Distack

A Framework for Anomaly-based Large-scale Attack Detection

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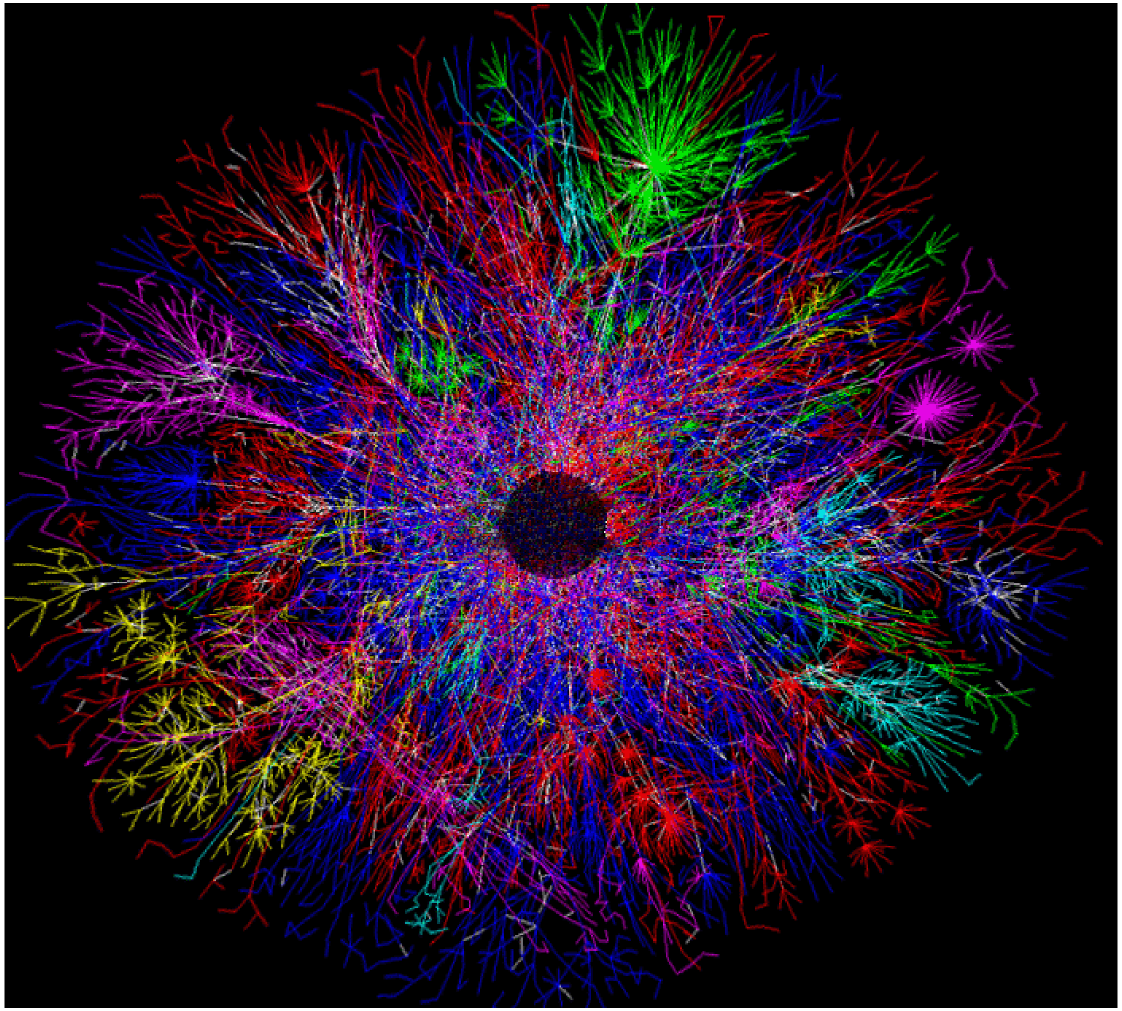
Distributed Denial of Service

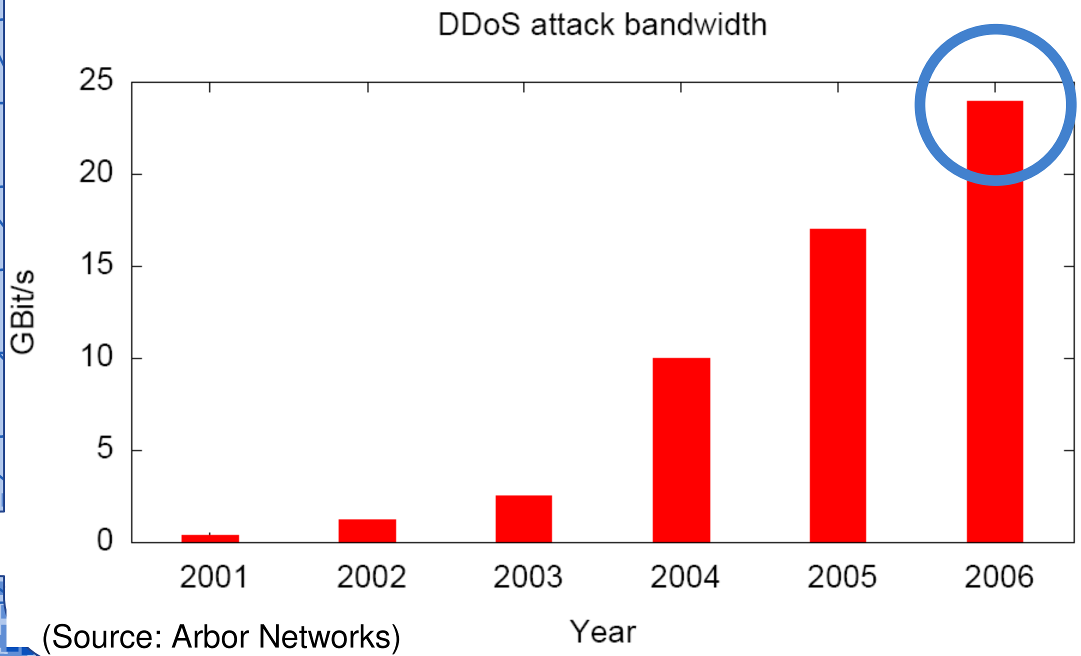


Source: Prolexic

DDoS – Huge threat to the Internet

„New Zealand teenager controlled botnet of ~~1.3~~ 50 million computers“ (Heise-Online, Nov. 2007)

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



(Source: Arbor Networks)

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!

Why can`t we cope with DDoS?

- 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!

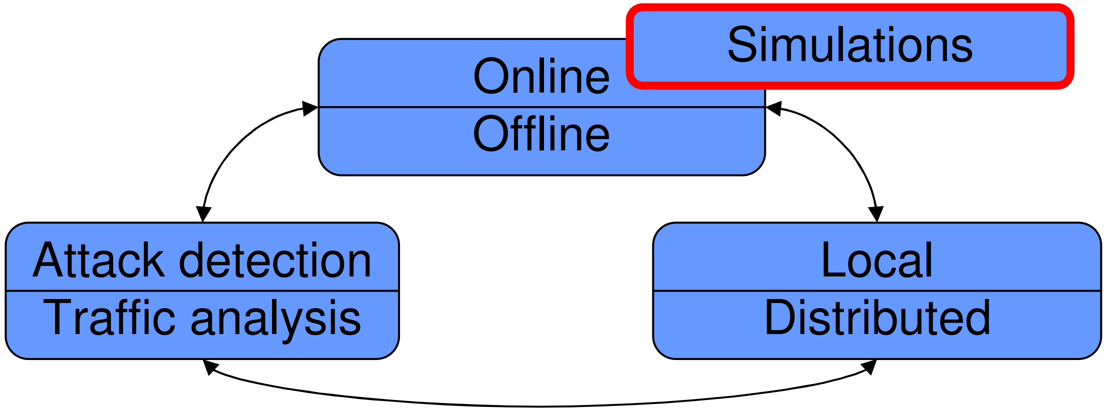
What you can do with Distack

- 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 …

… even more fun with Distack

- Distack use-cases



- 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!

Distack: Distributed attack detection

distack
distributed attack detection

Framework for distributed attack detection and traffic analysis

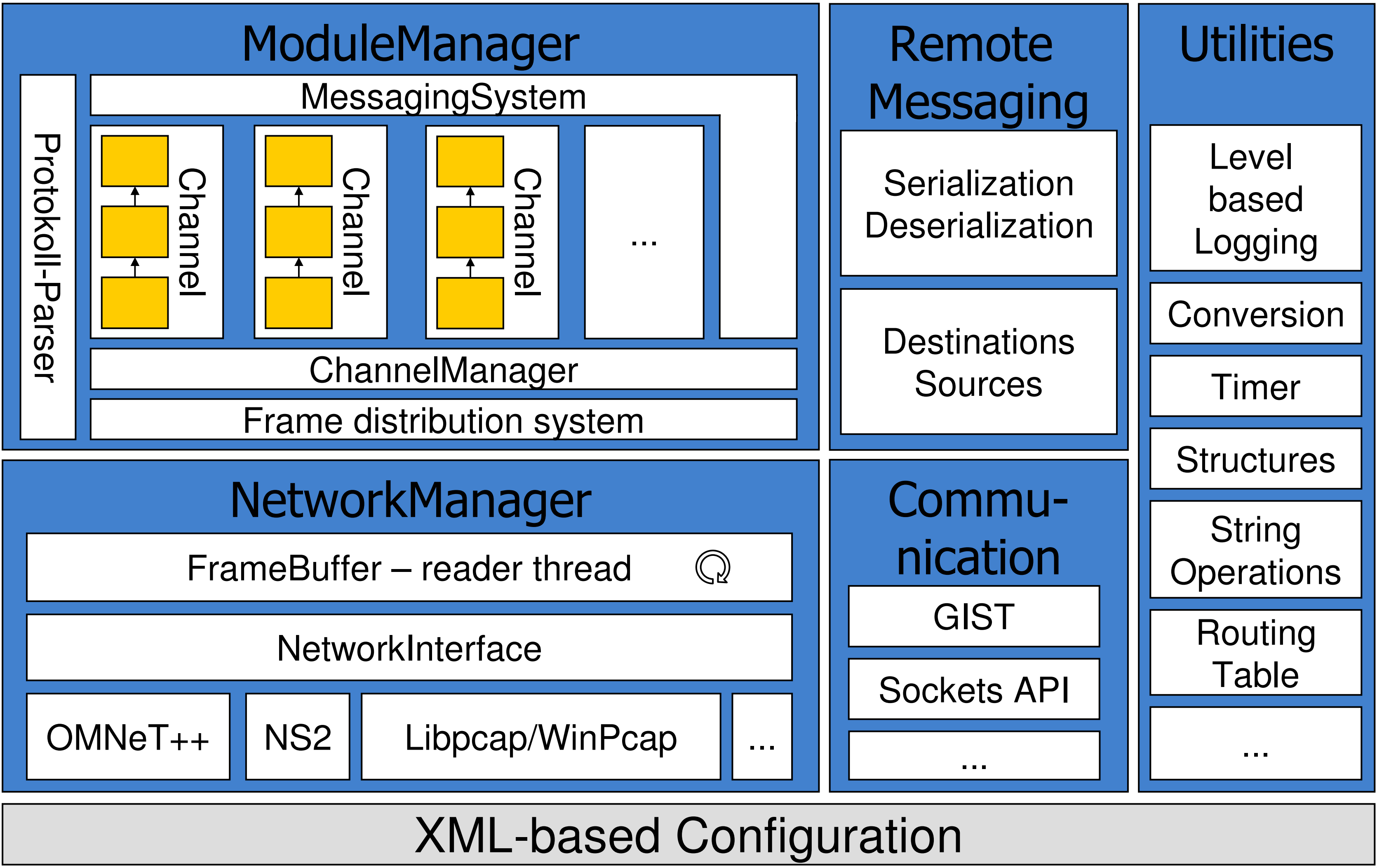
What it gives to *you*

- 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

Distack High-level Architecture



ModuleManager

Protokoll-Parser

MessagingSystem

Channel

Channel

Channel

...

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

...

Commu-nication

GIST

Sockets API

...

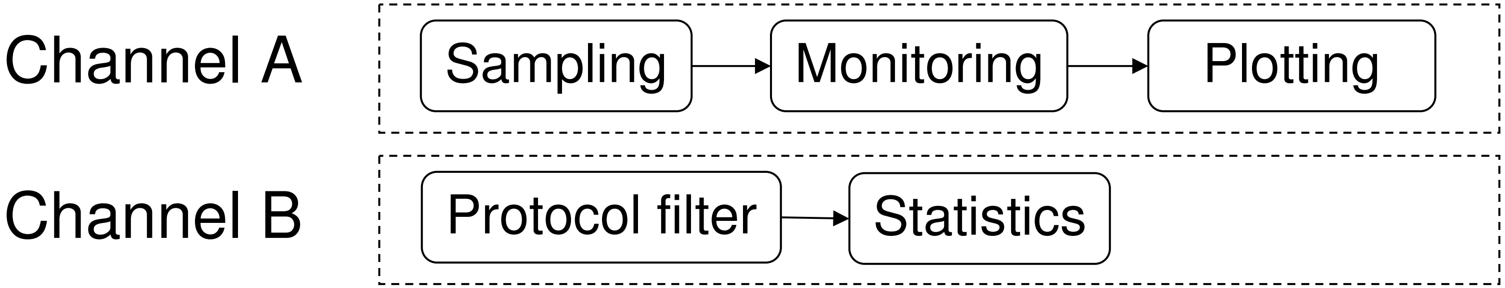
XML-based Configuration

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 instance

Library the module is based on

```
<module name="Modules">
  <submodule name="BasicSampling"
    [illegible]>
    <configitem name="SamplingCount">200</configitem>
    <configitem name="[illegible]">[illegible]</configitem>
  </submodule>
...
</module>
```

Module parameters

Channel name

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

```
<module name="Channels">
  <submodule name="SimpleMonitoring" stage="1">
    <configitem name="1">BasicSampling</configitem>
    [illegible]
  </submodule>
...
</module>
```

Use of the module

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

Communication

- Modules are leightweight, 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

Transparent Abstraction

- 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

```
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?

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

www.tm.uka.de/distack