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Attack analysis and Security concepts for
MObile Network infrastructures
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Countering Mobile Malware in the Network and directly on Smartphones

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Motivation

- Mobile malware is on the rise
  - Easy to write malware with arbitrary functionality
  - Sensitive data on the phone attracts data thieves
  - Easy to distribute malware via uncontrolled app stores and websites
- Available anti mobile malware solutions are immature
  - Signature-based approaches and anomaly-based approaches proposed
  - Quality of solutions hard to measure/compare, depends on
    - Environment and type of misbehavior
    - Trained model in the anomaly-based variants

The General Problem

- Malware, Trojan, (Viruses)
- General issues with classical anti-virus products
  - Signature-based
    - Requires external experts for malware analysis and signature generation
    - Only able to detect malware that has been captured before
    - Comes with computation and storage overhead
- Are not well suited for smartphones
  - Still significantly slower
  - Frequent scanning is energy intensive

Our contributions

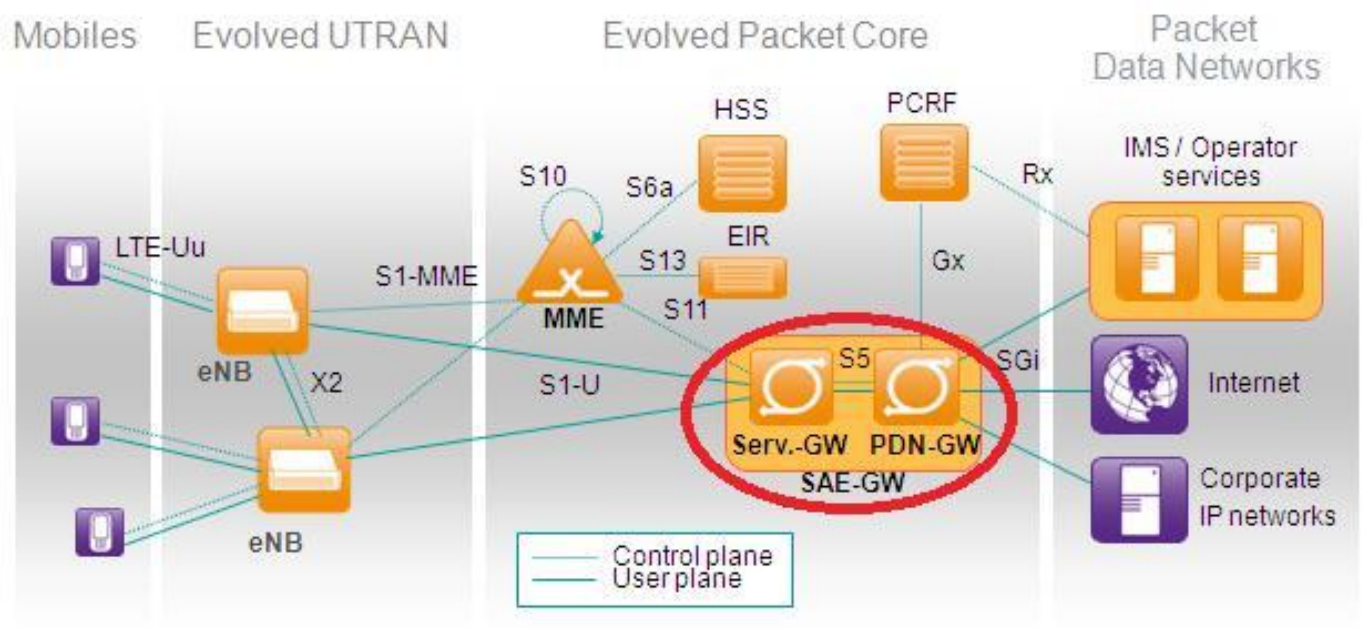
- Dynamic and static analysis of mobile malware
  - Classification of mobile malware based on traffic observable by a network operator
- 4G MOP sensor for in-network detection of mobile malware
  - Self-learning malware detection at the mobile operator
- Anomaly-based detection of mobile malware on the smartphones
  - Based on anomalies found in system call traces
  - Detection on per-app basis

Mobile Malware

- Our classification from the mobile operator’s perspective
- Results from static and dynamic analysis of mobile malware families
  - **SMS only***
    - Premium SMS, Bombers
    - Mobile spyware, Botnets
  - **HTTP only***
    - Mobile spyware
    - Botnets
  - **Hybrid architecture ***
  - Other types

* our focus

In-Network Detection

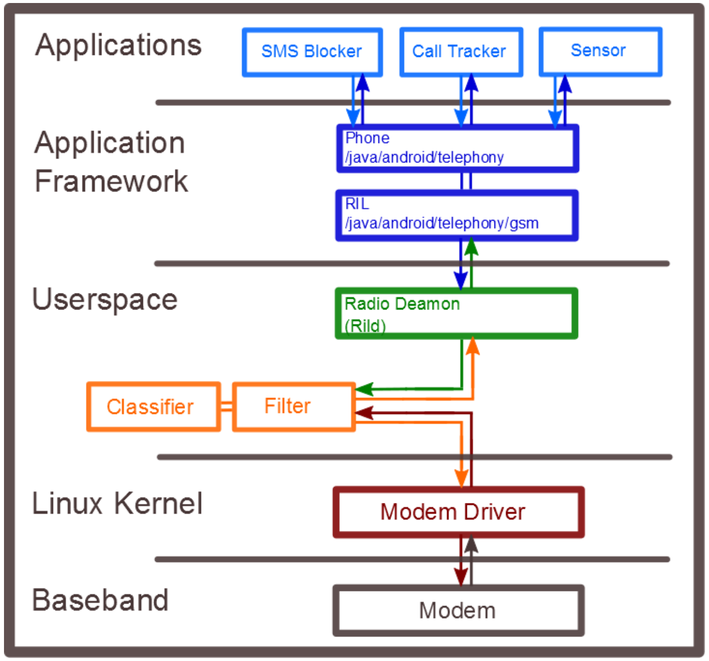


Sensor Requirements

- Must requirements
  - Independent security unit
  - Easy to deploy and maintain
  - Extendible architecture
- Should requirements
  - Real-time filtering and detection
  - Diverse learning approaches
  - Online learning

Sensor Simulation & Demo

- List-based
  - Black & white
- Rule-based
  - Call modes
- Pattern-based
  - Regex C2 commands

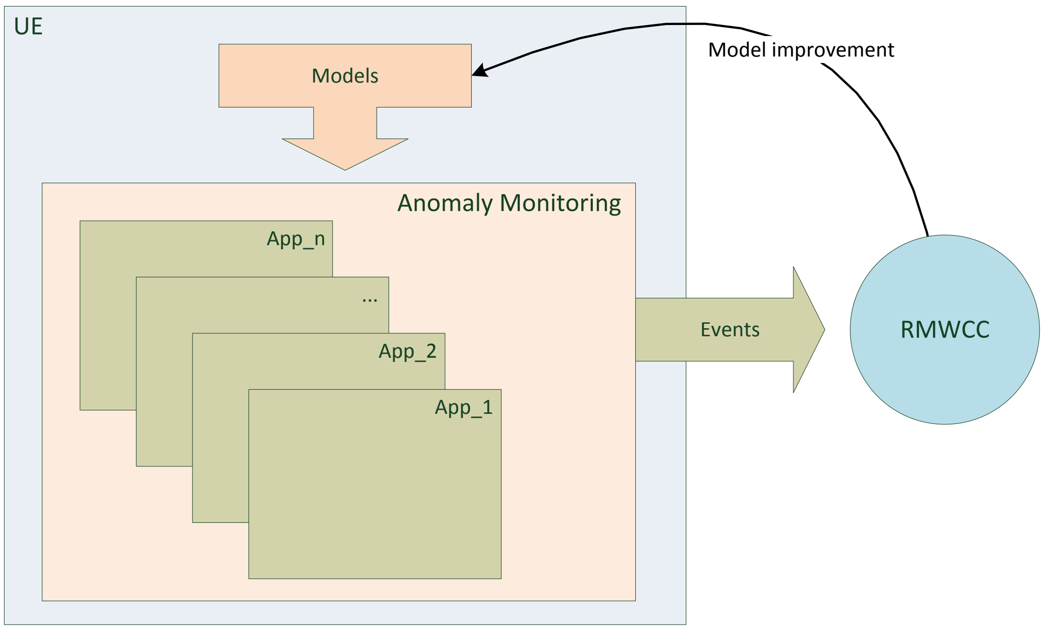


Alternative Detection Methods

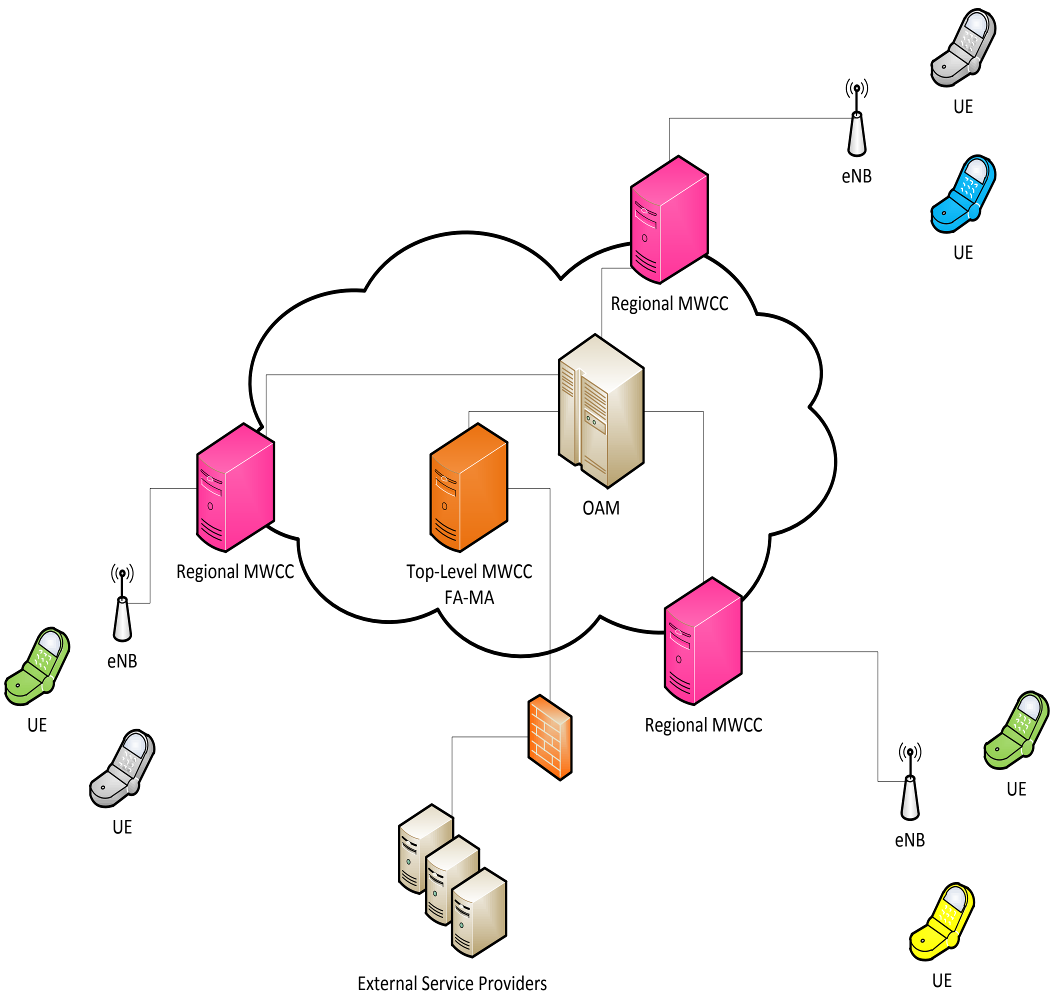
- Monitor behavior of
  - User
  - App
  - Phone
  - …
- Compare *traces* of monitored behavior to model of benign behavior
  - Detect as suspicious if significantly different from benign behavior
  - Iterative learning
- Allows partial matching to known good behavior

Anomaly Detection (UE)

- UE System Call Monitoring
  - App → process
  - Logical coherence
  - Pre-trained models of benign behavior



Anomaly Detection Backend



Backend Communication

- All mechanisms are transported using IP
- Event messages BSON encoded
  - Lightweight, traversable, efficient
- Regional Malware Collection Center
  - Signaling similar to S11 MME-SGW
- Top-level Malware Collection Center
  - Triggers more detailed event information
  - Initiate reactive measures (e.g., UE isolation)

http://bushwarriors.org

Summary & Conclusion

- Manifold malware detection is necessary
- Our two-fold approach provides
  - In-network filtering and detection
  - UE-centric detection on per-app basis
- Intelligence aggregation within the MNO domain

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