KalKi: High Assurance Software-Defined IoT

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- Security concerns over **untrusted supply chai** obstacle.

- We are developing a **solution that remains re** **trustworthy**, even in the presence of a powerfu

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devices to breach networks

arstechnica

arstechnica

Latest Mirai variant targets routers and other IoT devices using 13 exploits

cyware.com

A 100,000-router b
feeding on a 5-yea
bug in Broadcom c

arstechnica

Your smart air conditioner could help bring down

Hacked appliances could overwhelm the grid, resear

cnet.com

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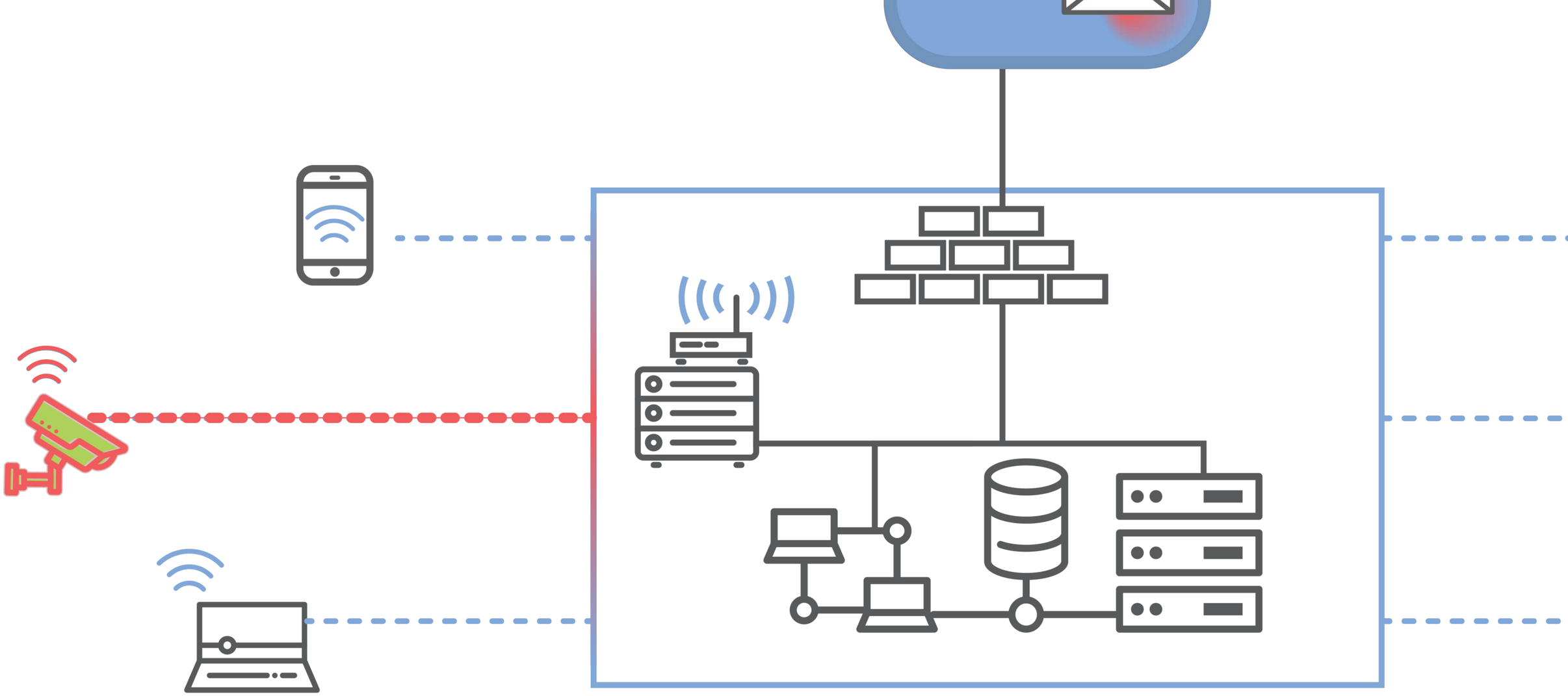

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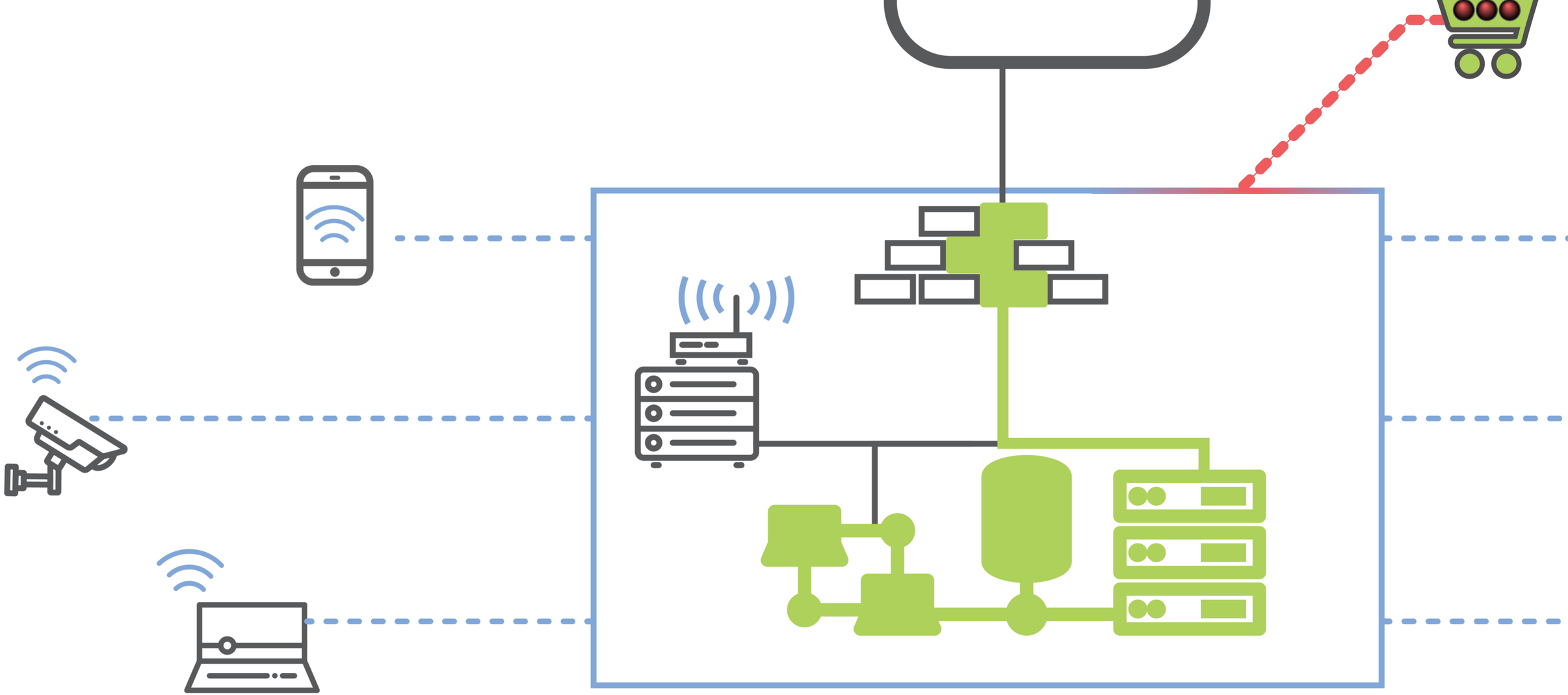

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Solution: Move Security Enforcement to the Network

Create an IoT security platform highly resilient to a collection of presc

- Enables the integration of IoT devices into DoD networks
- Protects the networks even if the IoT devices are not fully trusted o

The term “KalKi” is of Sanskrit origin, and it is the name of an a
the god Vishnu, the destroyer of filth and bringer of purity, truth a

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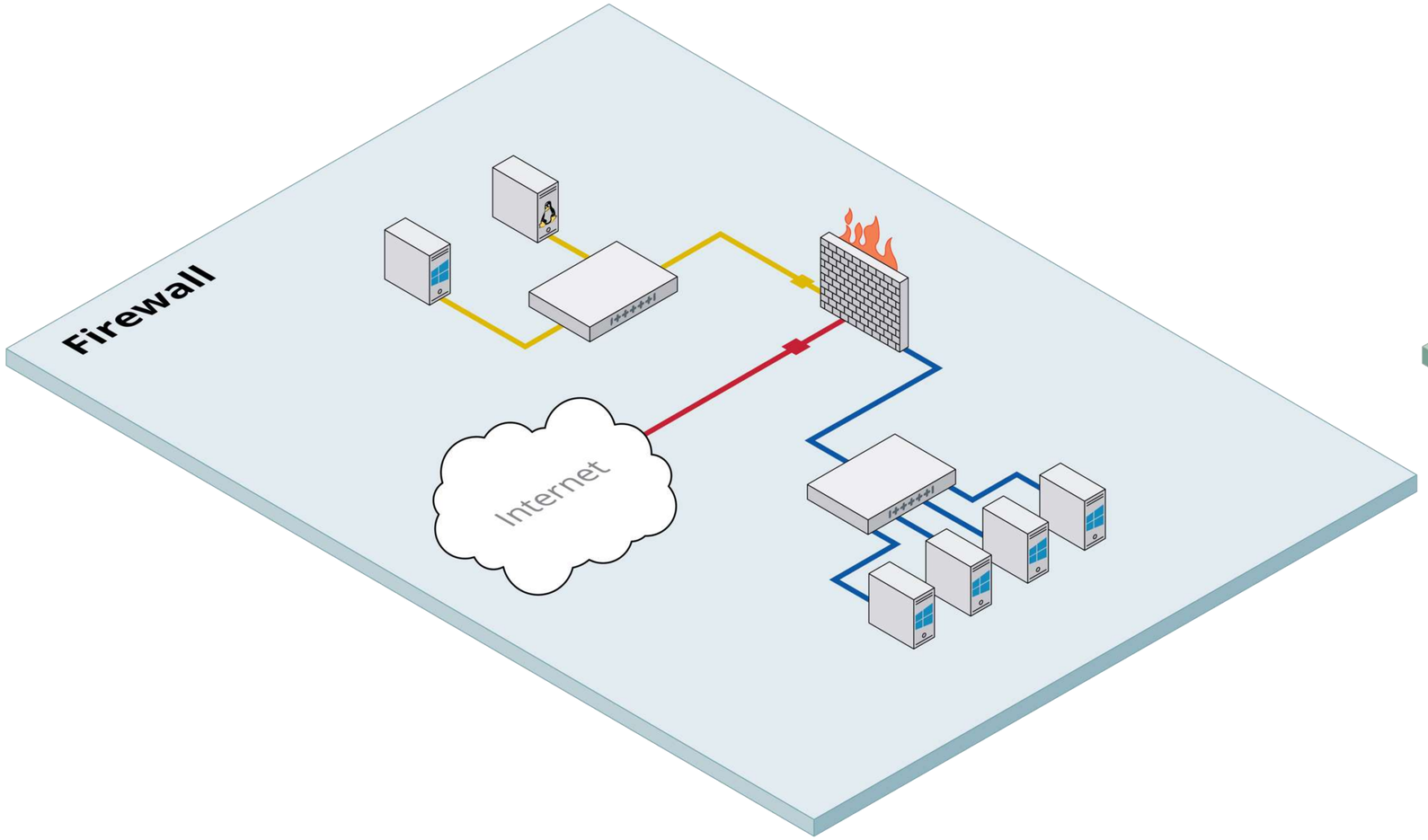
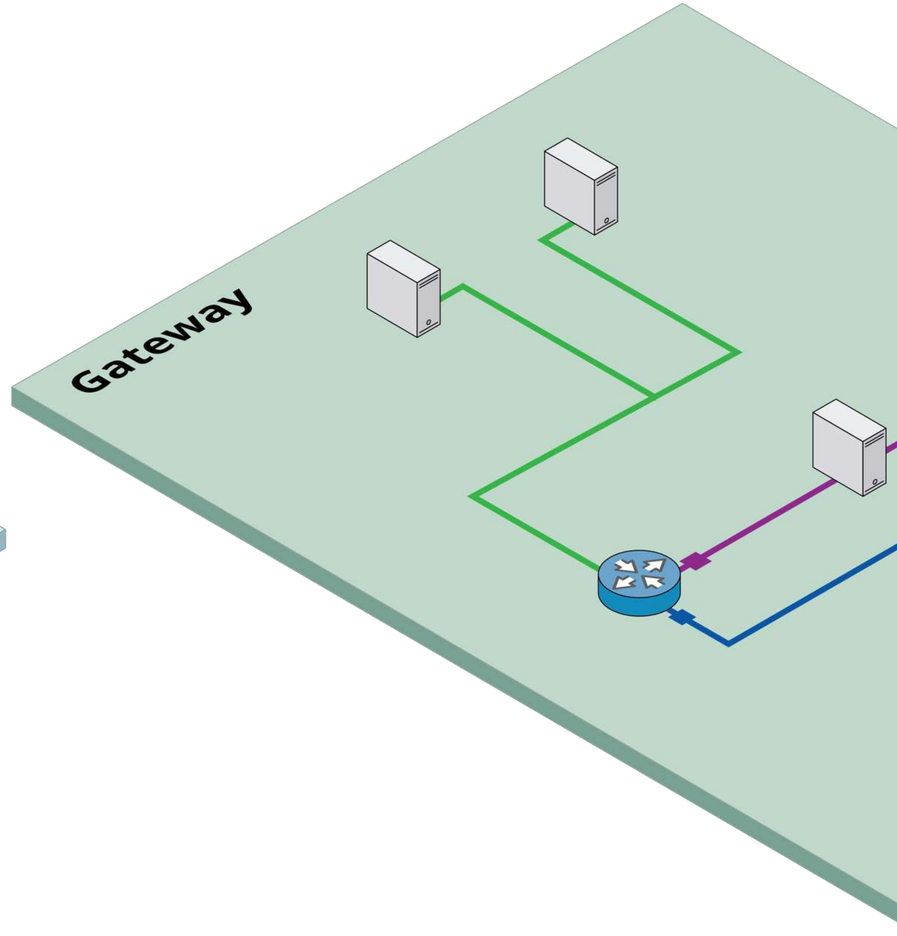
- Are not device-specific
- Cannot adapt to changing security states

- Can become compromi





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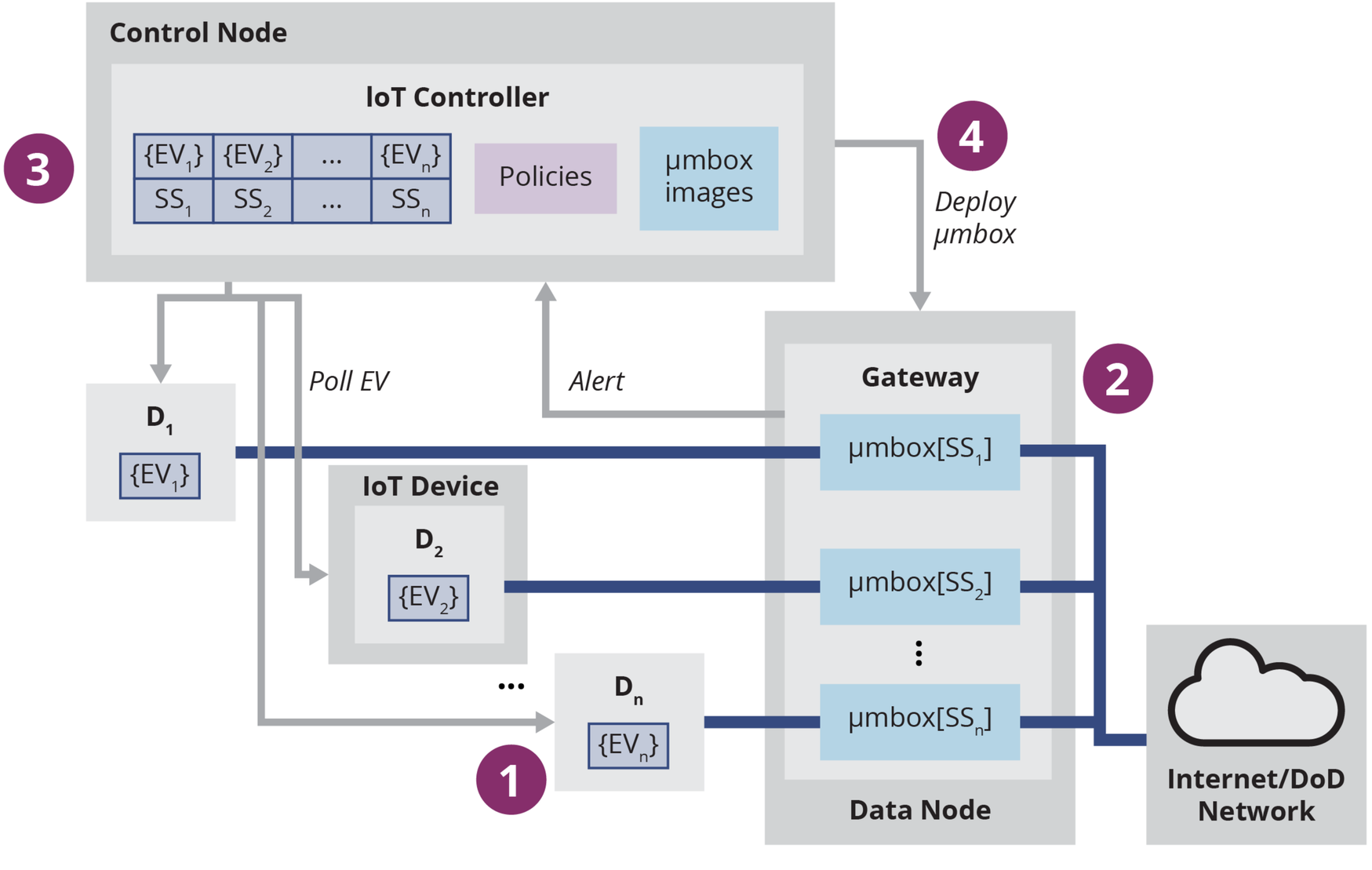
create a highly dynamic IoT security platform.



1. Each IoT devi
set of environ

2. Network traffic
tunneled throu
implement the
for the device'
µmbox[SS_1]
µmbox[SS_2]

3. IoT controller m
statespace cor
security state (
SS = {Norma

4. Changes in the
evaluated by p
the deploymen

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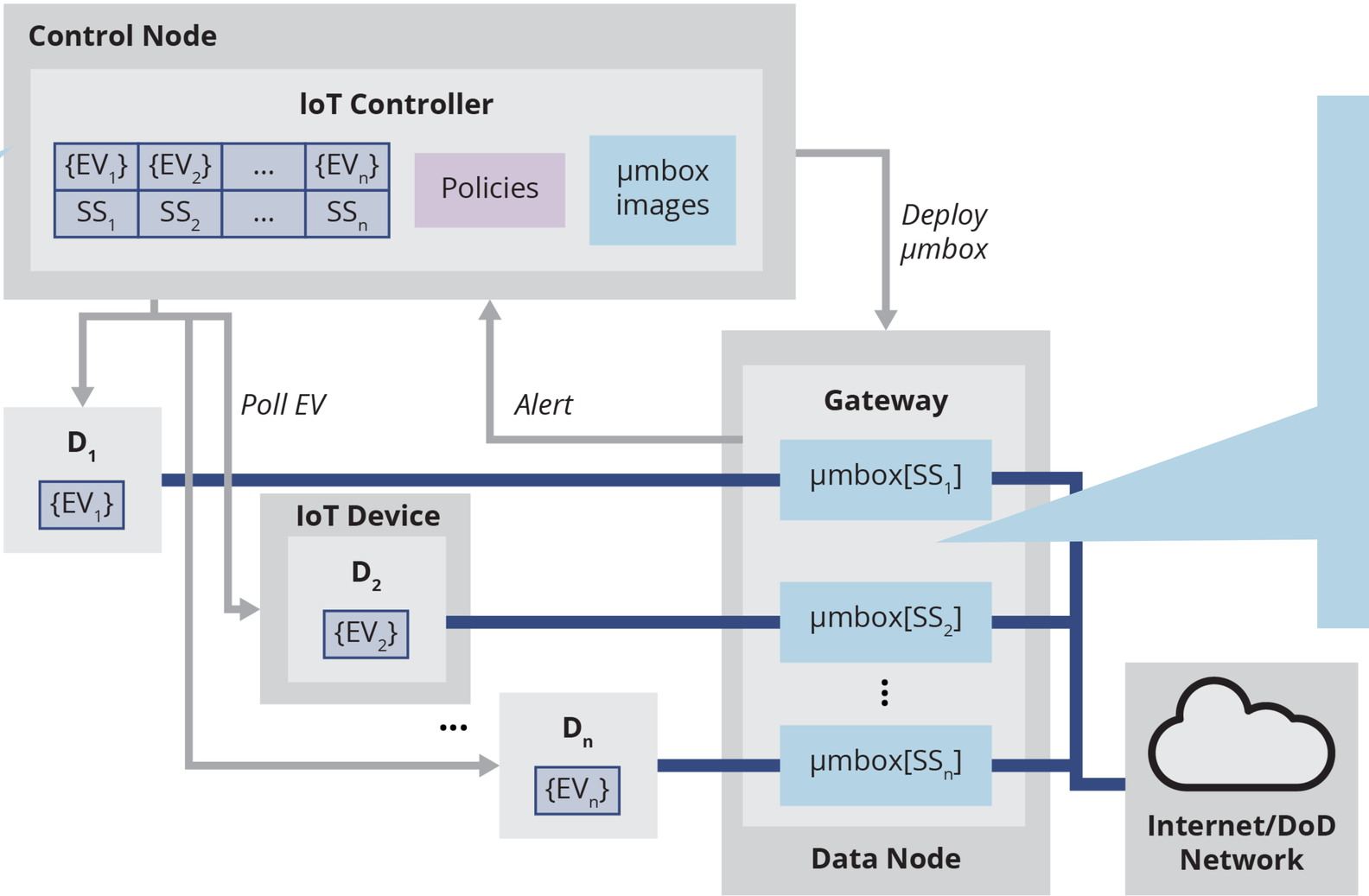
defined IoT security platform using uberSpark/uberXMHF, a framework
secure software stacks.

Control Node Properties

- Policy data integrity, including security state machine



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Initial Threat Model to guide development

Policy Model to set conditions to change security state, and actions to be taken

Initial Architecture and prototype of the IoT Security Platform

FUNCy Views (Secure) system architecture: hardware-assisted, low-latency, low-TCB, compartmentalization of legacy code on x86 platforms

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IoT Security Platform prototype full development

Dashboard Update

Creation of Policies and µmboxes for four representative IoT devices

Experiment to Test different scenarios an red team attacks

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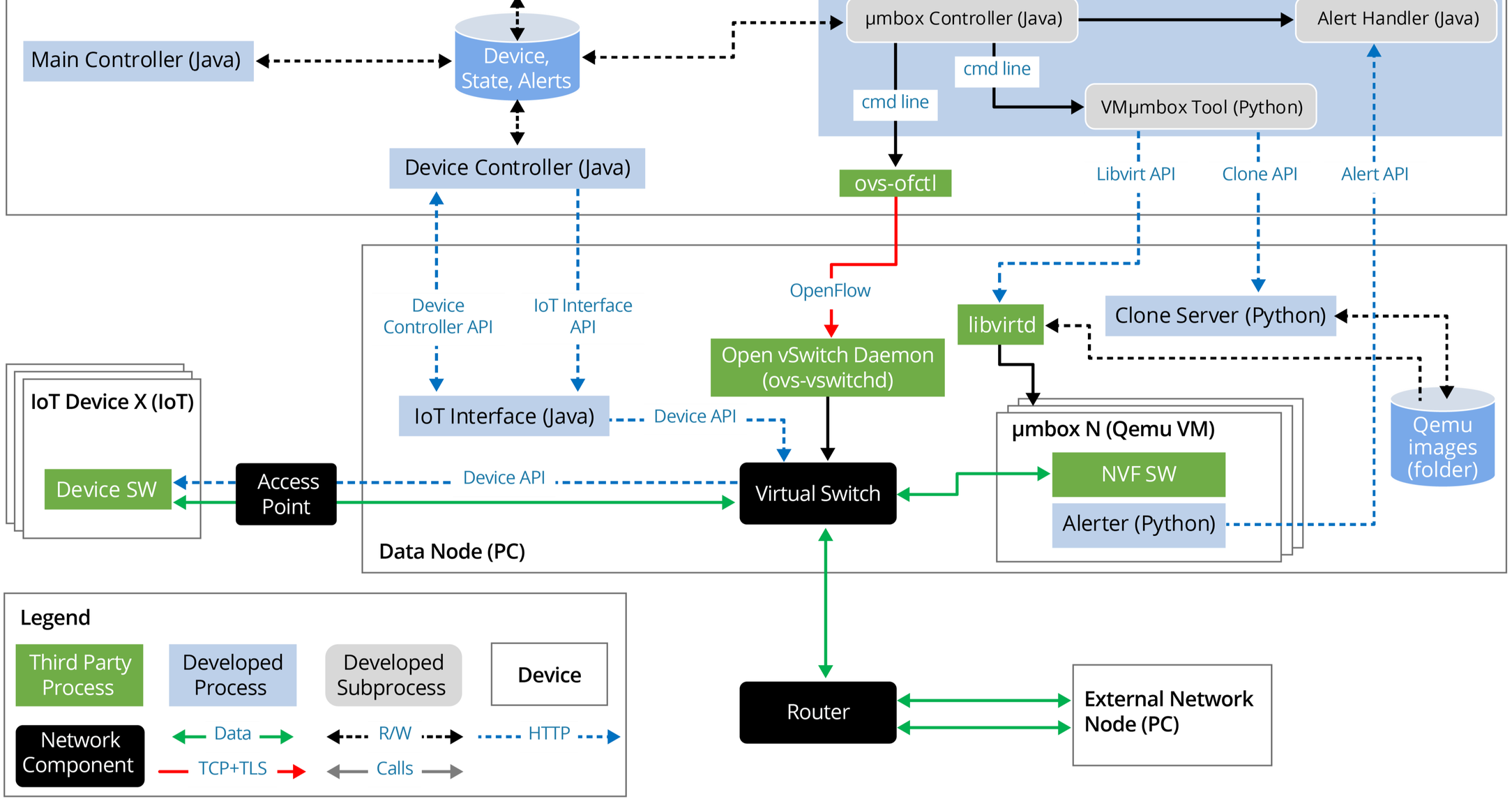

- Abl
  spe
- Sup
  poli
  sec
- Run
  har

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KalkiDashboard

Home | FUNCy View | DB Management

UNTS

State Reset

Udoo Neo

Type: **Udoo Neo**
IP Address: **10.27.151.101**
Tags:

Security State: **Normal**
Group: **N/A**

Alert History | Status History | Alert Conditions | State Transitions Reference | umBox Instances

Refresh

Show 10 entries Search:

Time	Attributes
Sep 13th 19, 9:40:36 am	accelerometerX: 0.013663999999999999 accelerometerY: -0.040504 accelerometerZ: -0.98576 gyroscopeX: 1.75 gyroscopeY: 0.8125 gyroscopeZ: 0.25 magnetometerX: 59.6 magnetometerY: 115.5 magnetometerZ: 53.900000000000006 tempinput: 0.0 tempmax: 0.0 tempmax_hyst: 0.0
Sep 13th 19, 9:40:26 am	accelerometerX: 0.010003999999999999 accelerometerY: -0.041968 accelerometerZ: -0.995764 gyroscopeX: 2.1875 gyroscopeY: 0.625 gyroscopeZ: -0.1875 magnetometerX: 67.3 magnetometerY: 115.5 magnetometerZ: 40.7 tempinput: 0.0 tempmax: 0.0 tempmax_hyst: 0.0

Showing 1 to 2 of 2 entries Previous 1 Next

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KalkiDashboard

Hom

Device List

Show 10 entries

Device	Security State	Latest Alert
DLC	Normal	no alert history
Kalki	Normal	no alert history
PHLE	Normal	no alert history
UNTS	Normal	unts-acceleration

Showing 1 to 4 of 4 entries

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Smart Plug

Temperature Sensor

IP Camera

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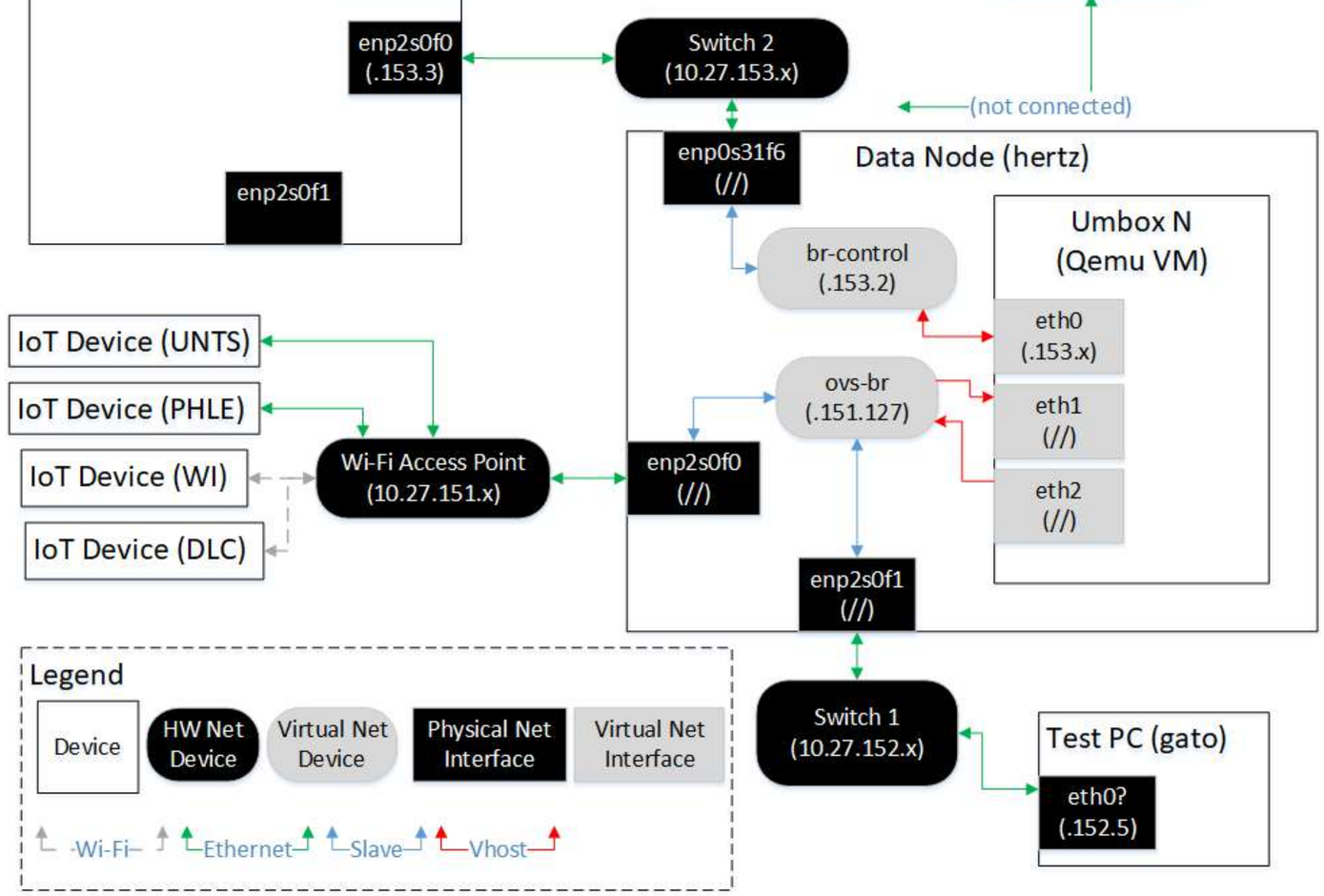

measure:

- Resiliency to attacks
- Performance (time to re
- Scalability (effect of the devices in performance

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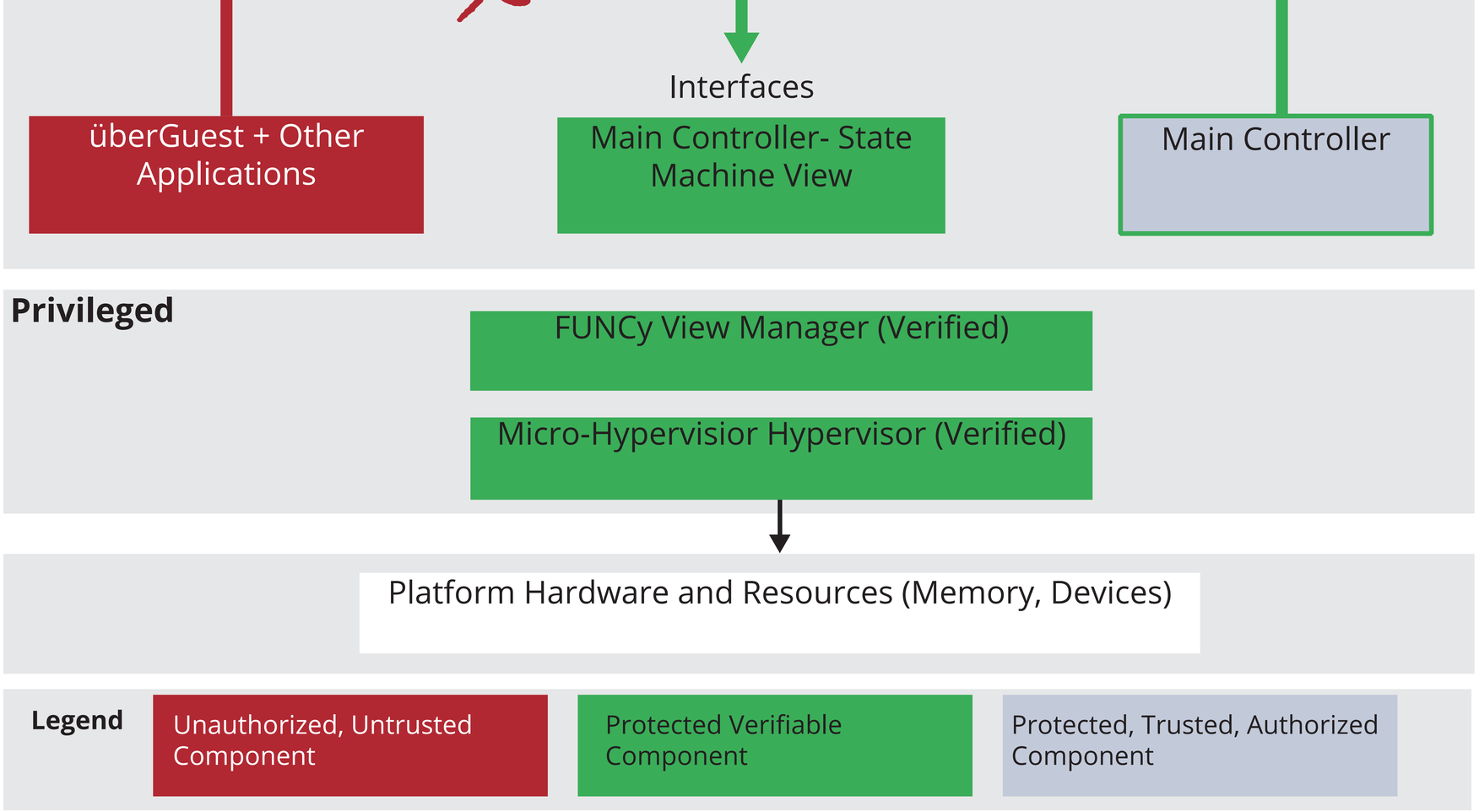

machines using t
FUNCy views

- Verified, lightw
  hypervisor prot
  access
- Unauthorized a
  can’t access St
  encapsulated a

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- Integrate überXMHF security properties into prototype
- Simplify integration of new devices and policies
- Increase performance and reduce resource utilization

- Transition activities — identify transition partners for validation, testi and adoption
  - Working with CMU liaisons for Navy (LCDR Christopher Lueken) and M (LCDR Jeff Greenwald)
  - Establishing contacts with organizations leading IoT projects, including Research Office (Durham), USAF Office of Scientific Research (Arlingto University
- Publication of results and open source release of platform code

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NEAR

- Full platform tested with realistic IoT deployments
- Results published

MID

- Platform adapted and integrated into existing DoD networks

- AI tech
to auto
securit
protec

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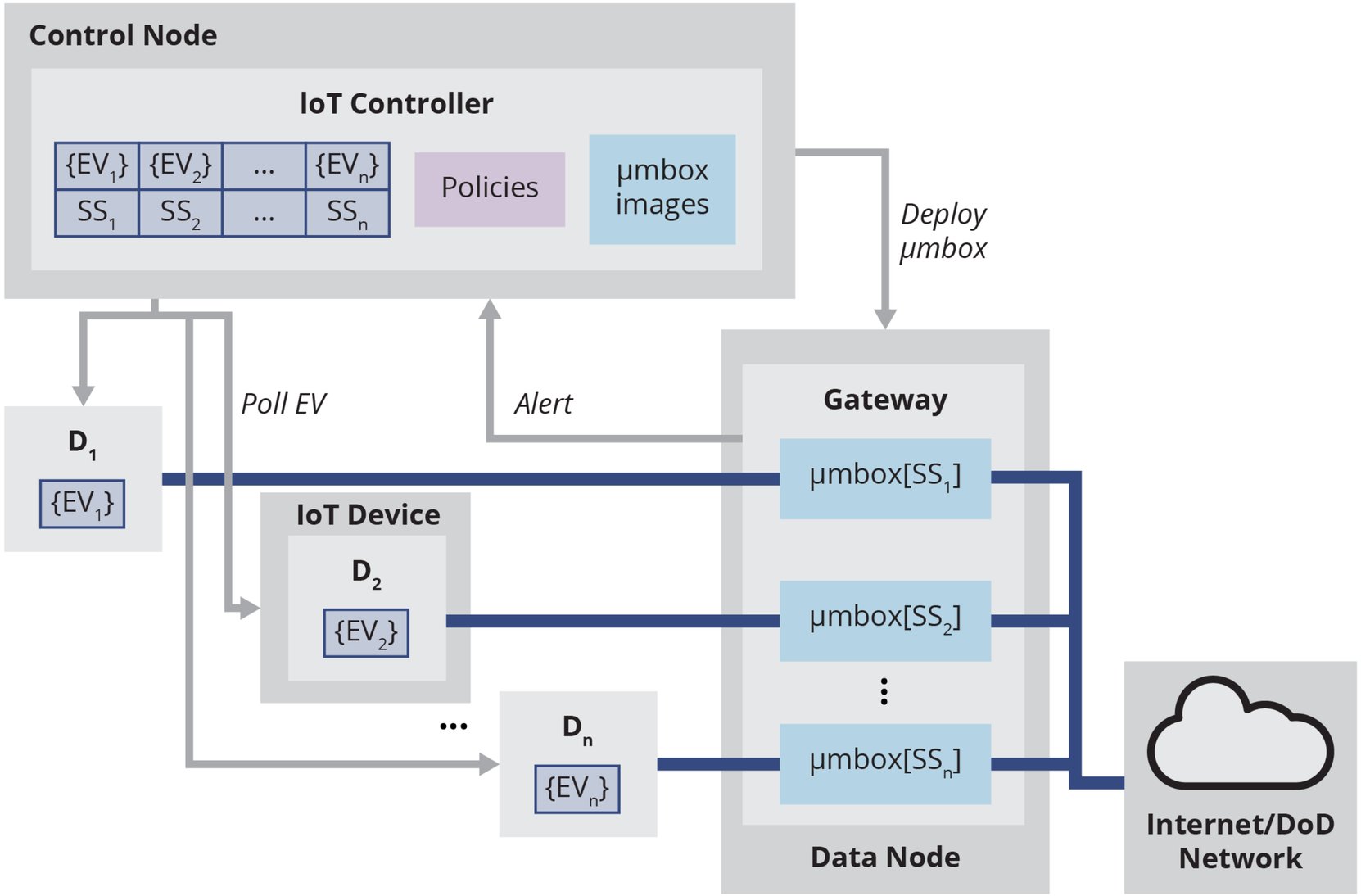

- Has flexible **po** states, transitio
- Reacts using **n** **environment** i
- Uses **different** **defenses** for e state
- Adapts to **devi** **vulnerabilities**
- Secures critical integration with **/überXMHF**

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