Fuzzing the Lightning Network

Matt Morehouse

https://github.com/morehouse

What is fuzzing?

- https://en.wikipedia.org/wiki/Fuzzing

Why fuzz the LN?

- To find bugs.

Why are LN bugs bad?

- Bad user experience.
- Money is at stake.

Money at Stake

- Credit card

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- Credit card

Money at Stake

- Credit card

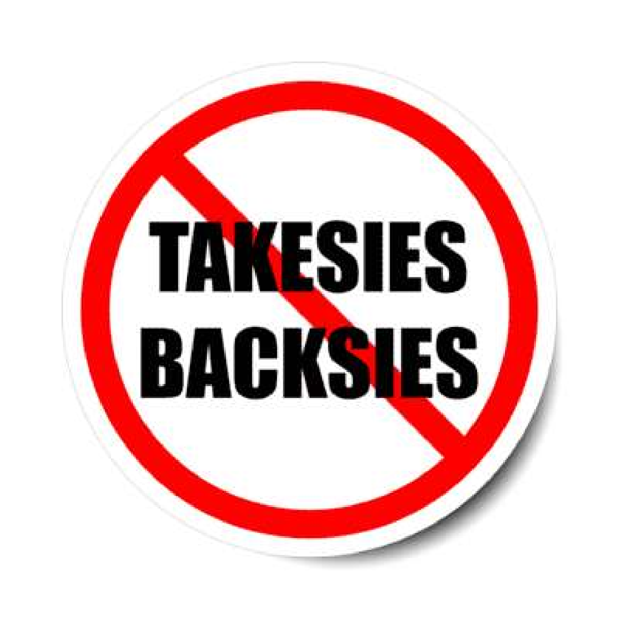
- Lightning

Money at Stake

- Credit card

CUSTOMER SERVICE

- Lightning



Money at Stake

- LN nodes *need* to be online to prevent theft.
- Any crashes put funds at risk.

Example Bugs

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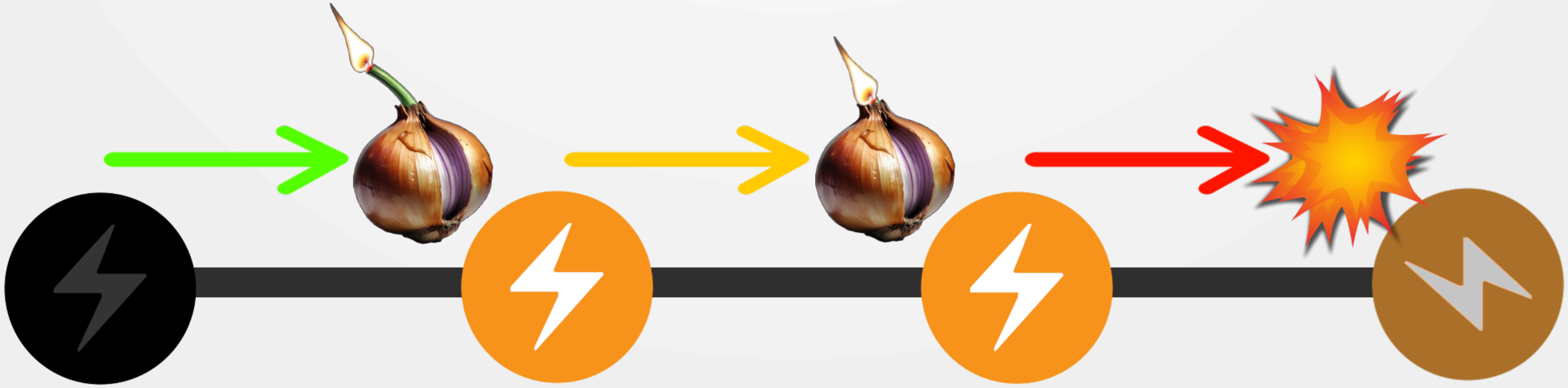
- CLN invoice parsing (prior to 23.11)
  - Paying certain invoices caused:
    - Crashes
    - Reading uninitialized memory
    - Buffer overflows
    - Undefined behavior
  - Discovered by fuzz testing (joint work @dergoegge and @morehouse).
  - https://morehouse.github.io/lightning/cln-invoice-parsing/

Example Bugs

- LND onion bomb (prior to 0.17.0)
  - Any node could be instantly and repeatedly crashed by sending malicious onion packets.
  - Source of attack concealed by onion routing.
  - Discovered by fuzz testing (@morehouse).
  - https://morehouse.github.io/lightning/lnd-onion-bomb/



State of LN Fuzzing

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- Not great.

State of LN Fuzzing

- LND

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    - 58 basic encode/decode fuzz tests.
    - All fuzz tests were bit rotten and no longer ran.
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  - Today:
    - 106 basic encode/decode fuzz tests.
    - Fuzz regression tests run in CI on public corpora.
    - Minimal new contributions from anyone but @morehouse.

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- CLN

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- CLN
  - Maintenance issues:
    - UBSan checks inadvertantly disabled.
    - Fuzz regression tests disabled in CI.

State of LN Fuzzing

- eclair

State of LN Fuzzing

- eclair
  - A few randomized (“fuzzy”) tests.
  - No modern fuzz tests (e.g., using Jazzer https://github.com/CodeIntelligenceTesting/jazzer/).

State of LN Fuzzing

- LDK

State of LN Fuzzing

- LDK
  - 60 basic fuzz tests.
  - 3 state machine fuzz tests.
  - Fuzz tests run in CI.
  - Continuous fuzzing by Chaincode Labs.
  - Private corpora maintained by @TheBlueMatt and Chaincode Labs.
  - No major contributions in the past 1-2 years.

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- Many maintainers are unfamiliar with fuzzing best practices.
- Few outside contributors (@morehouse, @dergoegge).

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- Fuzz testing for eclair.

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- More differential fuzzing:
  - Invoice (de)serialization
  - Commitment transactions
  - LND: Decred secp256k1 vs libsecp256k1

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- More state machine fuzzing:
  - Channel funding
  - Commitments and HTLCs
  - Splicing
  - On chain resolution
  - Network graph (gossip)
  - Watchtowers

Questions?