Secure Scuttlebutt: An Identity-Centric Protocol for Subjective and Decentralized Applications

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Secure Scuttlebutt: probably the most radical decentralized protocol

- no central authority, data structure, consensus or trust infrastructure
- one source of truth: per-ID cryptographically secured append-only logs

- a log consists of signed events
- Hey, it's named data! The name of a single event is "id:seqno",
  events also have an intrinsic name (hash)
- event content can be encrypted, no leaking of recipient ID
- "distributed app thinking": events for Linda-like "buffered broadcast"

- created in 2014, currently 10'000 users, ca 20-30 core developers
- clients for Win, Mac, Linux, Android, iOS soon
SSB has rich social media clients

- Javascript/Electron
- Several other clients and libraries
  - Rust, C, Python, Kotlin
    (but not full-fledged yet)
- NaCl crypto library, JS and heavy DB ops
Overview

1. SSB as a technology:
   motivation, log replication, subjective reader concept

2. Some example applications

3. The human dimension:
   log replication along the social graph, trust and the onboarding problem

4. A comparison of SSB and NDN

5. Challenges, future work
1a) SSB tech: motivation

SSB started with a wish list, empowering the human user:

• no ads, no irrelevant chatter (dial down buddies), yet have social media

• *must* work offline (offline-first)

• *secured* with user-controlled trust (no Cert Authority, please)

• *permissionless* naming (no Naming Authority, please)

• not dependent on consensus (beyond common packet format)

• SSB name: water cooler is where news travels
  on ship: water cooler is called scuttlebutt, which also is lingo for gossip
1b) SSB tech: log replication

- Application (=frontend) only works on local log replicas
- Log updates are automatically replicated (backend), somehow and at some time
1c) SSB tech: subjective reader

Ground truth are the individual **append-only logs**

- Log = hash-chained signed event list
  => causality-preserving

- Applications locally compute their state from events in the available logs:
  - reconstruct e.g. chat dialogue from events in multiple logs
    (a ‘map-reduce task’)

- **“subjective reader”** (the ‘map’ step):
  - app/user to choose which logs to consider
  - app/user could also lack the replica of some logs that others see
1d) SSB tech: the protocol

- The thin waist of SSB:
  - ED25519 public keys as IDs
  - log event: up to 4KB, including ID
  - events MUST be signed, chained
    = reliable in-order delivery

- Current SSB: an IP overlay
  - epidemic broadcast tree (EBT) routing
  - peering uses a ‘secure handshake protocol’ between trusted nodes

- Plus a separate “blob” replication protocol (a hack, more NDNish client/server)
2a) SSB app: user directory

Q: How to have a SSB-wide user directory ..
without consensus or central data aggregation?
A: Be subjective like humans are

• SSB app = common content format
  SSB app state = some reduction of all such events

• The “about” app:
  - people assign names to IDs, publish in their log
  - for given about target and log, remember the last
  - from these per-log assignments, pick as you like
    (self-assigned first, if absent then name given by
    a friend, else name given by a random person etc)

In other words: a directory of display names where IDs are the underlying unique names
General comment: think CRDTs (conflict-free replicated data types)

- **Chat** uses event records with three fields: starting-event, in-reply-to, text (plus the usual per-event author and sequence number fields)
  - chat thread = directed acyclic graph with same starting-event
  - state reduction = your subjective linearisation of that DAG

- **Git** naturally is a DAG: just map commits to SSB events
  - except the singleton decision on “head of the master branch”, where in SSB conflicts are solved by humans instead of central GitHub

- **Chess**: initial mutual “let’s start a game” events, then publish your moves, simply ignore moves by others or moves from other game instances
3a) Human factor: social graph

SSB = “Internet of people” i.e., their log
- self-declared *follow* events
  (mutual follow == “friend”)
- replicate content along the social graph

• When peering, a client subscribes to:
  - it’s own log
  - the logs of followed IDs
  - the logs of IDs followed by people whom they follow (friends-of-friends)

• There are also *unfollow* and *block* events.
3b) Human factor: trust and onboarding

SSB onboarding as an “existential” experience

- Newcomers MUST be introduced
  Some hacks exist: automated “invite codes” by SSB relay nodes

- Receiver-driven mindset, leads to very strict filtering what events you see

- “Web of trust” instead Cert Authority
  “follow” declarations replace PGP’s signing parties

HELP - nobody is following me, hence nobody will see what I post!
4) Comparing SSB with NDN

Different planets?

- SSB:
  - no consumers, only producers
  - no pull: new content is pushed
  - no hierarchical name space
  - no mutable name binding
  - strict data structure rules (log)

- In the paper:
  three attempts to “emulate” or layer
4a) SSB over NDN

Select insights (about the pain)

- Emulate SSB’s push with either polling, or long-lived-interest (reverse pull, parallel pre-registration for efficiency)

- (not in the paper): NDN offers “read” but has unclear “write” operation, linked to “SSB only has producers” property: —> perhaps use NDN’s mobile producer support?

Still does not match SSB’s replication property: in SSB, your followers are your log’s backup
4b) NDN over SSB

“Pull”: read in your local replicas or introduce per-data structure IDs, then “subscribe at runtime to a file”

But have to emulate two other NDN aspects: global namespace, forw+trust

- **Namespace**: SSB must implement a “NDN name authority” ID, plus app-level protocol how to register a NDN name (but how does the authority “follow” all potential requestors?)

- **NDN follows IP mindset**: “free forwarding”, where free=ISP ecosystem SSB would need to introduce “contractual friends”, happy to replicate your “real friends”’s content
4c) NDN + SSB

Combining the two approaches?

- NDN as “data access” pull protocol, best effort:
  - get random content out of a hierarchical name space
  - or pull single events from logs (out of a flat ID space)
  - optional caching

- SSB integrated as a push service, event streams:
  - a natively supported pub/sub service
  - beyond long-lived interests: “controlled push”
  - reliable, only for signed event chains, some kind of TCP receive window
  - caching mandatory for logs
5) SSB challenges, future work

- Is SSB a risk for “people at risk”?  
  - pseudonymous, exposes IDs  
  - events are immutable and not refutable  
  Only for the privileged “who have nothing to hide”? (Google’s Eric Schmidt)

- Scaling concerns from a caring community: What will be the (economic) force that turns SSB into a disruption, could abandon its goals?

- Still global singletons in the system design: e.g. “type” field of events

- Evolution of SSB:  
  binary encoding schema / off-chain content (can delete payload, but keep the event trace) / event-level tangle support / scalable encrypted chat groups / log compaction / log life cycle management / alignment with DAT..
6) Conclusions

SSB’s tech choices seem contrarian, but identified a very convincing spot in ICN’ solution space

- value system - disintermediation, plurality (SSB a “neutral” infrastructure)
- push - vs pull
- event-source integrity - way better than signing anything
- trustful - instead of trustless crypto currencies: info bubbles are ok
- consensus-avoidance - yet comes with powerful low-level sync

When push comes to shove - does not need a network - sneakernet ok