Proactive Defenses Against DDoS and Worm Attacks

Harnessing the Power of Power-Law Topology for Scalable Network Security

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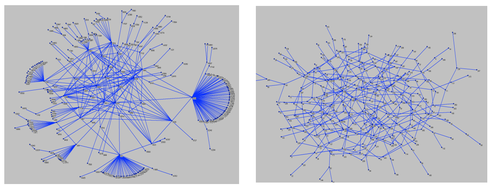
Objective

Proactive protection: Prevent attacks from imparting harm in the first place
Reactive protection: Respond, attribute, and contain new and non-preventable attacks

→ new approach: distributed packet filtering (DPF) → proactive & reactive filtering

Internet Power-Law Topology

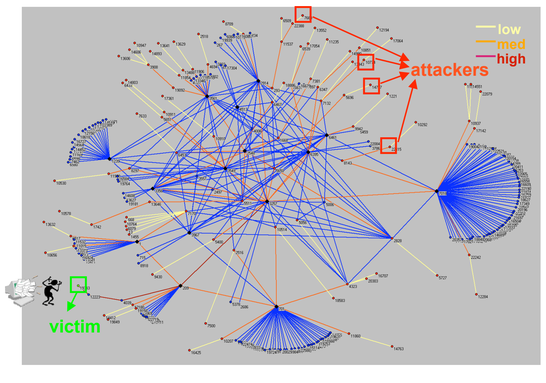
"A few are connected to many, many are connected to a few."



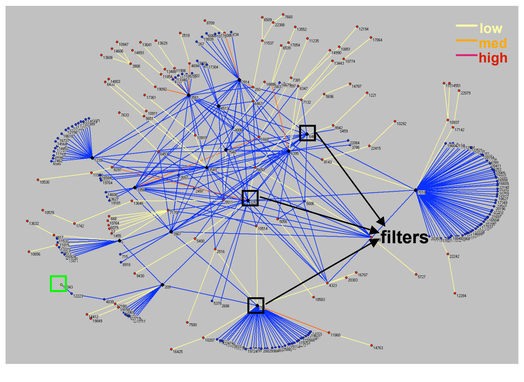
→ facilitates strategic & economic filter deployment

DDoS Attack Protection

→ DPF: route-based filtering "unde venis?"



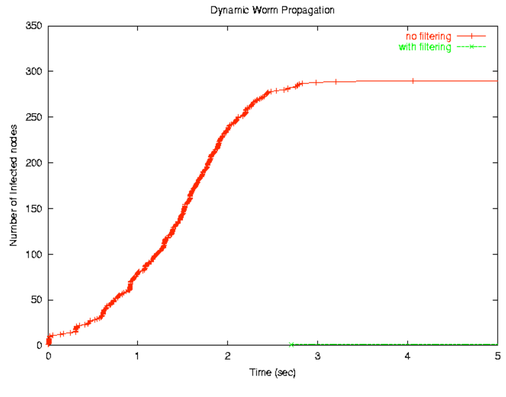
Without DPF



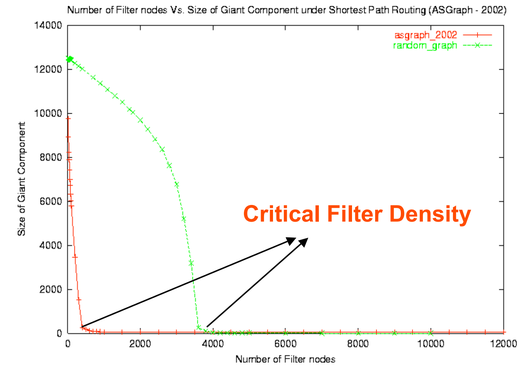
With DPF

Worm Attack Protection

→ DPF: content-based filtering



Infection Dynamics

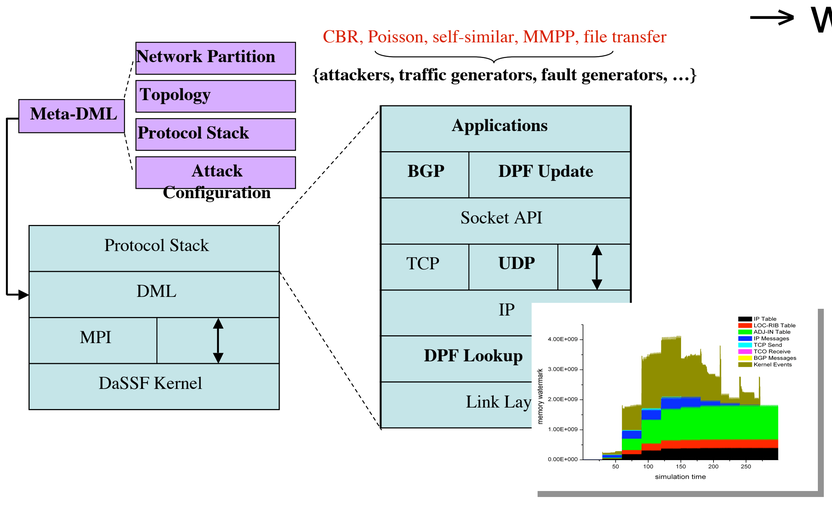


Percolation Threshold

→ 4% deployment achieves significant protection: containment & traceback
→ NLANR (1997-2002), CAIDA, RIPE, USC/ISI, UMich Internet AS measurement data

Tools: Large-Scale Simulation & Prototype System Building

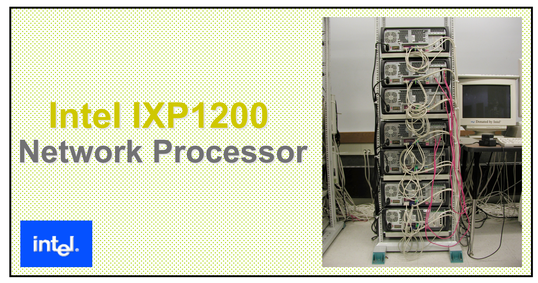
Dynamic DPF Simulator: Parallel Network Simulation



→ workstation cluster

- 12,500+ node networks
- Failure model
- Power-law partitioning
- System measurement
- Meta-DML configuration
- Trace-driven visualization

Network Processor Prototyping



- 7-node IXP1200 NP testbed
- DPF implementation & evaluation
- Teja development environment

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