Multiscale Networked Systems

EPI Framework: Approach for traffic redirection through containerised network functions

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MultiScale Networked Systems
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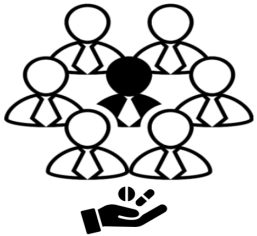
Why is it important?

- Personalised medicine is a novel approach to improve clinical care
  ⇒ Individualised approach to diagnose and treat,
  ⇒ Vital to enable collaboration between healthcare provider,



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  ⇒ Policies.

Our Contribution

How do we contribute:

1. **EPI**[1] **Framework** Novel data-sharing framework to support healthcare applications
   - Automated setup per application,
   - Orchestration and provisioning of **Bridging functions**

[1] https://enablingpersonalizedinterventions.nl/

Our Contribution

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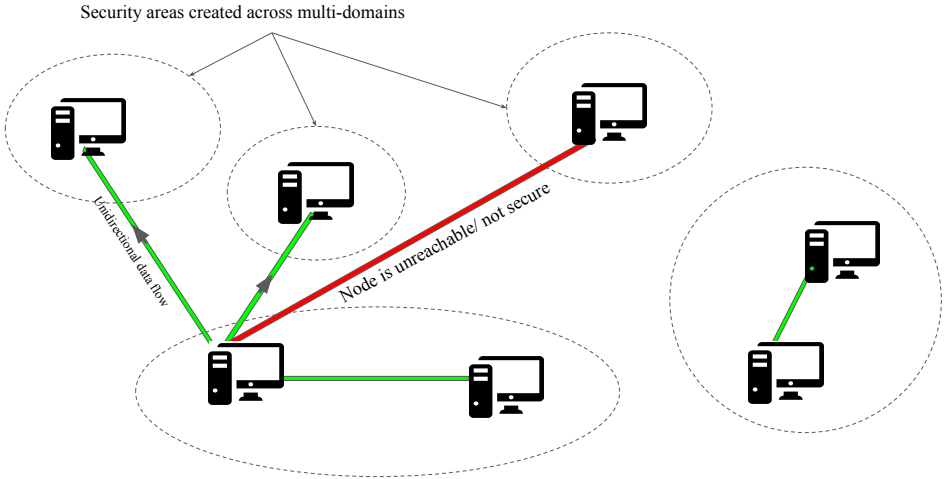
1. **EPI**[1] **Framework** Novel data-sharing framework to support healthcare applications
   - Automated setup per application,
   - Orchestration and provisioning of **Bridging functions**
2. Our approach features containerised virtual network functions, and we focus on
   - Traffic manipulation via proxy tools implementation
   - Benchmark redirection tools
   - & The results can be reused outside the EPI scope

[1] https://enablingpersonalizedinterventions.nl/

Bridging policies and Resources



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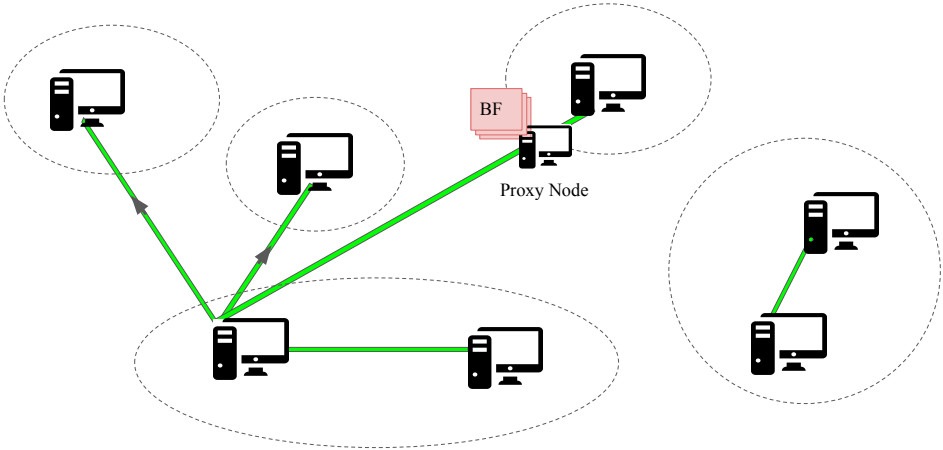
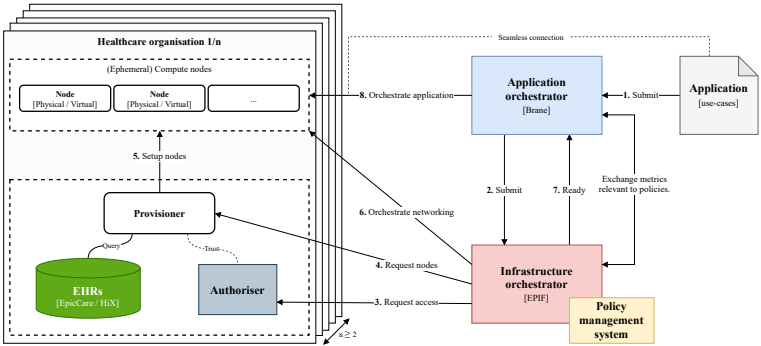


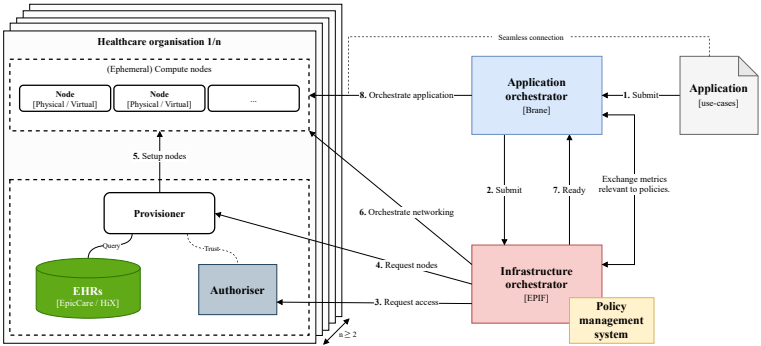
The EPI Framework



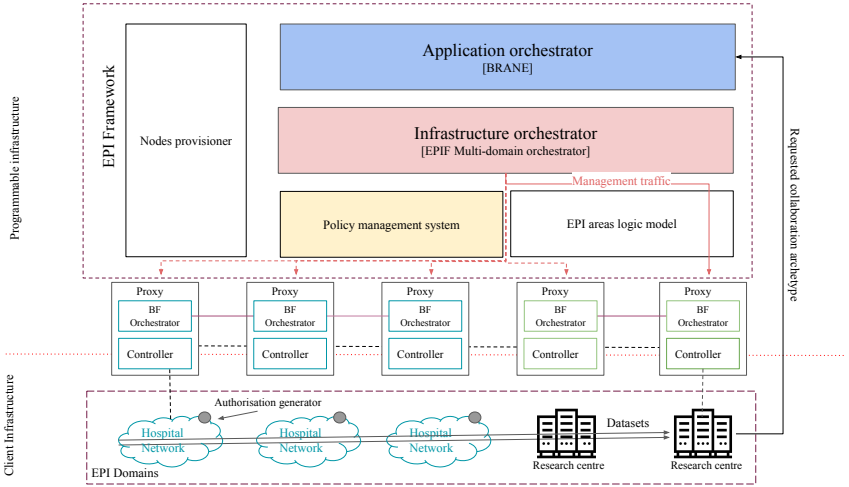
The EPI Framework

EPI components:

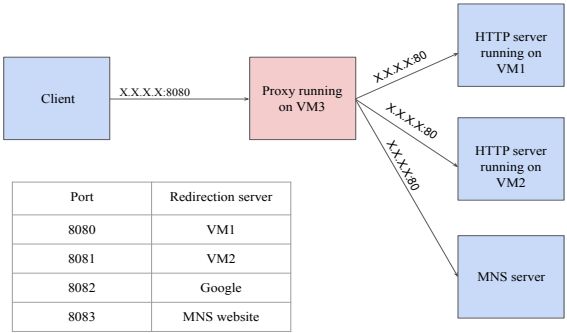
1. Orchestrators:
   - ⇒ Application orchestrator
   - ⇒ infrastructure orchestrator
2. Policy management system
3. Domain components
   - Resources provisioner
   - Authoriser components



The Architecture



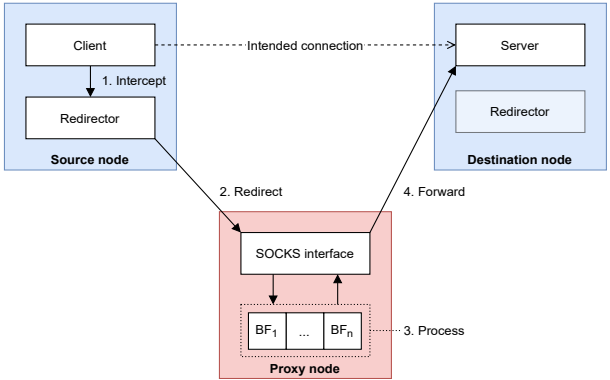
Proxy Implementation



Port	Redirection server
8080	VM1
8081	VM2
8082	Google
8083	MNS website

NGINX-based reverse proxy

Proxy Implementation



SOCKS-based proxy

Experiments & Benchmarks

Goal: To determine which implementation should be adopted

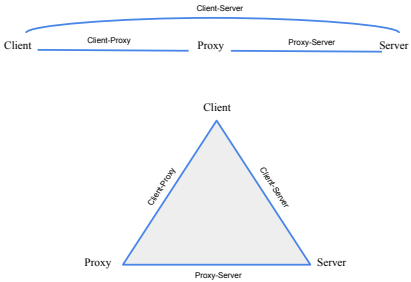
1. We benchmark the two approaches:
   - time overhead (Δt)
   - rate of processed transactions (throughput)
2. Fully containerised and automated the benchmark setup
   https://github.com/epi-project/proxy-bench

The experiment's setups:

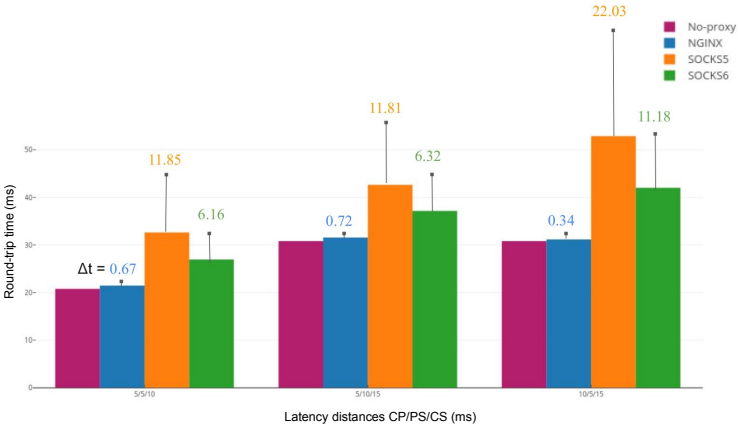
1. Experiments with different network configuration
2. Average round-trip time of 120 consecutive requests
3. Overhead vs no-proxy
4. Throughput vs no proxy
5. Network tools:
   - httping
   - wrk

Network Topology

Topology	CP (ms)	PS (ms)	CS (ms)
Proxy-in-between	5	5	10
	5	10	15
	10	5	15
Triangular	1	1	1
	5	5	5
	10	10	10

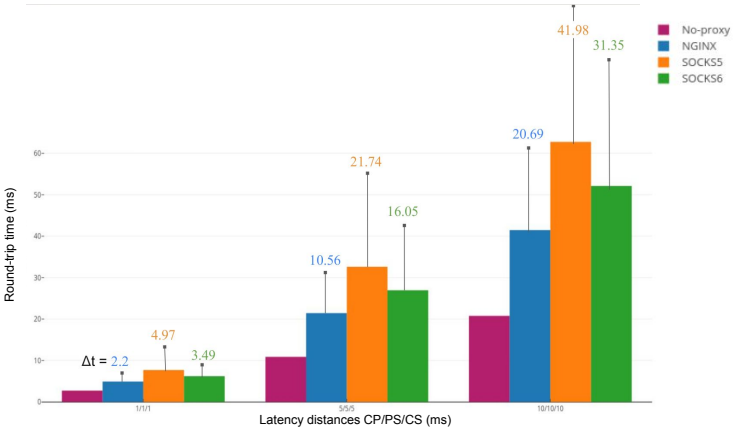


Overheard: Proxy-in-between Topology



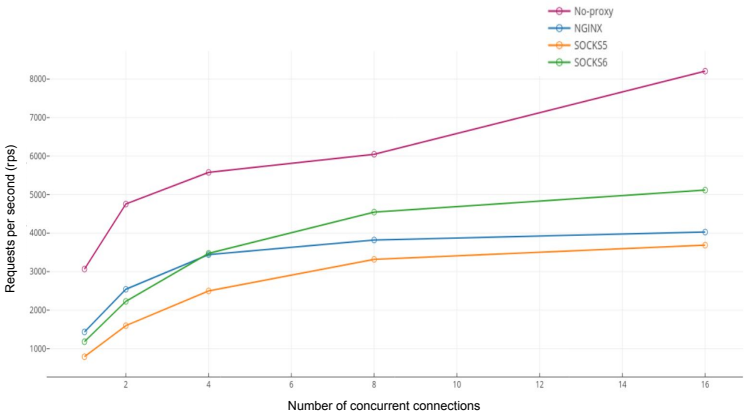
⇒ FIGURE 11
⇒ SOCKS-5 highest overhead,
→ NGINX Δt is $< 1ms$,
→ SOCKS6 Δt is $\simeq 6ms$,
→ SOCKS5 Δt is $\simeq 12ms$,
⇒ SOCKS imply more overhead.
⇒ Extra authentication steps during connection setup

Overheard: Triangular Topology



⇒ FiGURE 12
⇒ Much higher Δt
⇒ Overhead ↑ with:
→ ↑ distance CP,
→ Not as much ↑ PS.
⇒ Placement highly affects Δt,
⇒ Optimisation option.

Rate of processed transactions



⇒ FIGURE 13
⇒ Flattens when hits 8,
⇒ Bottleneck of resources,
⇒ SOCKS6 has the highest,
⇒ SOCKS5 has the lowest.

Comparison and Discussion

Parameters	NGINX	SOCKS5	SOCKS6
Δt	●	○	○
Processing rate	○	○	●
Port scalability	○	●	●
Reconfiguration	○	●	●
Dynamicity	○	●	●
Security	○	●	●

Conclusion and Future Work

Manipulating traffic is a core feature

- We evaluated and benchmarked two different approaches
- Δt depends on positioning of the proxy
- Choice depends on
  $\Rightarrow$ The application requirements
  $\Rightarrow$ Specific relevance of performance parameters
  $\rightarrow$ Time-critical application, NGINX
  $\rightarrow$ Data streaming application, SOCKS6

Conclusion and Future Work

Ongoing work:

- Implementing more EPIF functionalities
- **Bridging Function Chaining**
- Uniform interfaces of bridging functions
- Extra plug-ins needed in the redirection tools
- Real test-beds and EPI usecases

Resources & Pointers

- EPI website enablingpersonalizedinterventions.nl
- More about the area logic model: Jamila Alsayed Kassem, Cees de Laat, Arie Taal, and Paola Grosso, The EPI Framework: A dynamic data sharing framework for healthcare use cases", IEEE Access journal
- ICT.OPEN 2020: Jamila Alsayed Kassem, "EPI infrastructure: A dynamic infrastructure to secure data sharing in healthcare applications."
- ICT-Open 2021: Jamila Alsayed Kassem, "EPI Framework: A dynamic infrastructure to support health applications."
- More about BRANE: https://docs.brane-framework.org/
- Source code: https://github.com/onnovalkering/brane