Distack
A Framework for Anomaly-based Large-scale Attack Detection

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Distributed Denial of Service

Source: Prolexic
DDoS – Huge threat to the Internet

„New Zealand teenager controlled botnet of 1.3 million computers“ (Heise-Online, Nov. 2007)

„DDoS attacks and worms pose biggest threat to the Internet“ (Worldwide Infrastructure Security Report, Arbor Networks, 2007)

1.3 million systems send at Ø 19kbit/s each

How can you detect and block such low traffic early?

→ Cooperation between detection instances seems promising!
Some exemplary issues
- Little knowledge about global behavior of DDoS
- Attacks highly distributed. Attack detection and countermeasures mostly not!
- Few directly reusable results

**Initial challenge:**
Complex development and evaluation of mechanisms for local and distributed attack detection and traffic analysis

→ Initial development effort as base for your mechanisms is incredibly high!
What you can do with Distack

- **Attack detection and traffic analysis**
  - Rapidly implement and run your attack detection and traffic analysis schemes
  - Lots of reusable modules (e.g. sampling, plotting)
  - Run on live traffic or captured traces
  - Comfortable communication between remote instances → easier distributed detection

- **Simulations**
  - Run your modules transparently in large-scale simulations
  - Integrates seamlessly with the toolkit OMNeT++/INET/ReaSE

and that`s not even all …
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● Distack use-cases
  - Online
  - Offline
  - Simulations

● Examples
  - Local traffic analysis: easily analyze online traffic and traffic traces
  - Distributed traffic analysis: several measurement points in the network, report to a central instance

→ There is more than distributed attack detection!
Framework for distributed attack detection and traffic analysis

What it gives to you

- Fully **concentrate** on your methods for attack detection and traffic analysis
- **Write once** run everywhere: Transparently run your methods, e.g. on a PC or in a simulation environment
- **High reuse** through building blocks
- **Great support** for your attack detection
Rough Architectural Overview

- **Module manager**
  - Mechanisms are implemented in small building blocks → *modules*
  - The environment to implement your modules

- **Network manager**
  - Abstraction from the network
  - Handles the different ways packets come in

- **Local and remote messaging**
  - Communication for the lightweight modules
  - Data-centric communication, local and remote

- **Configuration**
  - Flexible way to configure your modules and Distack
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Distack High-level Architecture

ModuleManager
- MessagingSystem
- ChannelManager
- Frame distribution system

Remote Messaging
- Serialization
- Deserialization
- Destinations
- Sources

Utilities
- Level based Logging
- Conversion
- Timer
- Structures
- String Operations
- Routing Table
- ...

NetworkManager
- FrameBuffer – reader thread
- NetworkInterface
- OMNeT++
- NS2
- Libpcap/WinPcap
- ...

Communication
- GIST
- Sockets API
- ...

XML-based Configuration
**Lightweight Modules**

- **Modules**: implement well-defined functionality
  - Small building blocks for high reuse
  - Loaded at runtime on demand
  - Easily configurable (next slide)
  - Perform packet inspection ... or other tasks
  - this is where you implement your mechanisms!

- **Channels**: linear linked modules
  - Create more complex functionality

```
Channel A
Sampling → Monitoring → Plotting

Channel B
Protocol Filter → Statistics
```
Flexible Configuration

How can I configure my modules?

Module instantiation and configuration
→ Can use module libraries multiple times with different configuration!

Channels and actual use of modules
→ Flexible grouping of small modules into larger functionality!
Communication

- Modules are lightweight, small, decoupled
  → Enables high reuse, but how can they interact?

- **Data-centric communication** between modules
  - Modules register for message they are interested in
    - Modules send out messages
    - Messages delivered to registered modules
  - Module: `Hmm … interesting information I got here … maybe someone is interested in this` → send

- **Remote communication as easy as local**
  - Send messages locally, remotely, or both
  - Transparent message distribution to remote Distack instances
Distrack abstracts from traffic sources

- Live traffic: buffers handle busty traffic
- Recorded traffic: replayed with original timing
- Simulated traffic: packet transformation for OMNeT++

Easy and consistent packet access

- Traffic live, replayed, or simulated … you don’t care!
- Easy and safe access to protocol parsers

```cpp
TcpPacket* tcp = ippacket->getNextPacket();
if(tcp->isFlagSet(TcpPacket::TCP_FLAG_SYN))
    port = tcp->getDestPort();
```

Supported protocols

- Ethernet, ARP, ICMP, IPv4, IPv6, MPLS, TCP, UDP
- More to come. Easy to implement your own!
Integration into simulations

- Few simulations of DDoS attacks and detection
  - In our opinion the key to understand the global and distributed behavior of DDoS attacks

- Our simulation toolkit
  - OMNeT++: time discrete simulation environment
  - INET Framework: lots of protocols (TCP, UDP, …)
  - ReaSE: topology, self-similar traffic generation, DDoS zombies

- Distack is integrated into this toolkit
  - Packet formats
    - Transparent transformation into Distacks protocol parsers
  - Time domain
    - The simulation time runs different!
  - Modules source code compatible
    - just need to recompile …
Distack is real!

Everything presented here is *running code*!

- Go and **implement some modules**
  - Try it out! E.g. analyze a trace file
  - Use the communication between remote instances
  - There are already over 10 modules available

- Go and do a **large-scale simulation**
  - Could be DDoS, could be somethings else
  - Find out how easy Distack makes your life!
Summary and Outlook

- Framework for distributed attack detection
  - Easily integrate your attack detection and traffic analysis mechanisms
  - Easy to use local and remote communication
  - Highly flexible employment
  - Transparent support for different runtime environments (e.g. simulations)

- Outlook
  - GUI support
  - More runtime environments (routers, network cards)
  - More modules to support your research
  - More support for large-scale simulations
Thank you! Questions?

Try *Distack* now!
It's Open Source!

www.tm.uka.de/distack