University of Basel

Managing Resources of Network Nodes Using Append-Only-Logs

Simon Laube, simon.laube@stud.unibas.ch

Advisor: Prof. Dr. Christian Tschudin, Supervisor: Fabrizio Parrillo

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Content

Motivation

- Solar Community Network

Initial Goals

- Affordable Hardware
- Long Transmission Range (Wireless)
- Resilient Communication Protocol
  - Low Storage Usage
  - Low Power Consumption
- Hardware + Software $\rightarrow$ Proof-of-Concept

Thesis Focus

- Affordable Hardware
- Long Transmission Range (Wireless)
- **Resilient Communication Protocol**
  - **Low Storage Usage**
  - **Low Power Consumption**
- **Hardware + Software $\rightarrow$ Proof-of-Concept**

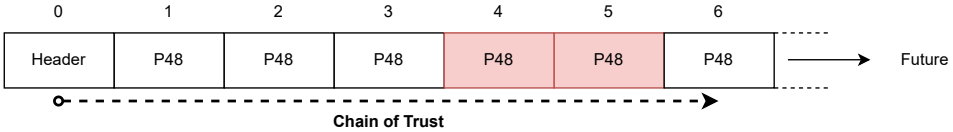
Resilient Communication Protocol

- TinySSB
  - Tiny Version of Secure Scuttlebutt (Peer-to-Peer Communication Protocol)
  - Append-Only-Logs
  - Trust Anchors and Chain of Trust

Feeds

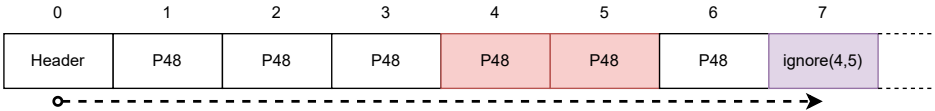
- Everything Stored in Feeds
- Child Feeds
- Continuation Feeds

Limitation: Reverting Packets



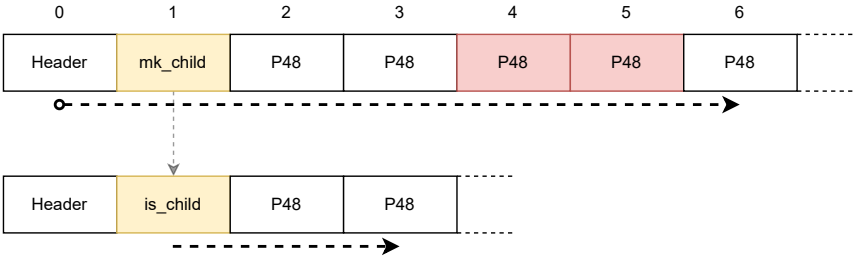
- E.g. Update Feed (Packets depending on previous packets)

Limitation: Reverting Packets



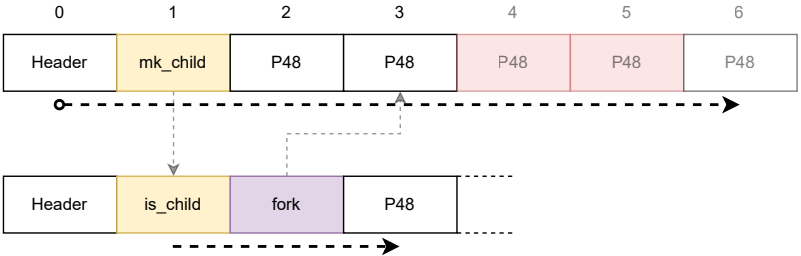
- (+): faulty packets are ignored, simple data structure (feed)
- (-): faulty packets still in storage and included in chain of trust

Limitation: Reverting Packets



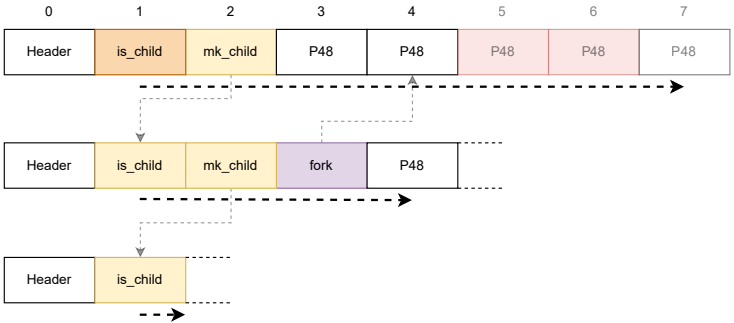
- (+): new packets in separate "trust-chain-branch"
- (-): faulty packets still in storage, feed with faulty packets can still potentially grow, unclear where new feed continues, only one time emergency feed

Limitation: Reverting Packets



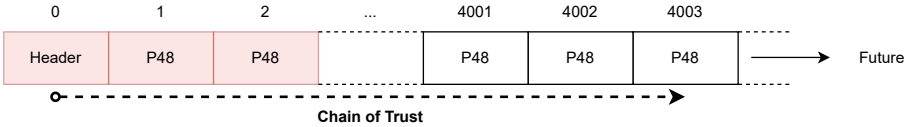
- (+): defined fork position, old feed can stop requesting packets, faulty packets can be deleted
- (-): only one time emergency feed

Solution: Fork Tree



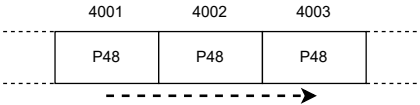
- (+): no emergency feed limit
- (-): more complex data structure (some storage and requesting overhead compared to single feed)

Limitation: Deleting Old Packets



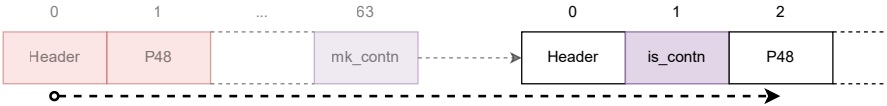
- E.g. Weather Data (Packets not depending on previous packets)

Limitation: Deleting Old Packets



- (+): Storage problem solved on producer node
- (-): Consumer may lose chain of trust

Limitation: Deleting Old Packets



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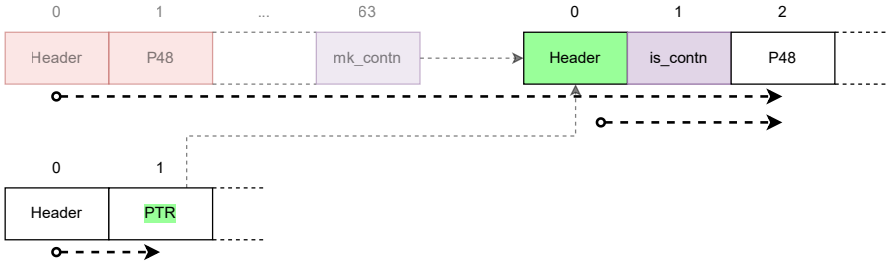
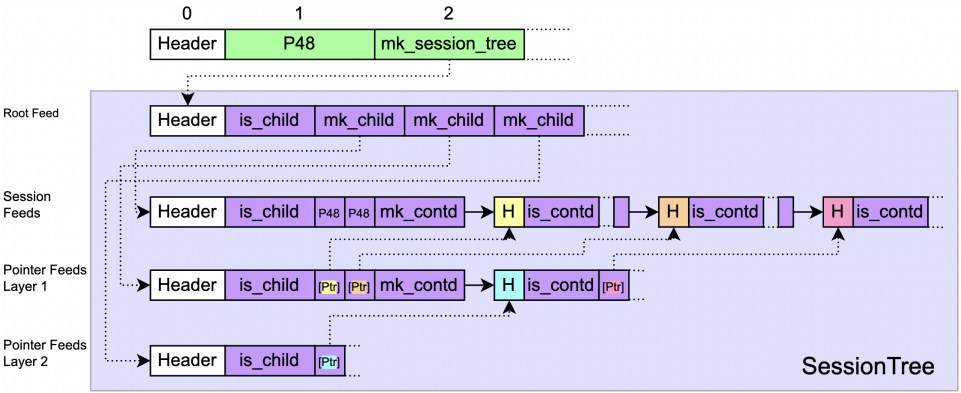
Limitation: Deleting Old Packets



- (+): Old feeds can be deleted, Consumer reaches new feeds
- (-): More complex data structure, Pointer Feed can get large

Addition: Session-Tree



Storage and Energy Usage

- Trees have different storage limitation strategies
- Energy consumption reduced with efficient dmx requesting / handling

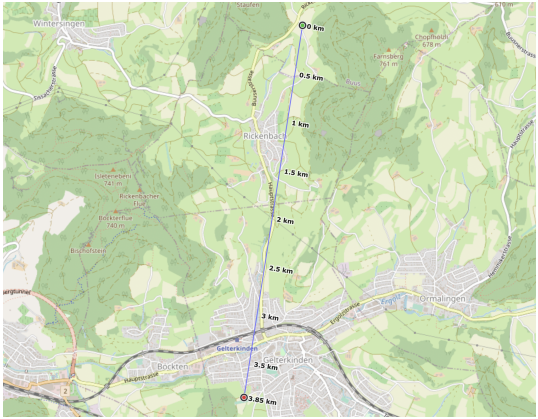
Development Setup

- Micropython
- Test Code on Computer (use UDP)
- Test Code on LoPy 4 (use LoRa)

Issues

- Stack Overflows
  - Too much memory usage (not noticed on computer)
  - Format of LoPy 4 disk
- Testing on LoPy much slower (e.g. Ed25519)
- PyMakr Extension (Visual Studio, Atom)

Real Life Test



Demo

- Fork-Tree on LoPy 4
- Session-Tree over UDP

Future Work

- Less pointers in Session-Tree
- Optimize DMX requesting (dynamic prioritization)