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Intent-Based Attack Mitigation through Opportunistic Synchronization of Microservices

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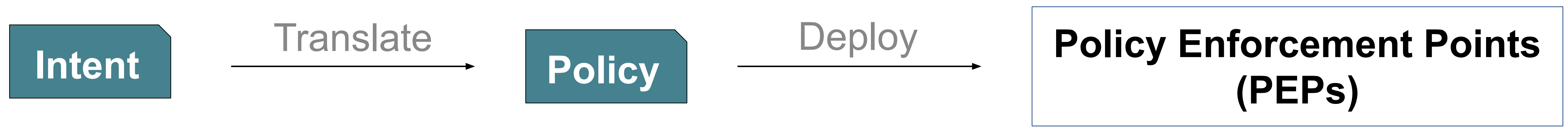
Context: the Case of Intent-Based Networking (IBN)

IBN System: allows expressing objectives expressed in high level languages or natural language to modify the behavior of network operations



e.g. Stop propagation of malware

- Drop packets from infected host X
- Isolate network Y

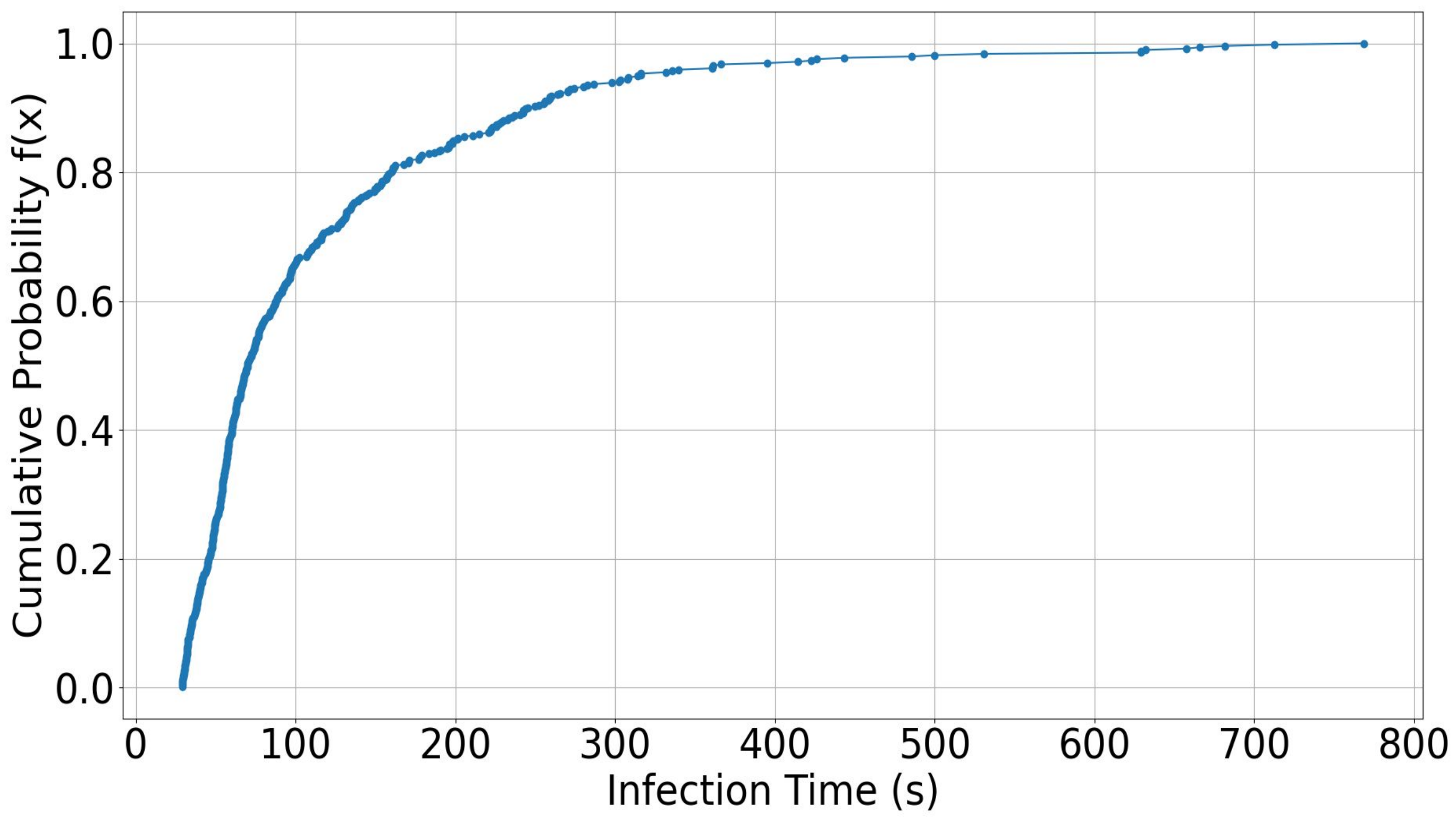
- Firewall
- Intrusion Detection System

➡ Avoid error-prone and time-consuming tasks and facilitates the expression of a security policy

Problematic and Research Question

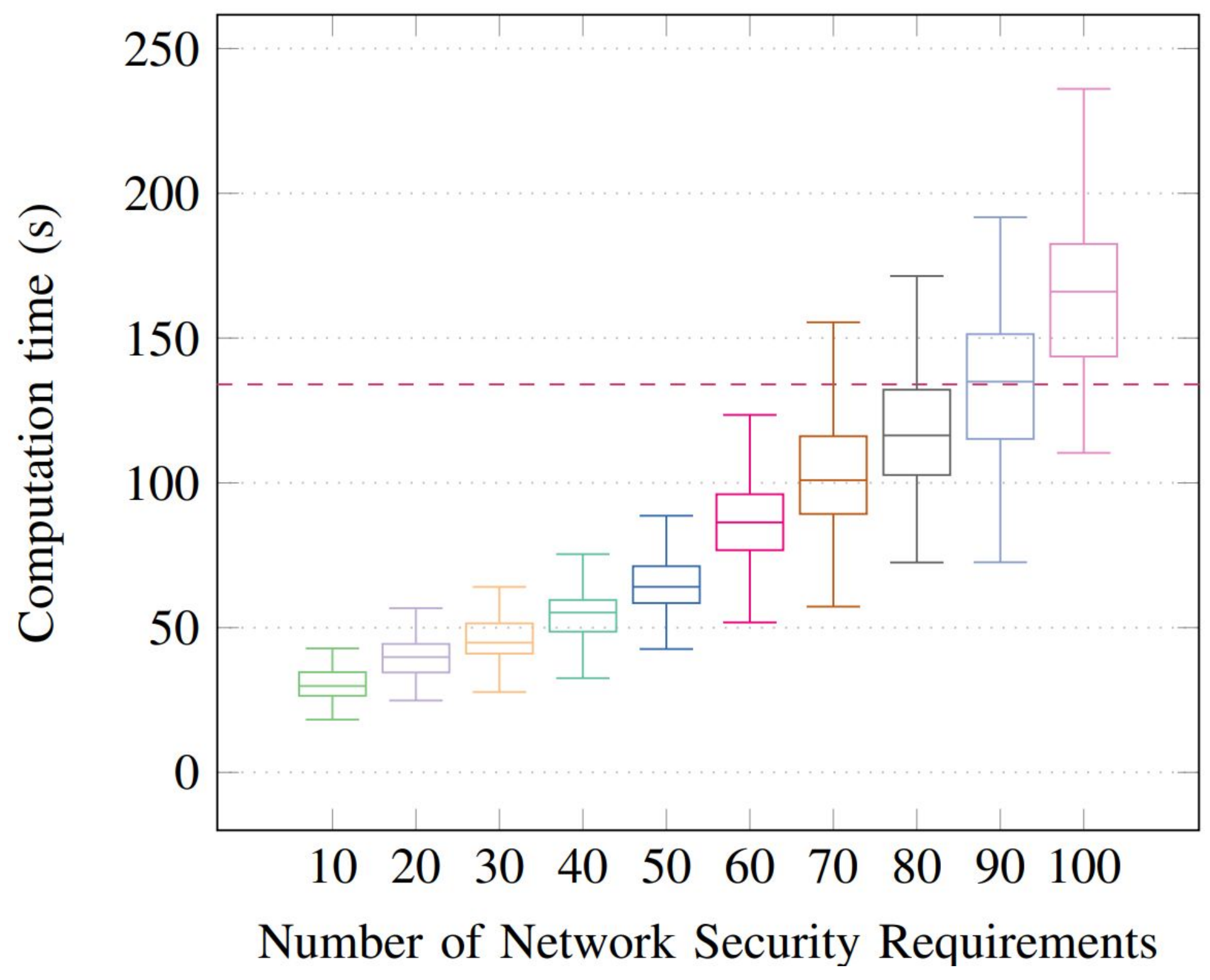
IBN systems may experience degraded performance and limited scalability

Question: Can state-of-the-art IBN systems deploy reaction policies fast enough in the context of fast propagating malwares?



Our empirical cumulative distribution function of infection times of WannaCry in 50-host networks [1]

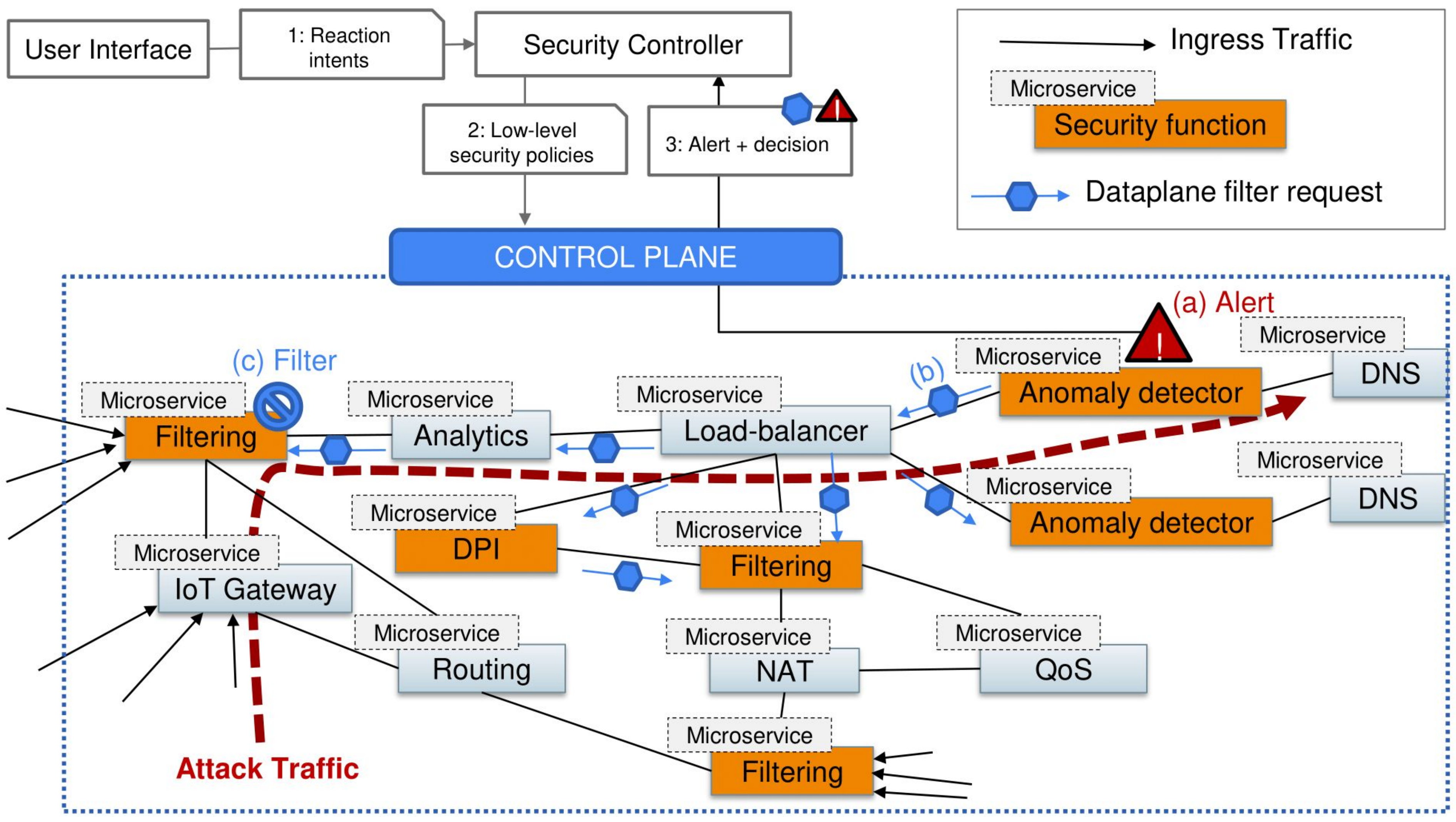
~20% of infections are processed in ≤50 seconds



Computation time of optimal firewall rules from user requirements [2]

>100 seconds required to compute 100 security requirements

An Opportunistic Approach Using Microservices



Target architecture using opportunistic approach

We propose to leverage

- Microservices as PEPs to enable
  - ➢ Scalability
  - ➢ Flexibility
  - ➢ Independent development and deployment
- A fast synchronization mechanism between microservices to
  - ➢ Share attack information
  - ➢ Autonomously response to attacks

The opportunistic approach is fast for synchronization

- Reuse existing packets to embed attack information

  e.g. The anomaly detector embed “filtering” decisions on detected malware propagation traffic

- Microservices with appropriate security functions update their response as soon as they receive these packets

  e.g. The “filtering" microservices update their response based on received decisions

Reference:

[1] Do Duc Anh Nguyen et al. ”How Fast do Malwares Leveraging EternalBlue Propagate? The case of WannaCry and NotPetya“. In: SecSoft Workshop. 2024.

[2] D. Bringhenti et al., “Automated firewall configuration in virtual networks,” IEEE Transactions on Dependable and Secure Computing, vol. 20, no. 2, pp. 1559–1576, 2022.

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