UNIMON

Efficient Monitoring of Unikernel-Based VNFs

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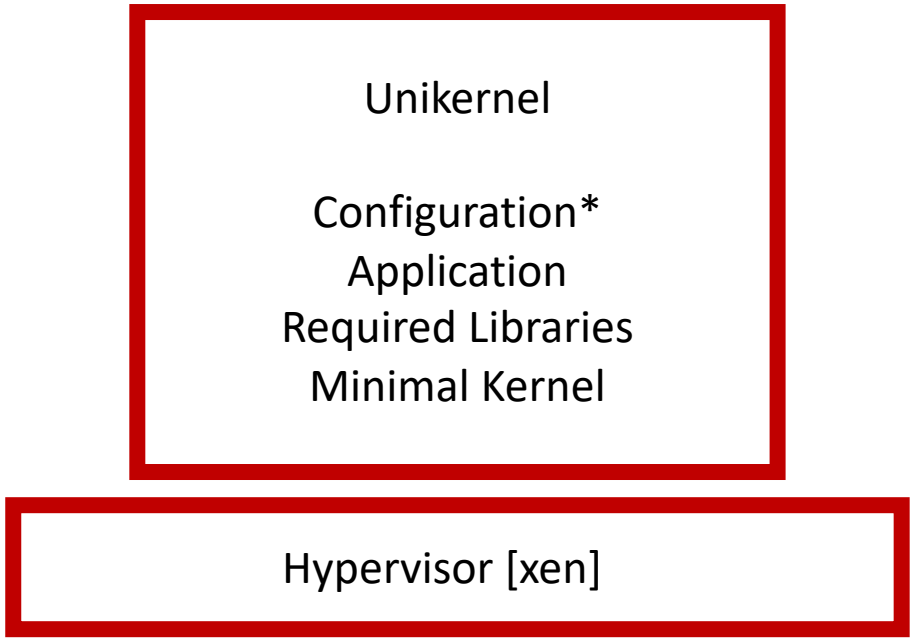
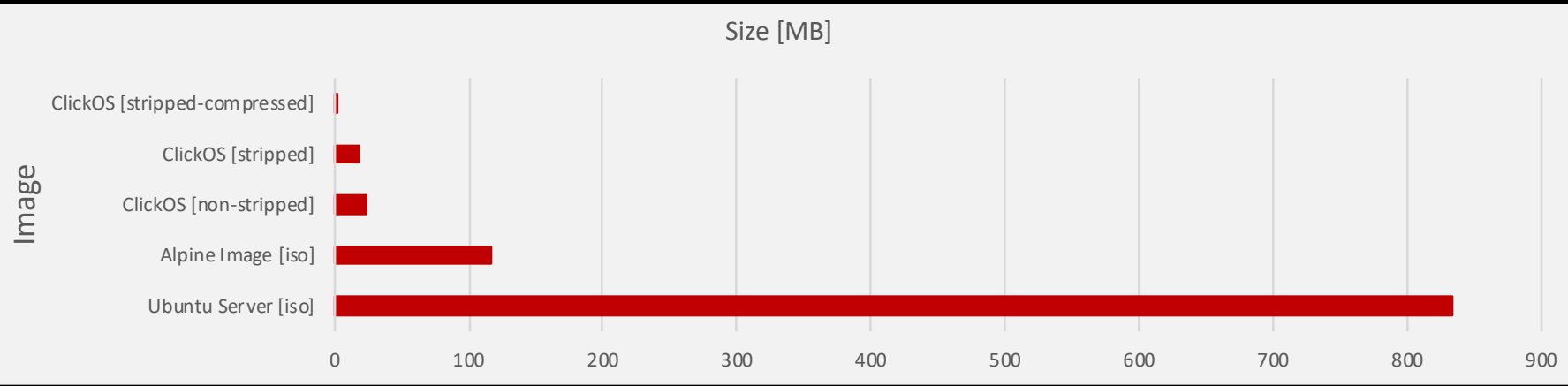
Unikernels

Pros:
- Small Image Size
- No Context Switching
- Small Attack Surface

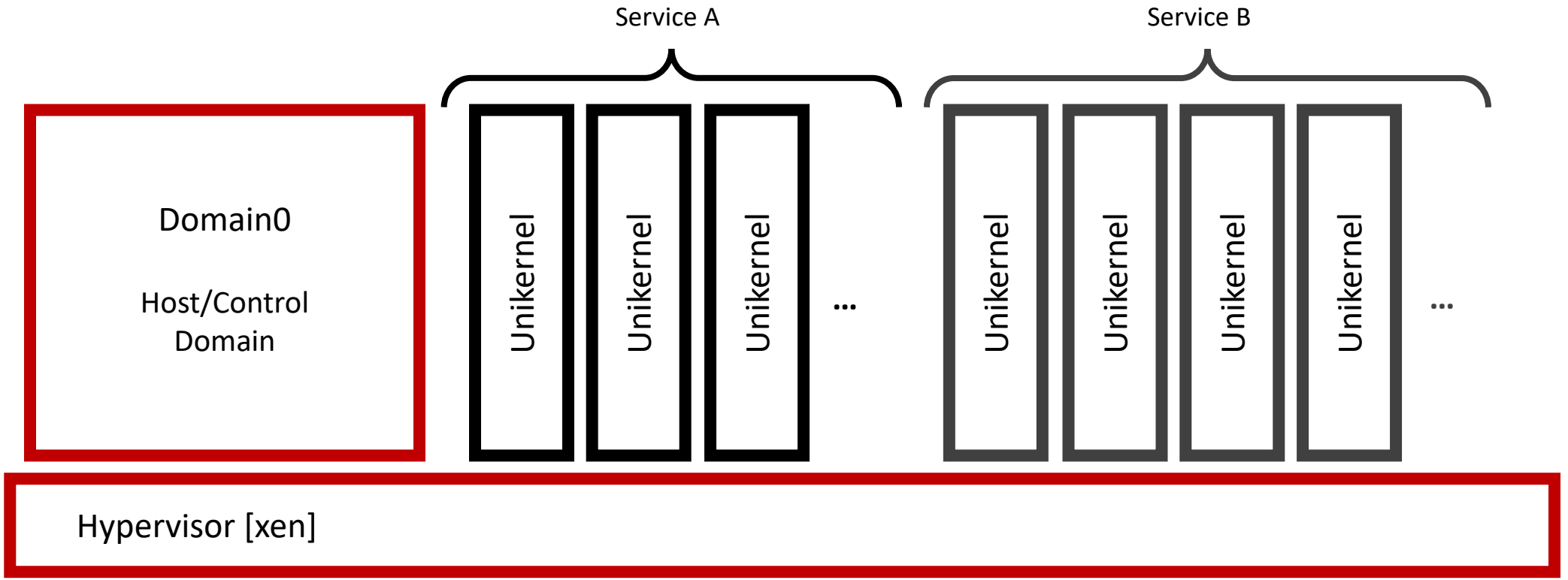
Cons:
- Difficult to Develop
- Harder to Manage





Scaling

- Low resource cost of a single Unikernel allows for vast horizontal scaling



(NFV+DevOps)= 💖

- The marriage of microservices and CI/CD as seen in SaaS
- Unikernels can ≃ Microservices for NFV in the context of CI/CD
- Can use the DevOps methodology with Unikernels

Challenges

- Poll-based packet I/O uses all free cycles to poll
  - ’Black-box’ Unikernel always appears to use 100% CPU
- Scaling decisions made by IM/MANO platform
  - Hardware statistics w/o context can be invalid
  - Limited interface options [no ssh]
- Single-core + cooperative scheduling [with ClickOS[1] example]
  - Guarantees in-pipeline monitoring to have impact
- Difficult development environment
  - Leads to issues to be discovered post deployment

[1] Martins, Joao & Ahmed, Mohamed & Raiciu, Costin & Olteanu, Vladimir & Honda, Michio & Bifulco, Roberto & Huici, Felipe. (2014). ClickOS and the Art of Network Function Virtualization. 459-473.

UNIMON Goals

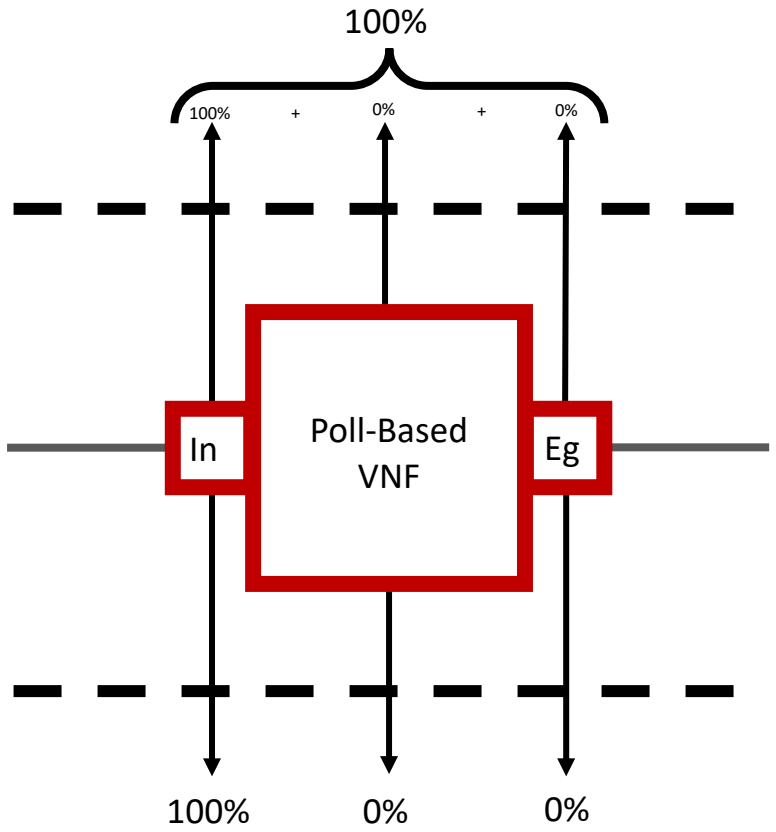
- Gain contextual data regarding the state of a Unikernel based VNF
- Minimize the impact of in-pipeline VNF monitoring
- Offer flexibility to both developers and operators
- Push stats out of the VM with minimal overhead

UNIMON:

Getting contextual data

NAME	STATE	CPU(sec)	CPU(%)	MEM(k)	MEM(%)
clickos [m	-----r	29	100.0	524288	1.6

CPU: As seen by IM or MANO platform



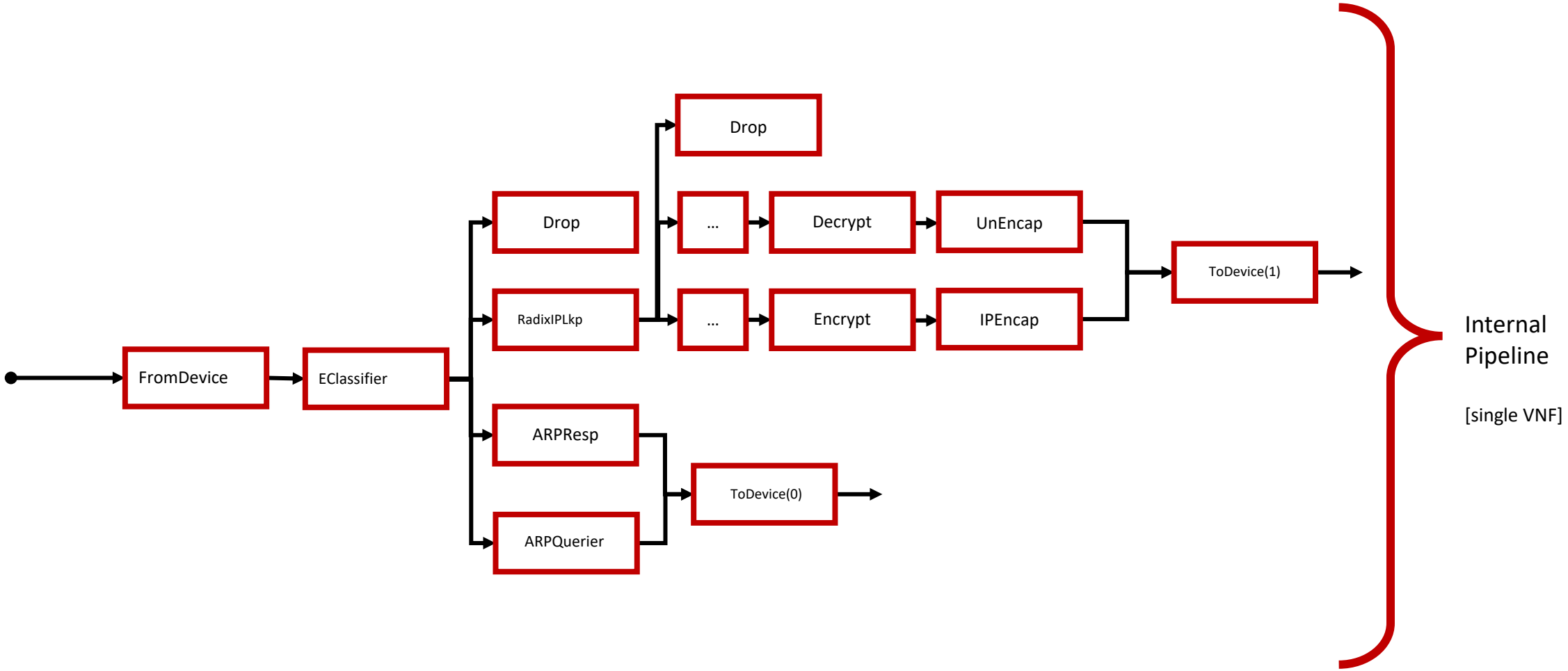
CPU: Split Values

- Deep external monitoring not suited for live VNFs. Uniprof[2] is an example and requires pausing VMs and only provides CPU usage when combined with unstripped binary.
- UNIMON opts for internal:
  - Can be used in live deployment scenarios
  - Comes inside the binary
  - Offers contextual data

[2] Schmidt, Florian. (2017). uniprof: A Unikernel Stack Profiler.

UNIMON:

ClickOS IPSec Element Pipeline



UNIMON:

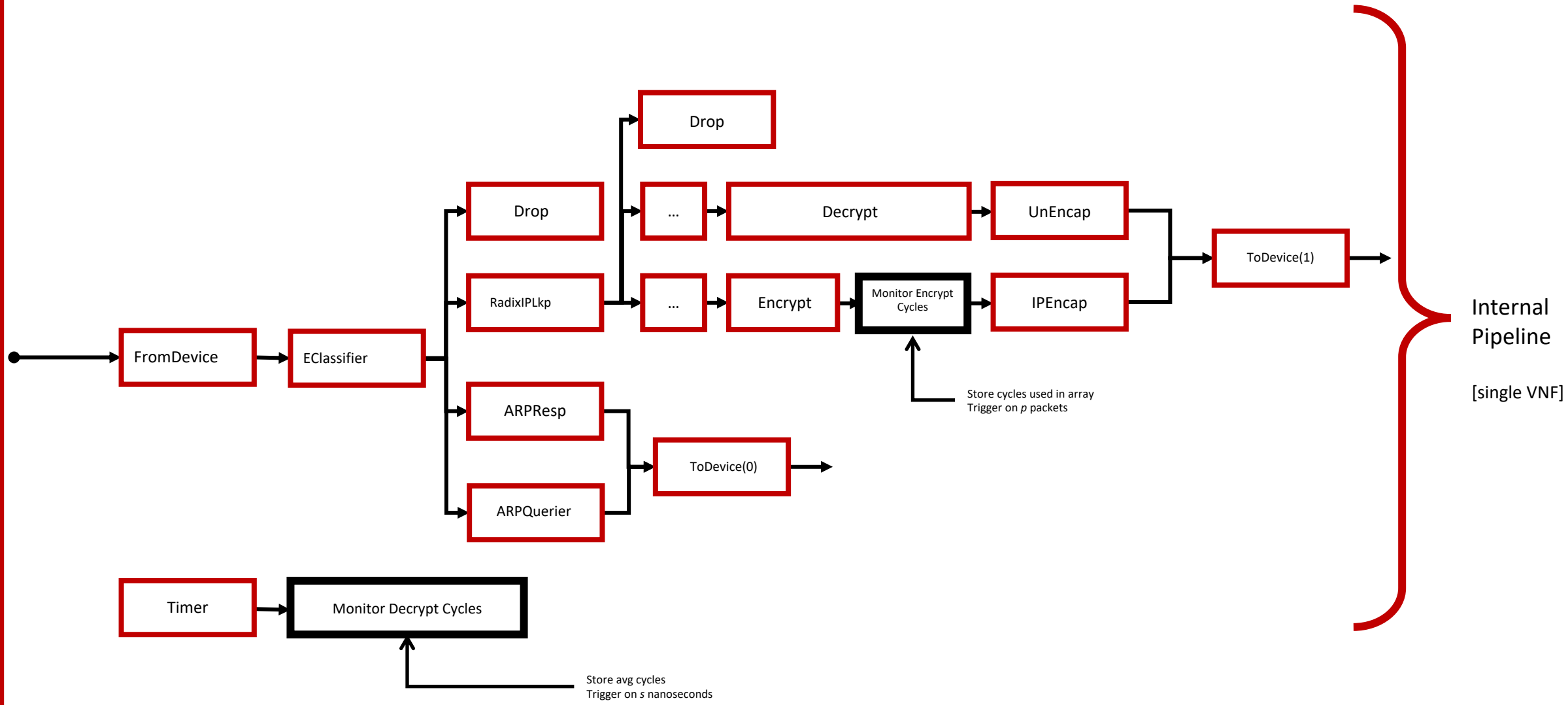
In-pipeline Monitoring

Attempts to reduce performance impact:

- Don’t monitor the whole system, only suspect ‘elements’
- Provide flexibility to both developers and operators of Unikernel VNFs
  - Per monitored element poll frequency
  - Separated frequency for pushing out collected stats
  - Wide range of values that can be monitored whilst keeping context

UNIMON:

Pipeline with Monitoring



UNIMON:

Zero-Copy Stats Transfer

```
Unimon Shared Struct
uint16_t tmc;
tagged_mon_t tagged_monitor[tmc];
mon_data_t mon_data[tmc];

Tagged Monitor Struct
uint8_t status;
char element_name[32];
char handler_name[32];
uint32_t data_size;
uint32_t data_offset;

Monitor Data Struct
uint64_t data[n];
```

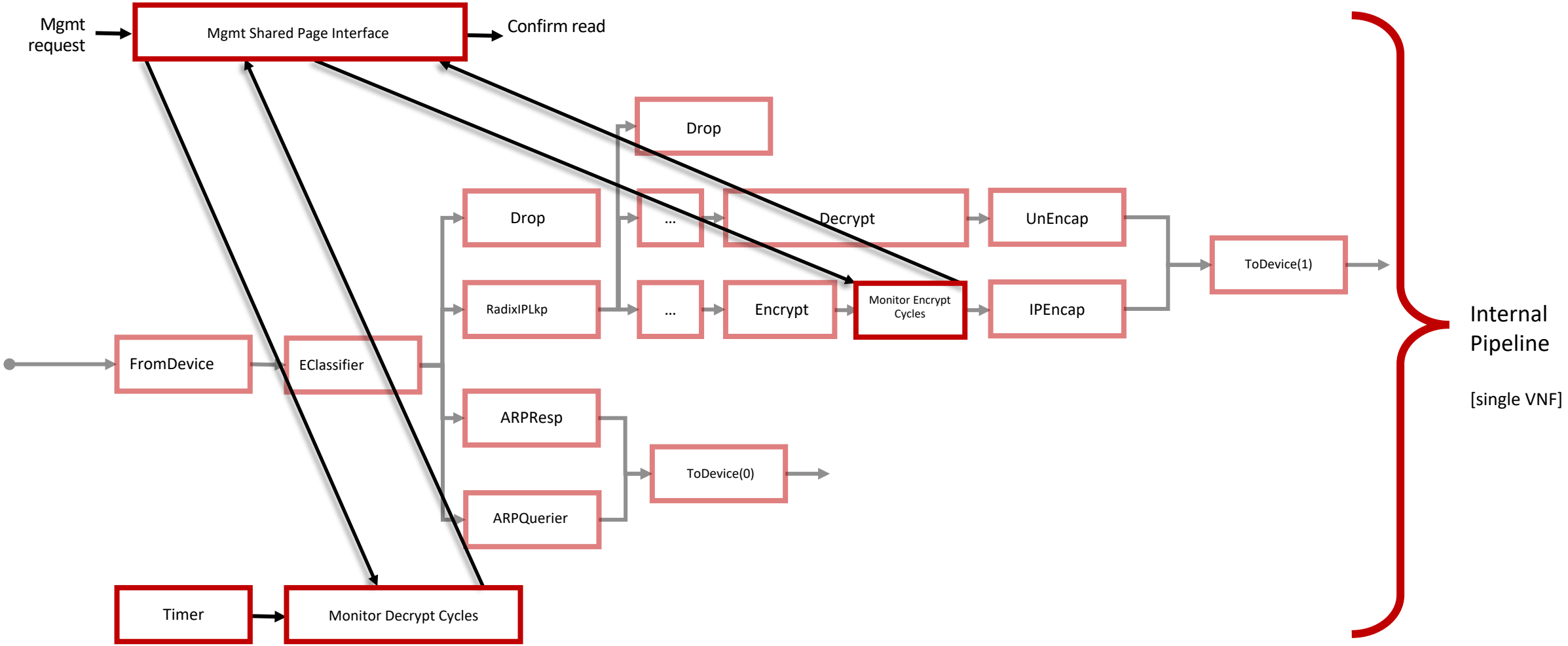
Optimizations to the flow of monitoring data:

- Separate frequencies for monitoring frequency and data push outs (leaving memory decisions up to the dev)
- Configurable average vs. time series array
- Using shared pages between the host domain and the VNF to allow for zero copy stats transfer (XenSocket[3])

[3] Zhang, Xiaolan & McIntosh, Suzanne & Rohatgi, Pankaj & Linwood Griffin, John. (2007). XenSocket: A High-Throughput Interdomain Transport for Virtual Machines.

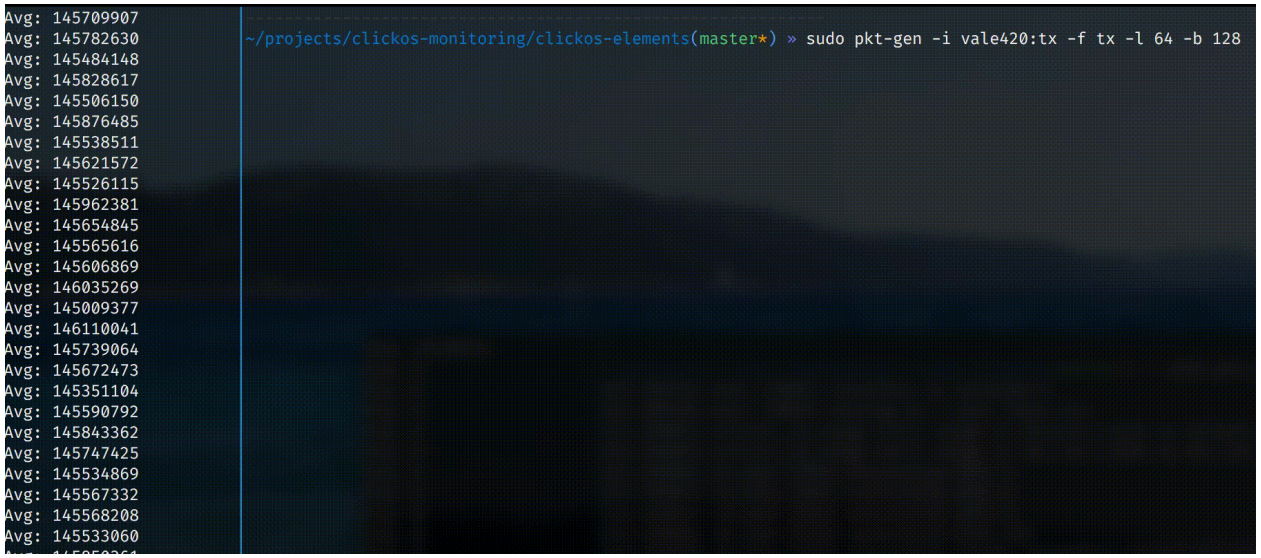
UNIMON:

Exporting Data



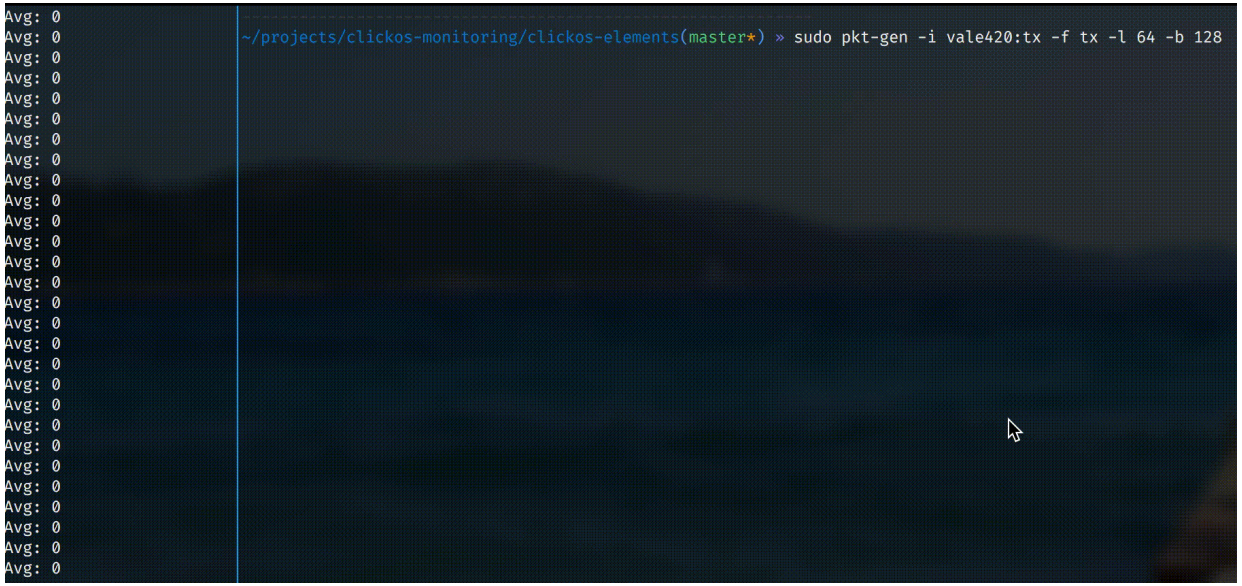
Testing

Does UNIMON Work?



Output when monitoring CPU cycles of an ‘fromdevice element’ every 0.1seconds

Output when monitoring CPU cycles of an ‘ethermirror element’ every 0.1seconds

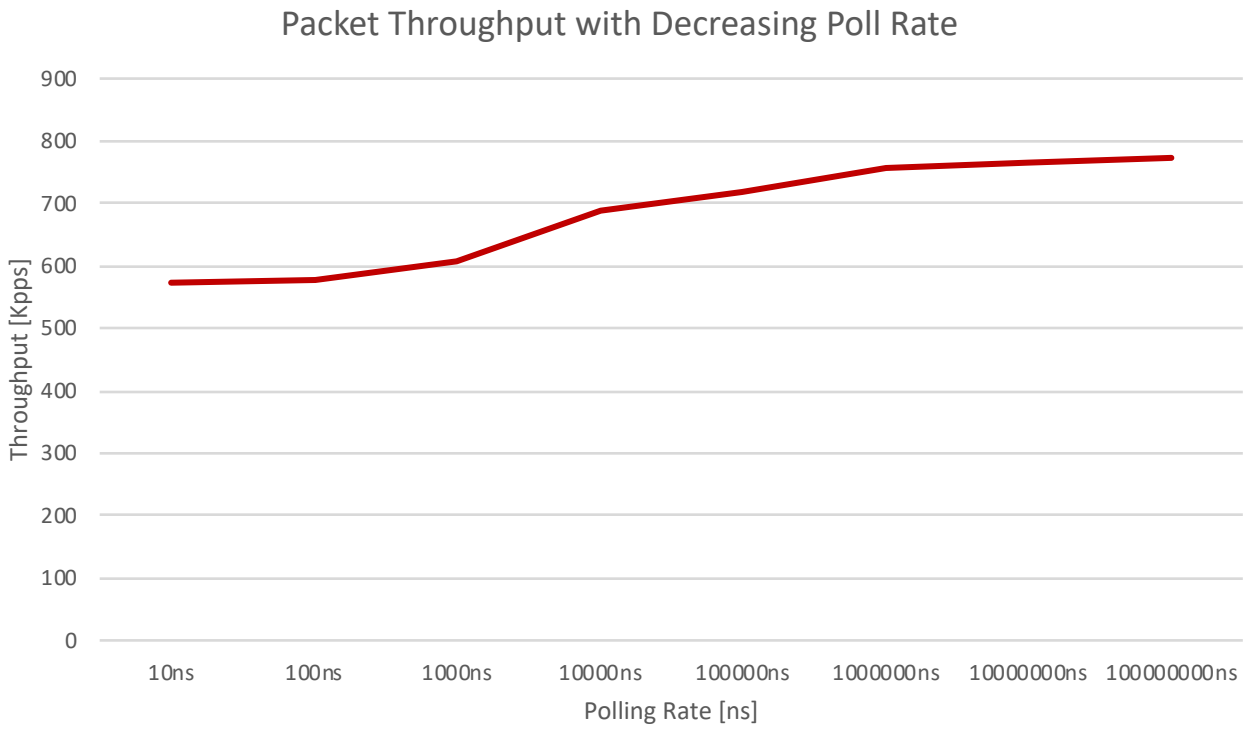


Testing

What's the Impact?

What does this show?

- 3.4% overhead when polling 1000x per second
- 27% overhead when polling every 10 nanoseconds



Future Work

- Enable host domain stats aggregation

  (Fractal presentation tomorrow covers how we could do a bit of this)

- Support live reconfiguration of VNF monitoring

- Batch monitoring of multiple elements

- Budget focused adaption

Thanks for Listening

Any Questions?

Very different UNIMON…

Unimon

Unimon is a Mythical Animal Digimon. It is a composite Digimon that has both the horn of the Unicorn, the legendary holy beast, and the wings of the Pegasus. With the gigantic wings growing from its back, it instantly runs about the world of the Computer Network, stabbing enemies with the sharp horn extending from its brow. A wild(?) Unimon has a rough temperament like a restive horse, but once tamed, it can be handled as if it was the tamer's own limbs.[2]

Attacks

- **Aerial Attack**[3] (*Holy Shot*): Spews a Qigong shot from its gigantic mouth.
- **Aerial Gallop**[4] ('*corn Thrust*): Stabs the enemy with the horn on its head.
- **Uni-Gallop**: Kicks with its hind legs.