Adversarial Testing of Wireless Routing Implementations

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Routing in Wireless Networks

Routing protocols
- Fundamental component of wireless networks
- Different from traditional routing protocols
  - Proactive: DSDV
  - Reactive: AODV
  - Secure: ARAN

Robustness and security
- Traditional efforts
  - Model checking
  - Simulation

Limitations
- Real-world implementations bring new vulnerabilities
  - Model checking and/or simulation not enough
- Adversarial testings discover critical vulnerabilities
  - Simulator-based implementation may not cover all

Goal / Contributions

Goal: Automate adversarial testing of real-world implementation of wireless routing protocols

Design platform for wireless routing protocols
- Extension of an existing platform (Turret)
- Leverage network emulation and virtualizations
- Support special features for wireless protocols

Demonstrate attack/bug discovery
- Case studies: AODV and ARAN
- (Re-)discover 14 attacks
- Discover 3 bugs

Turret-W Platform

Turret-W
- Wireless network emulation
  - to support wireless routing protocols
- Separation of control plane and data plane
  - to support basic attacks such as blackhole attacks
- Side channels among malicious nodes
  - to support colluding attacks such as wormhole attacks
- Replay packets

Evaluation methodology
- 12 VMs, vary # of malicious nodes
- Routing: AODV, ARAN
- Application: iperf
- Performance metric: PDR
- Combine blackhole/wormhole attacks
- Baseline performance from benign test

Case Study

AODV
- 1 new implementation-level attack
  - Lie RREQ type 2 - cause neighbors to crash
- 7 known protocol-level attacks
  - Reply RREP
  - LieAdd RREP destsq.
  - Blackhole/wormhole attacks
- 2 bugs
  - Kernel interaction order
  - Route packet harder

ARAN
- 6 known protocol-level attacks
  - Divert REP
  - Drop RDP
  - Blackhole/wormhole attacks
- 1 bug
  - Wrong postal address