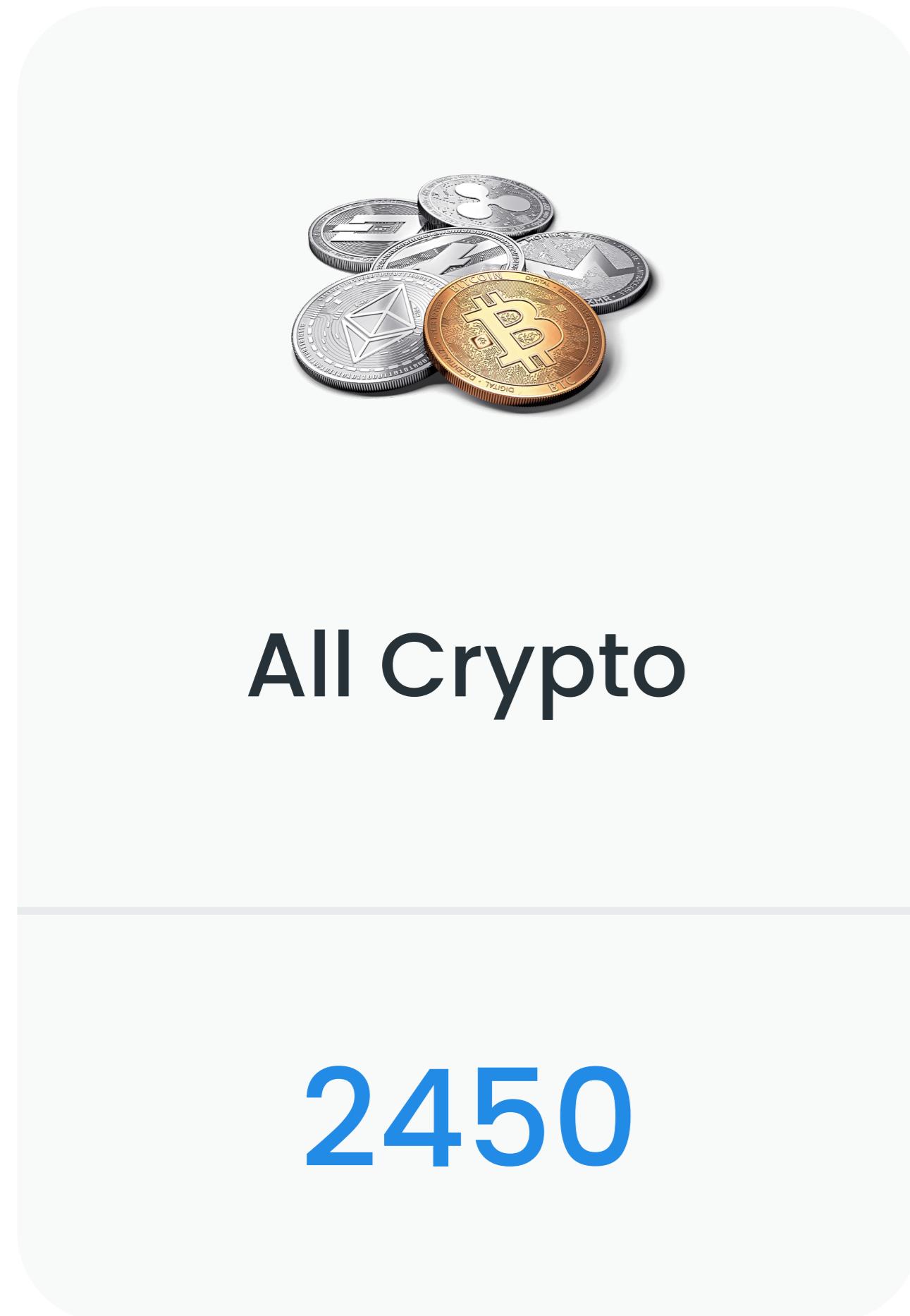


Number of
Projects

11260

* As for December 5, 2021

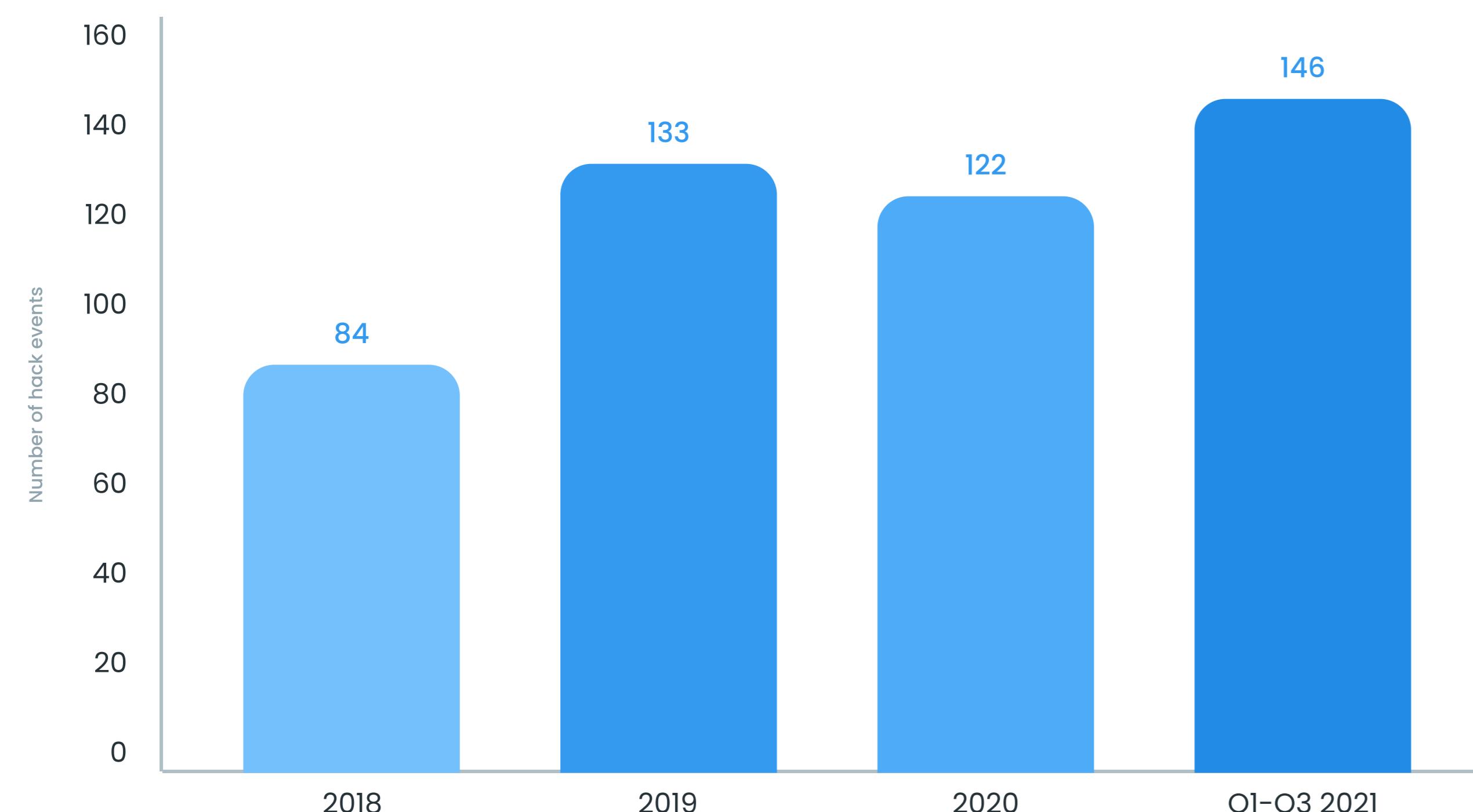
Decentralized Services as an Alternative



* As for December 5, 2021

Bad Design Decisions → Big Consequences

Blockchain-related hack events by year (2018 - Q3 2021)



Source: hacked.slowmist.io

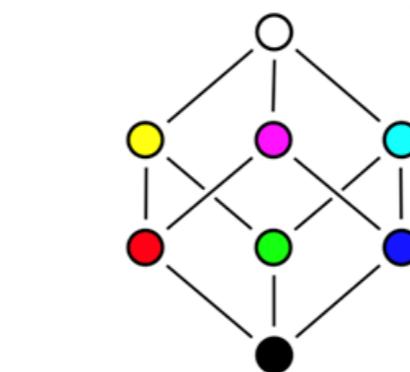
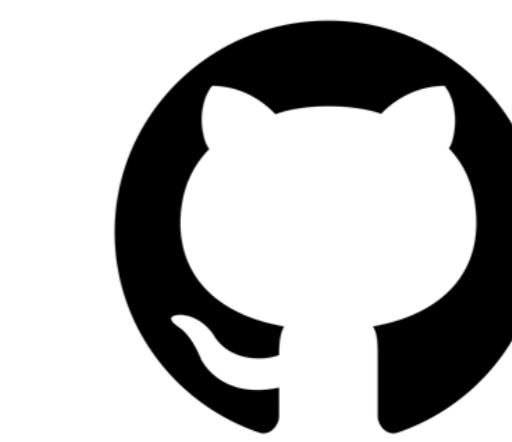
ETH Mean & Median Fee, USD



Source: COINMETRICS

Alternative Design?

- Better data organization
- No global consensus
- Non-masking Fault Tolerance
- No prevention but detect, recover, resolve

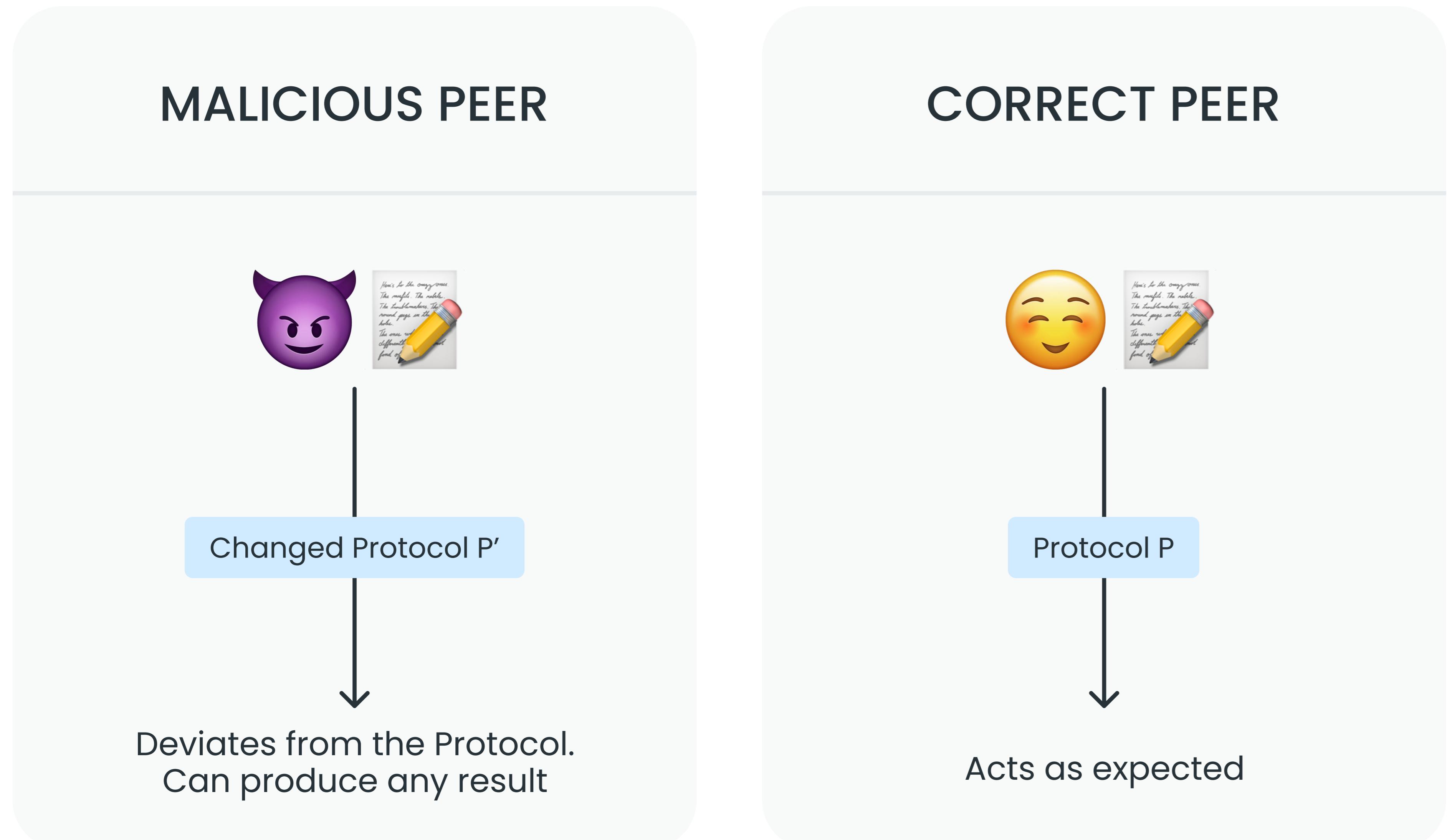


CRDT



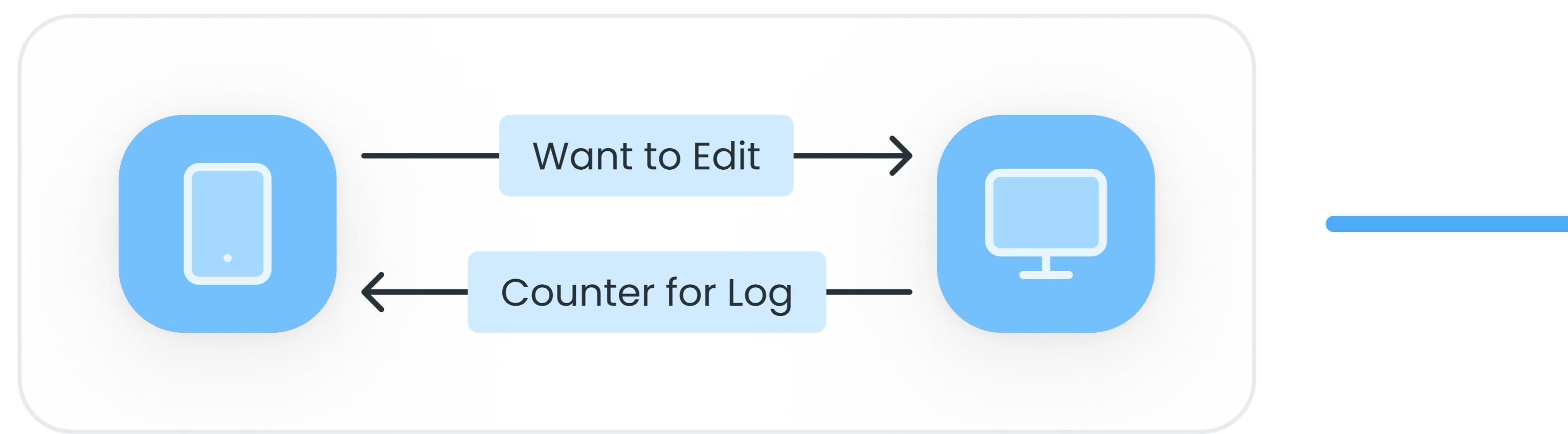
Inspiration: Make them Accountable

Malicious Peers and Accountability



But we need to define rules!

Wikipedia Case: Data



• (cur prev) 16:48, 31 October 2012	Whatamldoing (talk contribs)	m	(16,289 bytes)	(+1)	.. (Typeo)
• (cur prev) 16:47, 31 October 2012	Whatamldoing (talk contribs)	..	(16,288 bytes)	(+599)	.. (Once again, with feeling)
• (cur prev) 23:45, 28 October 2012	Whatamldoing (talk contribs)	..	(15,689 bytes)	(+133)	.. (→ See also: AIV)
• (cur prev) 20:43, 24 September 2012	Whatamldoing (talk contribs)	..	(15,556 bytes)	(+370)	.. (Expand lead)
• (cur prev) 18:19, 11 September 2012	The wub (talk contribs)	..	(15,186 bytes)	(-33)	.. (rm {{Leave feedback}}, has article feedback tool nc
• (cur prev) 16:36, 25 July 2012	John of Reading (talk contribs)	..	(15,219 bytes)	(-11,036)	.. (Reverted 1 edit by Ace JeRze (talk): Rv mispl
• (cur prev) 16:13, 25 July 2012	Ace JeRze (talk contribs)	..	(26,255 bytes)	(+11,036)	
• (cur prev) 20:47, 5 June 2012	Arcandam (talk contribs)	..	(15,219 bytes)	(+5)	.. (vector)
• (cur prev) 22:42, 5 May 2012	Sefid par (talk contribs)	..	(15,214 bytes)	(+44)	.. (Undid revision 490861562 by Sefid par (talk))
• (cur prev) 22:41, 5 May 2012	Sefid par (talk contribs)	..	(15,170 bytes)	(-44)	.. (faou16)
• (cur prev) 09:33, 10 April 2012	ElphiBot (talk contribs)	m	(15,214 bytes)	(+32)	.. (r2.7.2) (Robot: Adding no:Hjel:Revisjonshistorikk)
• (cur prev) 07:16, 22 March 2012	JAnDbot (talk contribs)	m	(15,182 bytes)	(0)	.. (r2.5.4) (Robot: Modifying sr:Помоћ:Историја измена,
• (cur prev) 11:04, 7 March 2012	John of Reading (talk contribs)	..	(15,182 bytes)	(+1)	.. (→ Overview: rv to old description of the edit sumn
• (cur prev) 22:42, 3 March 2012	PrimeHunter (talk contribs)	..	(15,181 bytes)	(+105)	.. (→ Overview: clarificatio17)
• (cur prev) 10:29, 3 March 2012	John of Reading (talk contribs)	..	(15,076 bytes)	(+246)	.. (→ Overview: Filled in one of the missing explai
• (cur prev) 09:56, 3 March 2012	John of Reading (talk contribs)	..	(14,830 bytes)	(+336)	.. (→ Overview: New screenshot and some change
• (cur prev) 16:48, 2 March 2012	5Q5 (talk contribs)	..	(14,494 bytes)	(+10)	.. (Outdated flag. Needs a new screenshot with the new green

- Nice Linear History of edits per Page
- Linear Log per User
- Vandalism, malicious actions are transparent

Wikipedia Case: Governance

Your edit was reverted.

Please see WP:SmarterThanYou

LordByron00 undid the revision by PubliusCornelius11
PubliusCornelius11 reverted the edit by LordByron00
LordByron00 undid the revision by PubliusCornelius11
PubliusCornelius11 reverted the edit by LordByron00

I'm having a hard time seeing good faith here.

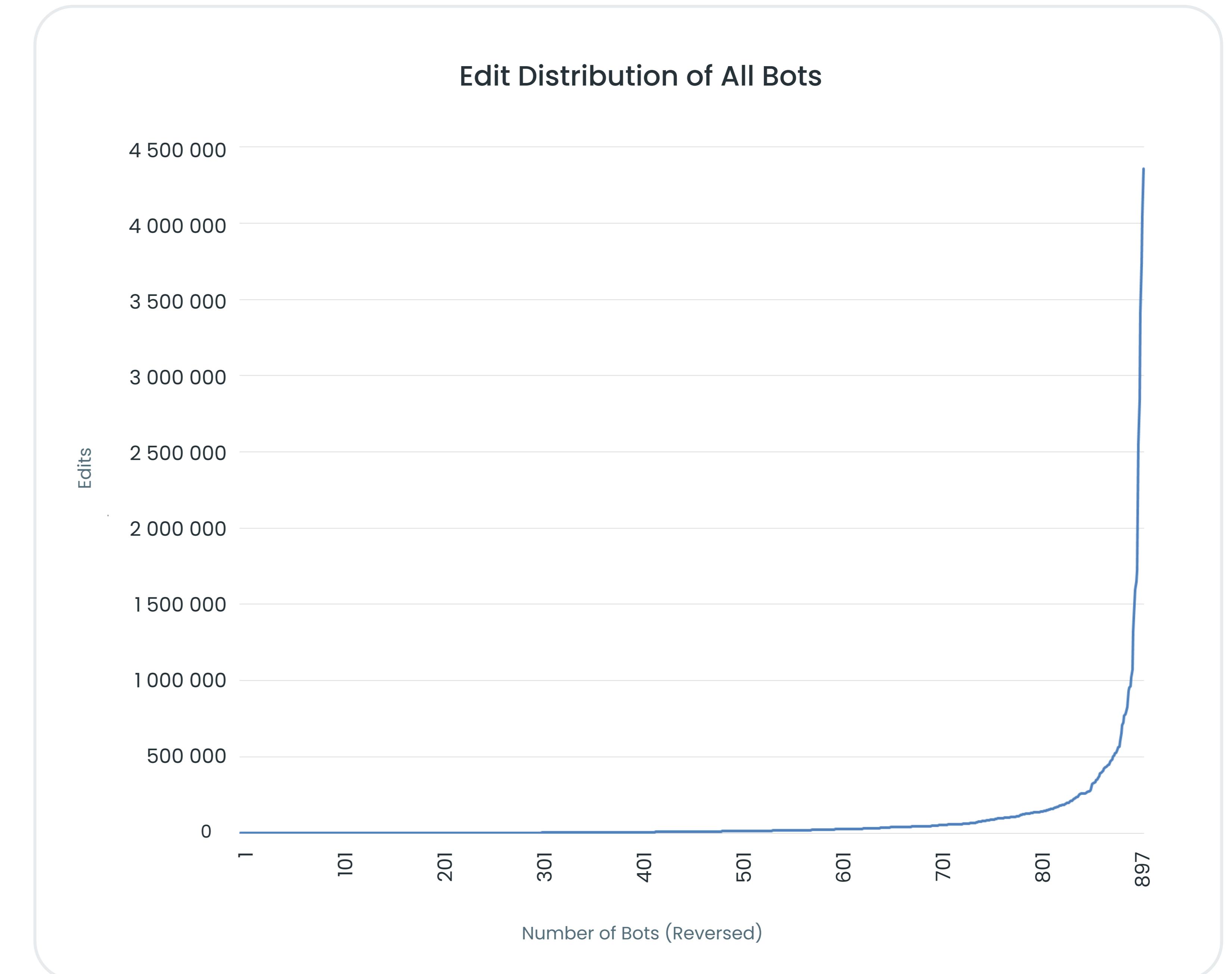
Blocked

You are currently unable
to edit Wikipedia.

You are still able to view pages, but you are
not currently able to edit, move, or create them.

The user page of the guy who reverted you

This block notice is from a user who has been reverted multiple times. The notice states: "You are currently unable to edit Wikipedia. You are still able to view pages, but you are not currently able to edit, move, or create them." The user page also shows a history of edits where LordByron00 has undone changes made by PubliusCornelius11, and vice versa. The user's profile includes various userboxes and interests.



How Can We Enable Such Collaboration?

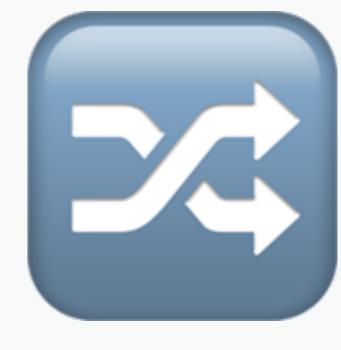
Consistency and Convergence



Eventual
Delivery



Strong
Convergence



Causal
Consistency

Accountability Goals

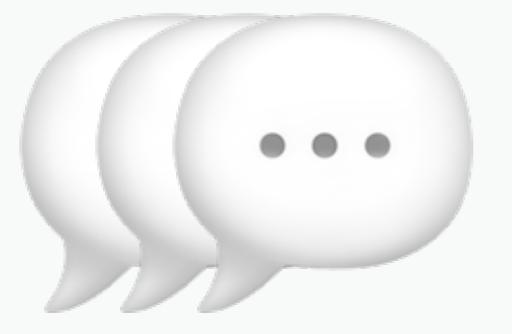


Accuracy



Unanimity

Design Decisions



- 1.**
Explicit Causality



- 2.**
Resolving Conflicts



- 3.**
Validity Rules



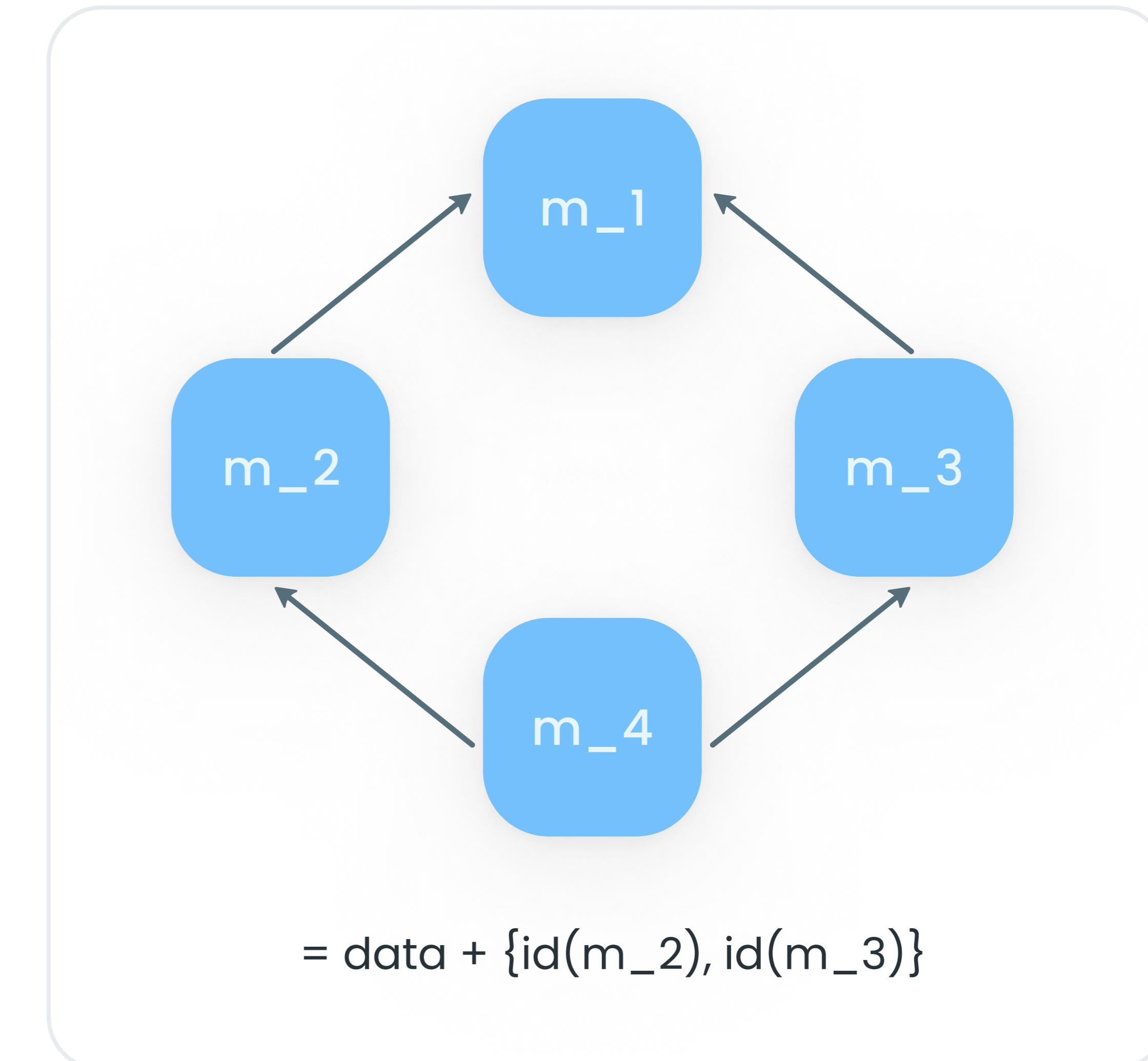
- 4.**
Reconciliation

1. Explicit Causality

- Embed the dependencies in the message, via set of hashes
- Inverted Lamport's 'happens-before'
- Preserve Linear Log where you can



Rule: Any new message "continues" previous

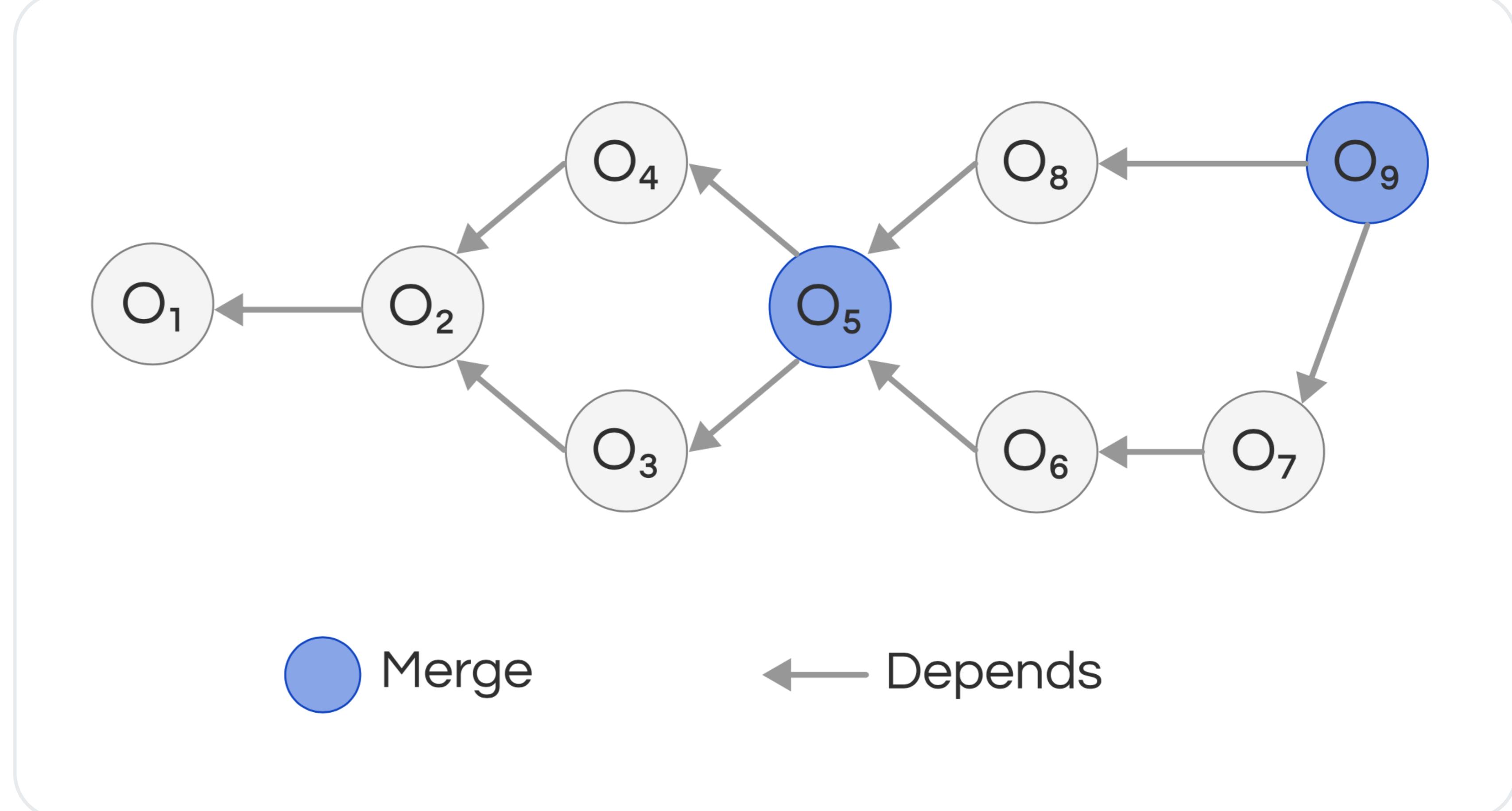


2. Resolving Divergence

- Special operation: 'Merge'
- If you link multiple → Should merge first
- Correct peer pre-agree on the merge policies



Rule: Resolve divergence with pre-agreed policy



3. Validity Rules

- Function 'Valid' against the state or messages
- Check message against local knowledge, no coordination required
- Examples: no double spend, no slur



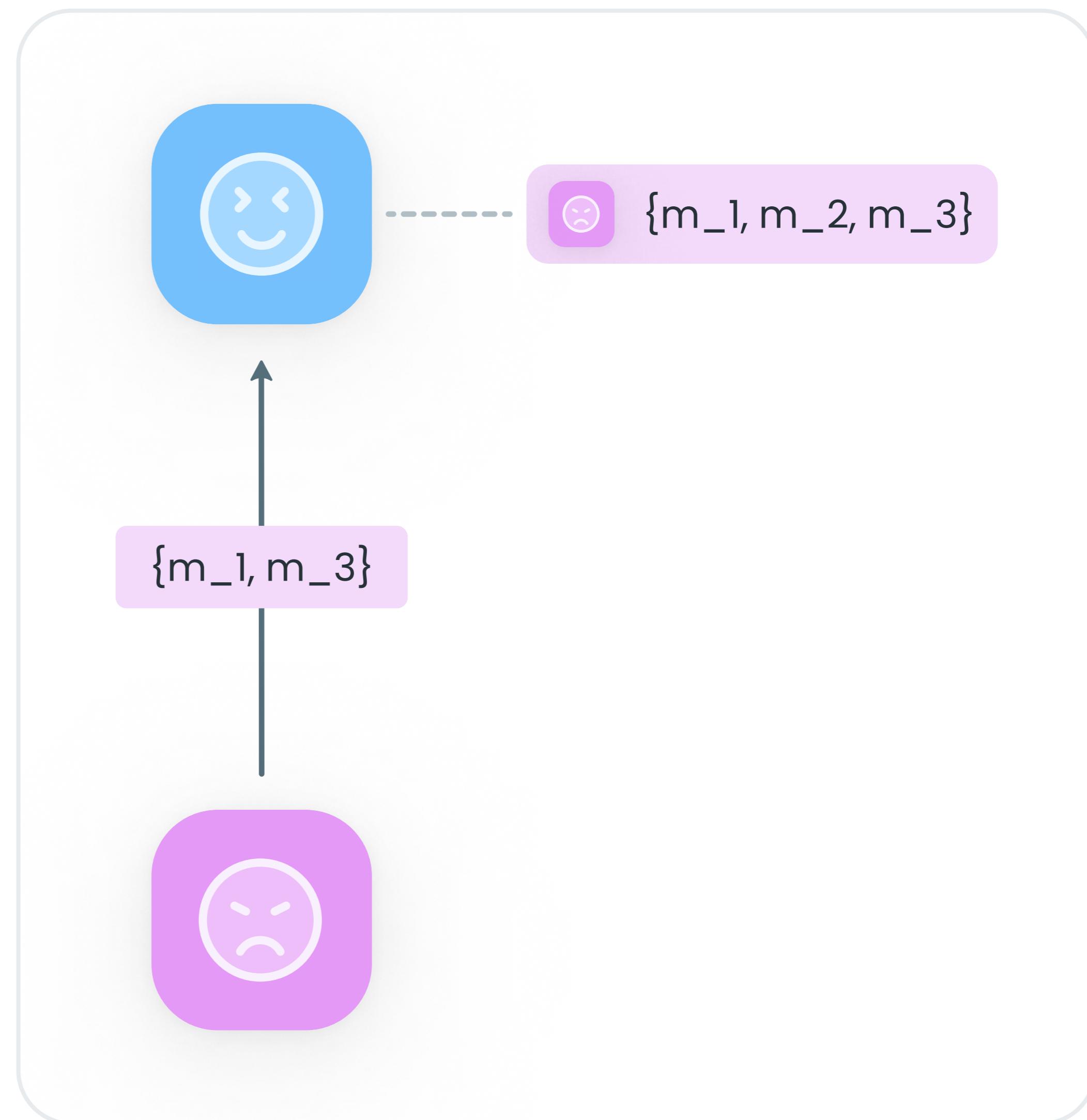
Rule: Never break pre-defined validity rules

4. Message Set Reconciliation

- 1996: Anti-Entropy
- 2011: Set reconciliation with Bloom Filters
- New: Compare against known last known set and check if node is hiding something



Rule: Report all messages



Accountable Protocols – Strong Foundation

- Expose peers that violate the rules
- Suspect peers that ignore requests
- Periodically gossip status to others



As a Result

- All observable malicious are exposed
- You only need 2 correct nodes to function

Q&A



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