A robust SNMP based Infrastructure for Intrusion Detection and Response in tactical MANETs

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Outline

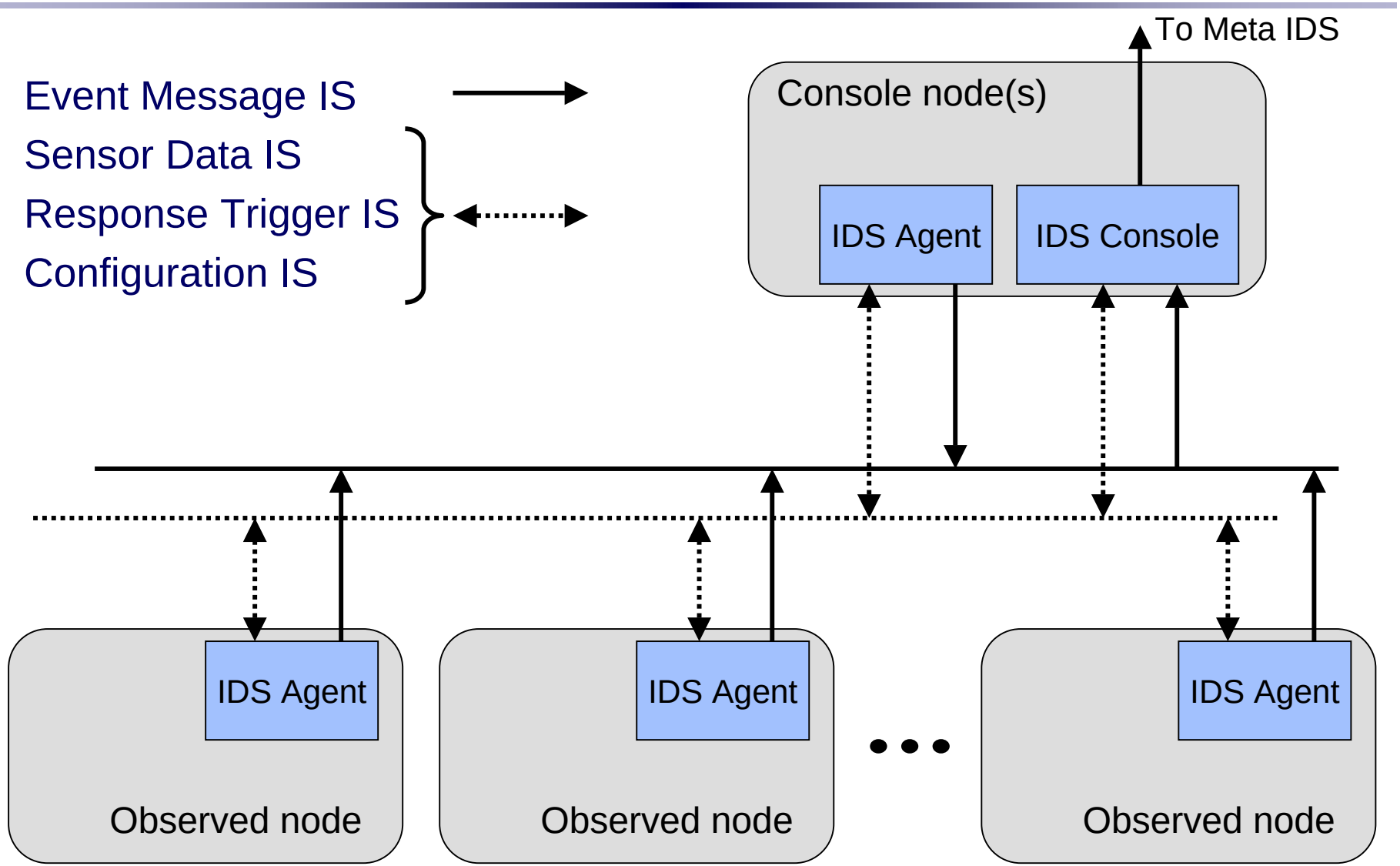
- Introduction
- Deployment Scenario: Tactical MANETs
- Network Management Domain: SNMP
- Modelling IDS Infrastructures w/ SNMP
- Performance Simulation
- Implementation Status
- Conclusions & Further Work

Terminology: Distributed IDS Components

- Agent
  - Sensors
  - Detectors
  - Responders
  - Message processing modules
- Console
  - Message consolidation
  - Databases
  - Correlation engines
  - Other analysis modules

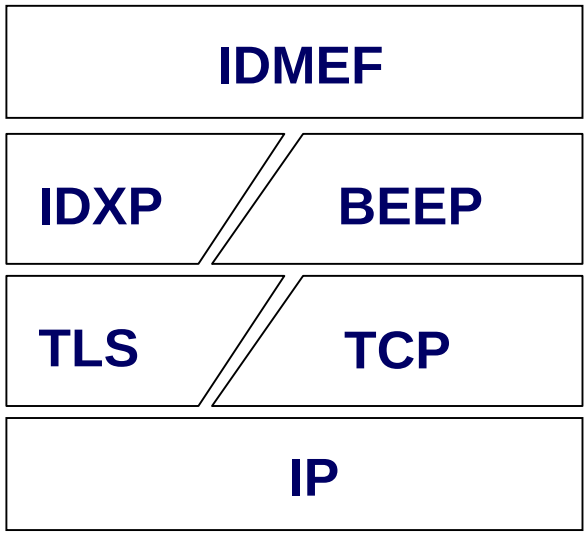
Types of IDS Infrastructures

- Event Message IS
- Sensor Data IS
- Response Trigger IS
- Configuration IS



Existing Data Models & Communication Protocols

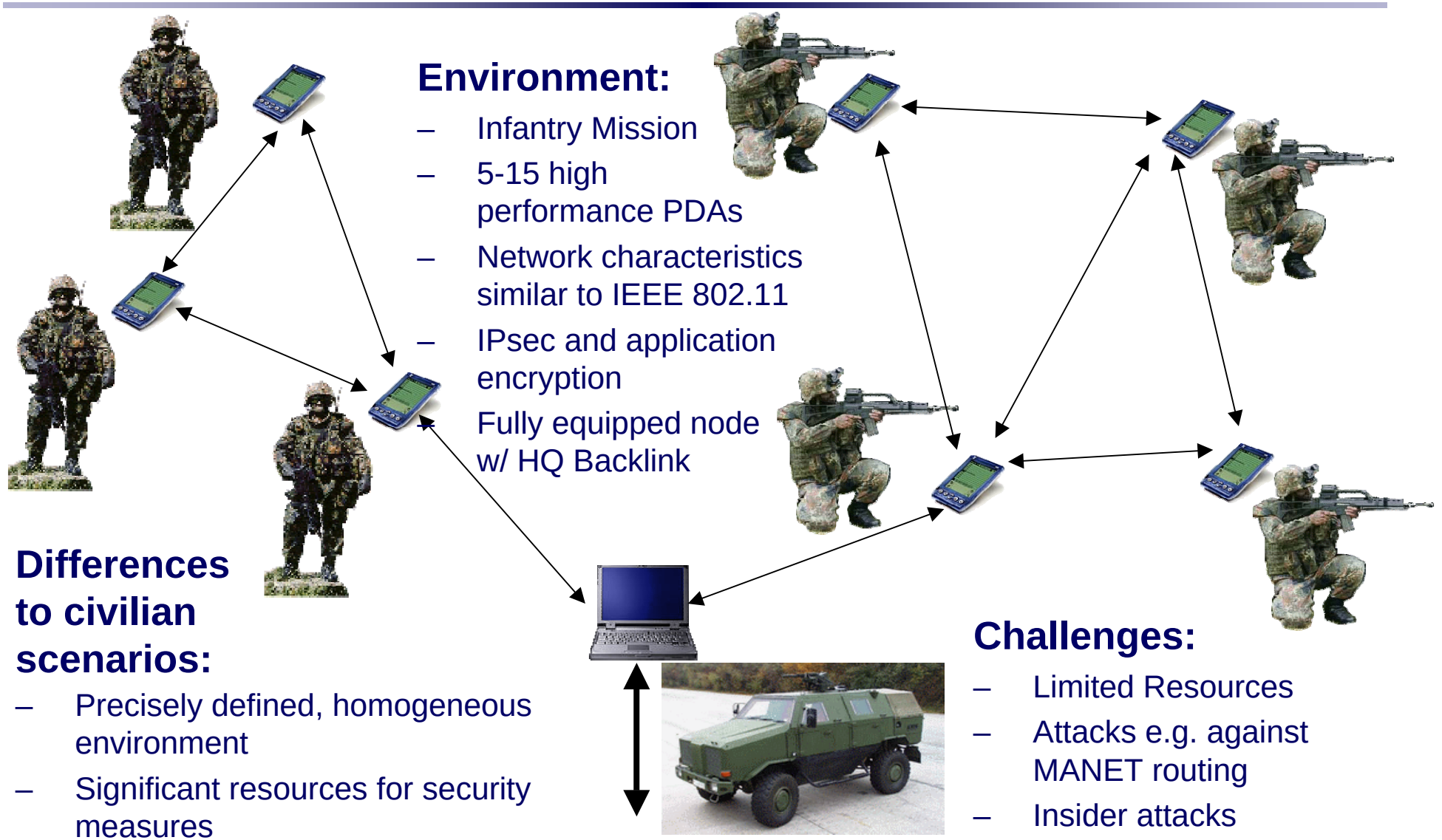
- IETF IDWG Recommendations



- **Drawbacks:** Overhead
  - TCP/SSL/BEEP Handshakes
  - Channel Management
  - XML Encoding

```
<IDMEF-Message version="1.0">
  <Alert ident="abc123456789">
    <Analyzer analyzerid="hq-dmz-analyzer01">
      <Node category="dns">
        <location>Headquarters DMZ Network</location>
        <name>analyzer01.example.com</name>
      </Node>
    </Analyzer>                                   who reports
    <CreateTime ntpstamp="0xbc723b45.0xef449129">
      2000-03-09T10:01:25.93464-05:00
    </CreateTime>                                 when
    <Source ident="a1b2c3d4">
      <Node ident="a1b2c3d4-001" category="dns">
        <name>badguy.example.net</name>
        <Address ident="a1b2c3d4-002" category="ipv4-net-mask">
          <address>192.0.2.50</address>
          <netmask>255.255.255.255</netmask>
        </Address>
      </Node>
    </Source>                                     who
    <Target ident="d1c2b3a4">
      <Node ident="d1c2b3a4-001" category="dns">
        <Address category="ipv4-addr-hex">
          <address>0xde796f70</address>
        </Address>
      </Node>
    </Target>                                     where
    <Classification origin="bugtraqid">
      <name>124</name>
      <url>http://www.securityfocus.com</url>
    </Classification>                             what happened
  </Alert>
</IDMEF-Message>
```

Deployment Scenario: Tactical MANETs



Environment:

- Infantry Mission
- 5-15 high performance PDAs
- Network characteristics similar to IEEE 802.11
- IPsec and application encryption
- Fully equipped node w/ HQ Backlink

Differences to civilian scenarios:

- Precisely defined, homogeneous environment
- Significant resources for security measures

Challenges:

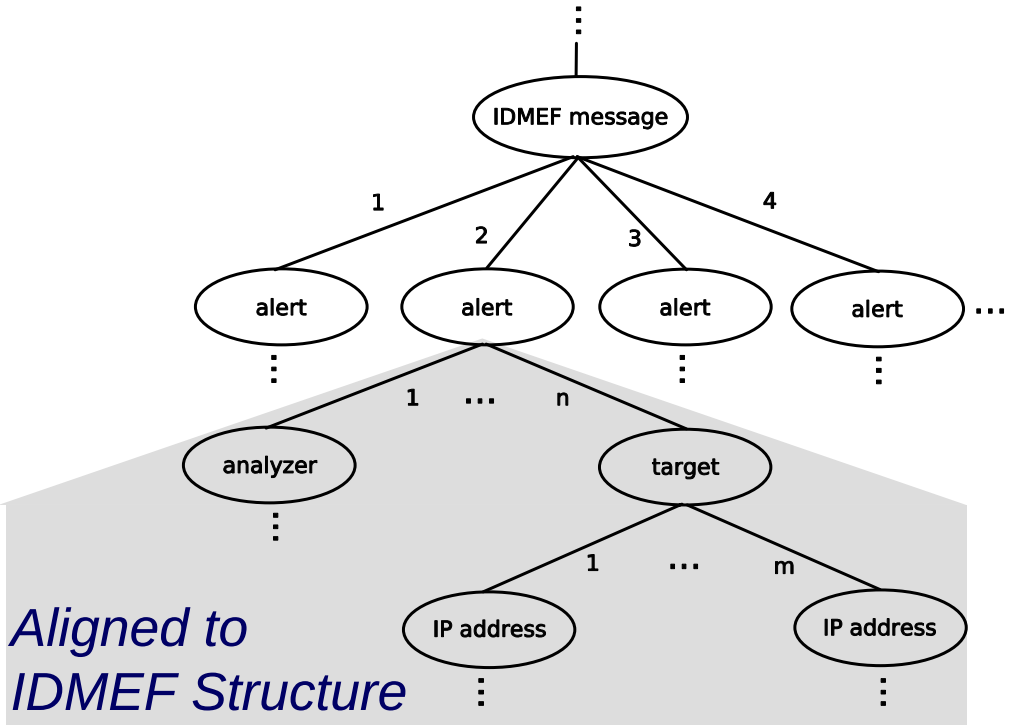
- Limited Resources
- Attacks e.g. against MANET routing
- Insider attacks

Management Domain: SNMPv3

- Monitoring & Configuration
- Agent/Manager based concept
- UDP based
- Security in SNMPv3
- Management Information Base (MIB)
- Object and Instance Identifier (OID/IID)
- get/setValue Requests (single value, list or bulk)
- Traps and Notifications

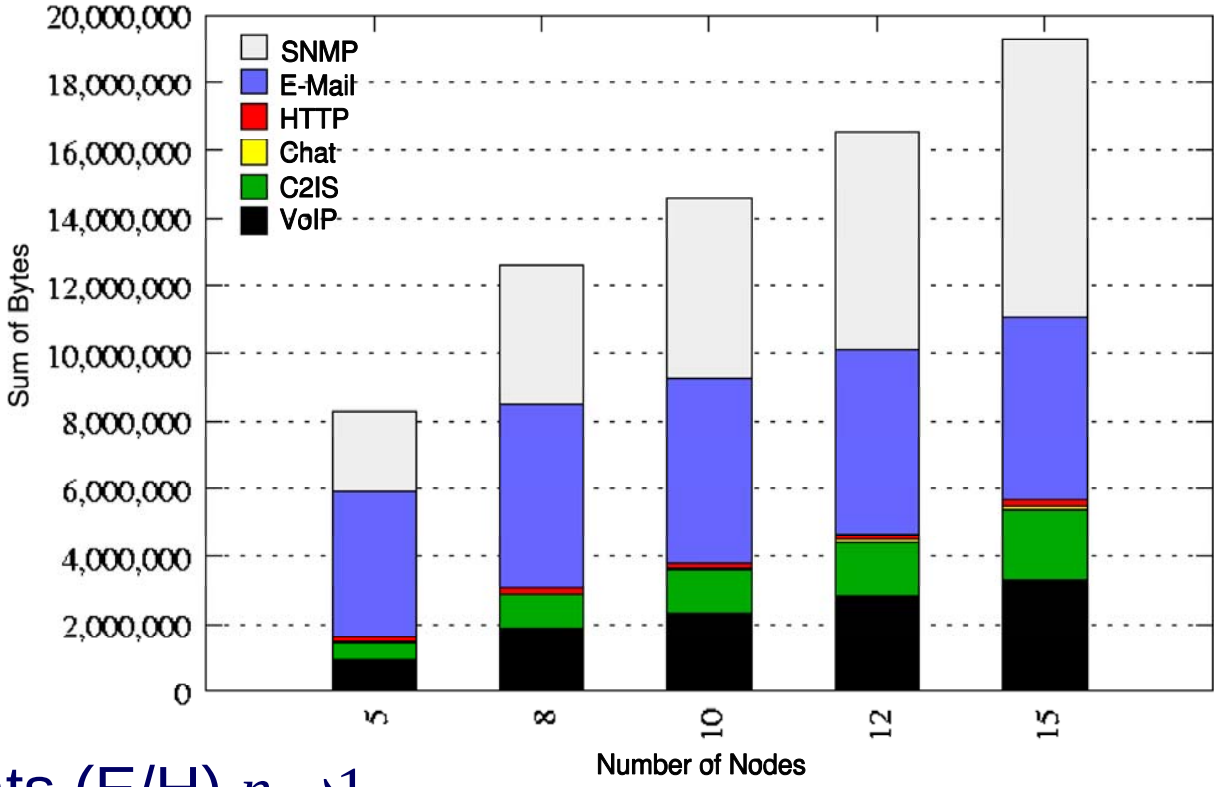
Modeling IDS Infrastructure w/ SNMP

- **Sensor IS**
  - getValue
  - getNext / Bulk
- **Response Trigger IS**
  - setValue
- **Configuration IS**
  - get/setValue
- **Message IS**
  - Insert new alerts into MIB as single subtree structure
  - Send an acknowledged notification to console, containing most important fields
  - Console may request additional message fields



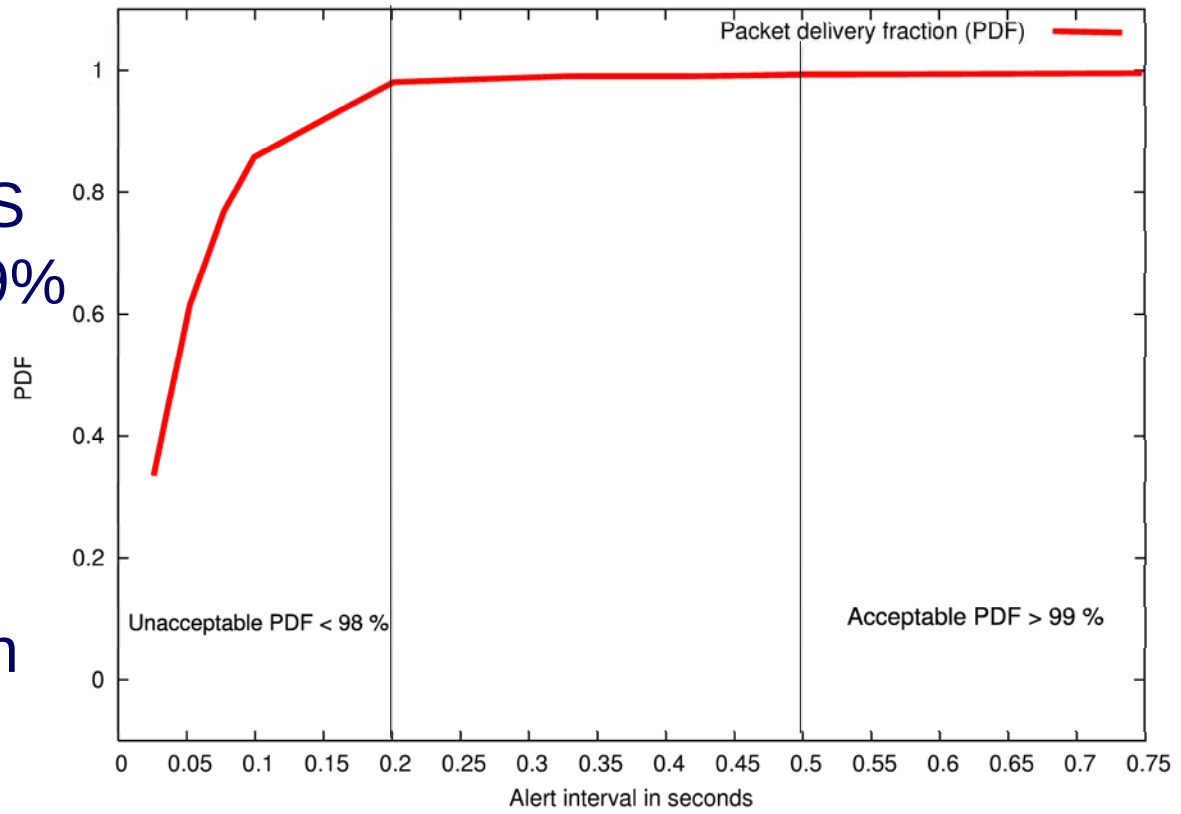
Performance Simulations (1): Overall Traffic

- Network
  - IEEE 802.11b
- Applications
  - VoIP (2.4 kbit/s)
  - C2IS (JMS)
  - UChat
  - SMTP/HTTP
- IDS Messages
  - Events/Heartbeats (E/H) $n \rightarrow 1$
  - Neighborhood Watching (NW) $n \rightarrow m$
  - Traffic Statistics (TS) $n \rightarrow 1$



Performance Simulations (2): Packet Delivery

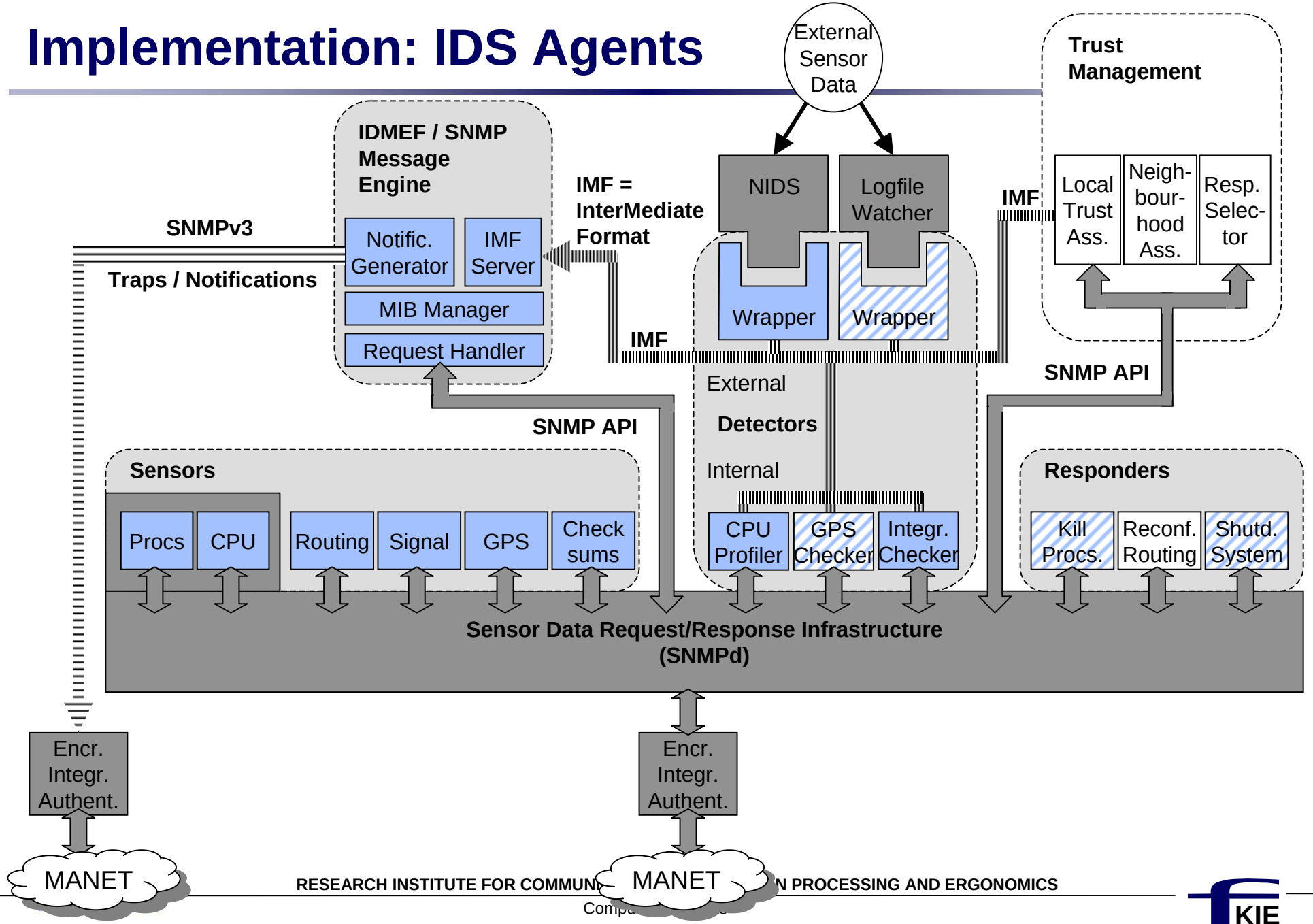
- PDF decreases due to significant amount of IDS traffic
- Maximum rates for IDS Messages for PDF>99%
  - E/H: 2 Hz
  - NW: 0.1 Hz
  - TS: 0.1 Hz
- Higher packet loss can be expected in reality:
  - Buffer overflows
  - Radio interference



Advantages of SNMP approach

- Characteristics of MANETs are considered
  - Dynamic behaviour and short link lifetimes
    - ➢Connectionless and robust communication
  - Low CPU performance and limited battery capacity
    - ➢Lightweight protocol and architecture
- Compatibility w/ existing protocols & data models
    - ➢(Meta-)IDS-interconnection
    - ➢Integration into SNMP Management Frameworks
- Free configurability for different IDS setups due to different deployment scenarios and network sizes
- Usage of existing products for message transport and security

Implementation: IDS Agents



Conclusions & Further Work

- Current IDS infrastructure protocols do not meet the requirements of tactical MANETs.
- SNMPv3 provides mechanisms for implementing all necessary types of IDS infrastructures.
- Development of architecture components
- Prototypical implementation
  - Sensor / detector / responder infrastructure
  - Dynamic storage of IDS event messages in the Management Information Base (MIB)
- Further Work:
  - Integration of more sensors / detectors / responders
  - Anomaly detection approach for traffic statistics

Questions?

Implementation (2): Event Message Handling