T2TRG Meeting 24-25 September 2016

Securebox and IoT Research at TUM Connected Mobility

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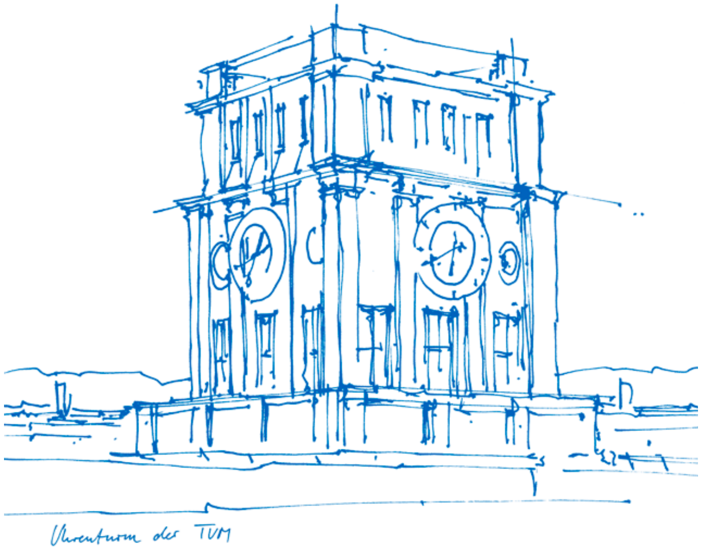


Outline

- IoT Research at TUM Connected Mobility
- Securebox – Safeguard Network Edge
- Summary

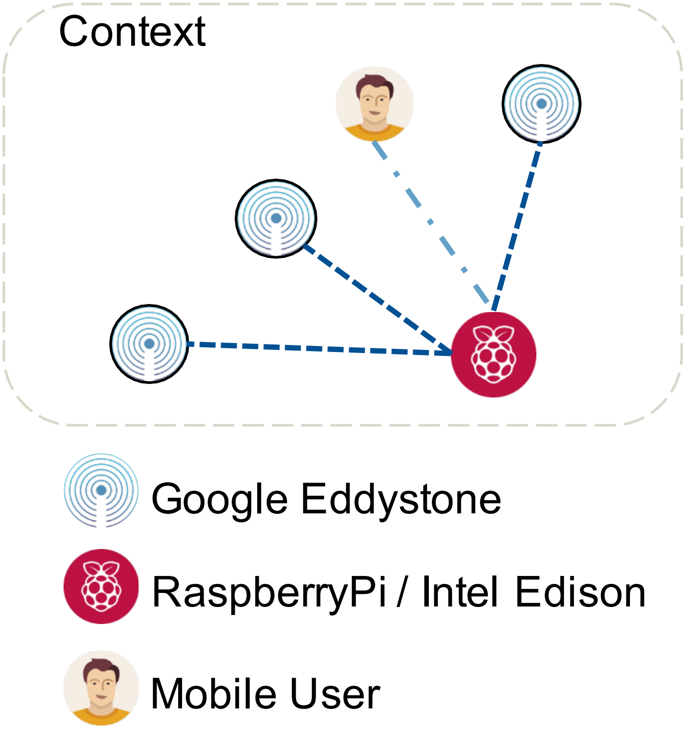
TUM Connected Mobility

- BMW-endowed Chair of Connected Mobility
  - Led by Prof. Jörg Ott

- Topics
  - Mobile opportunistic networking
  - Network architecture
  - Mobility and user activity modeling
  - Internet of Things
  - Internet measurements and analysis

IoT Research at TUM CM

- IoT Testbed
  - Google IoT Research Pilot Award
  - 50 x Bluetooth Beacons distributed over the campus
  - Boards: Intel Edison and Raspberry Pi
  - Sensors:
    - Temperature, Humidity
    - PIR Motion Sensor
    - Sound Sensor
    - Light Sensor
    - Camera
    - Status LEDs
  - Decentralized proximity detection



Context

Google Eddystone

RaspberryPi / Intel Edison

Mobile User

Outline

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Securebox

- Toward safer IoT networks
  - The growing pain of exponential increse

Internet of
(too many) Things

- Spin-Off of SoftOffload
  - Alarming spot in IoT industry – security
  - Platform dedicated for budget and resource restrained IoT networks
  - “Charge for Network Service” model

Challenges

- Internet of Things / Dreams?
  - Device limit, budget constraint, dev deadline, scale factor, lack of expertise,

Neighbors
Wireless Home Network
Hackers
Passersby

Insecure IoT Network
Private User Data

Challenge

- Internet of T
  - Device limit, bu actor, lack of expertise,

Insecure IoT Network
Private User Data

Vulnerabilities

Device	Vulnerability	Device No.
Avtech Camera	exposed account / passwd	130k
TV Set-top box	exposed access	61k
Smart Refrigerator	exposed access	146
CCTV Camera	Unprotected RSA key pairs	30k (by IP)
Traffic Light	No credentials	219
Belkin Wemo	DDoS, exposed access	>500k

[1] Handling a trillion (unfixable) flaws on a billion devices (HotNets 2015)
[2] SHODAN. https://www.shodan.io/

Existing problems

Admin / Admin

- Low budget device
  - Hard coded default passwd (lack of UI to change it !)
  - Exposed IP:Port access
  - Unprotected RSA key pair in the firmware image

- Unawareness and Incapability
  - Potential threat to network infrastructure
  - Privacy of individuals

Existing problems

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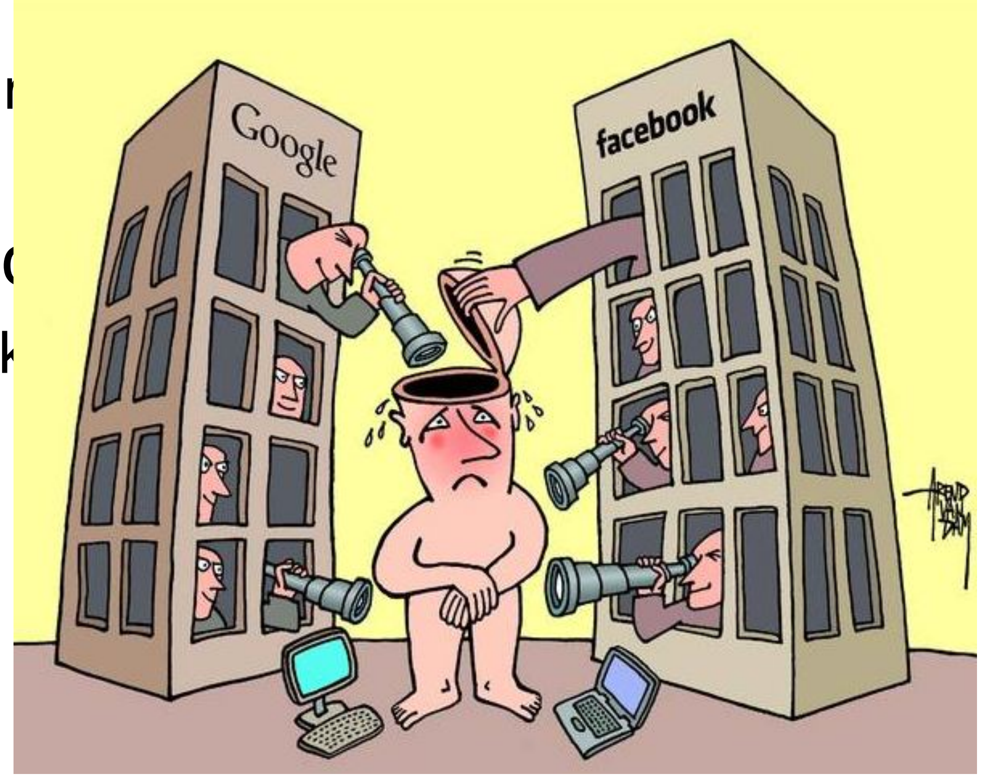


Main issues

- User-side limitation
  - Budget, expertise, lack of interface
- Scale and diversity of IoT devices
- Physical impact
- Cross-device dependency (system mechanism to discover, update and express it) *
- Longevity of IoT devices
  - Out of support circles

Why “old” tricks do not work

- Hardware-centric / host-centric
  - price, complexity, device limitation, update circles

- Lack of cross device/network policy enforcement
- Dynamic physical and computational context
- Crowd-source vs. cloud *

Going to the Cloud ?? Or ...

Securebox

- Cloud-assisted security service
- Affordable, incremental deployment
- “Charge for Network Service” model

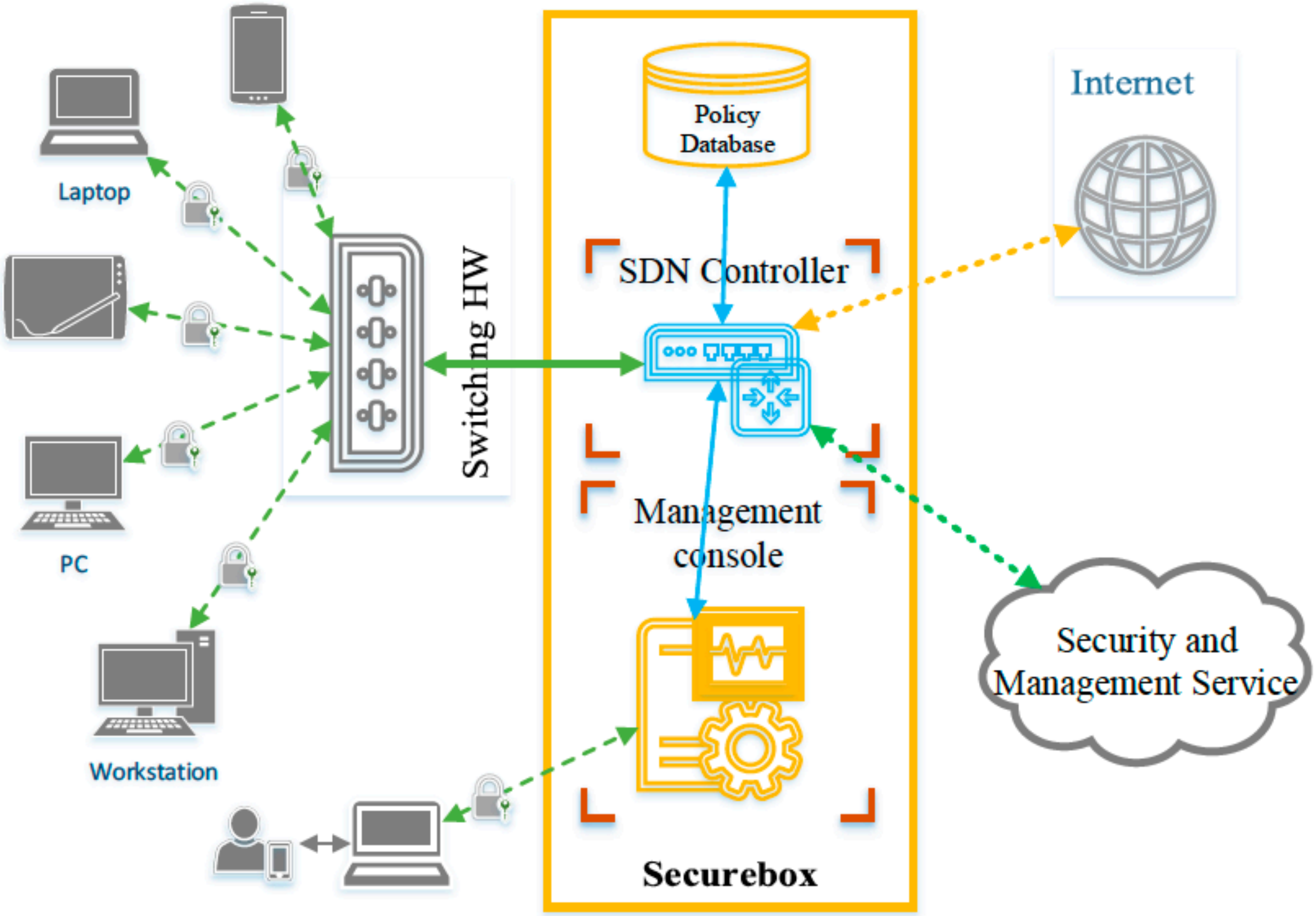
- Ibbad Hafeez
- Lauri Suomalainen
- Sasu Tarkoma
- Alexey Kirichenko

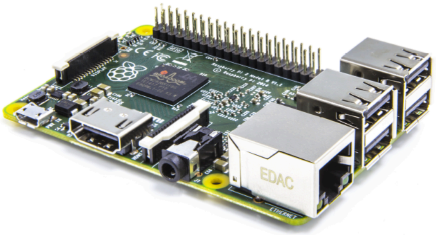
HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

F-Secure.

Securebox

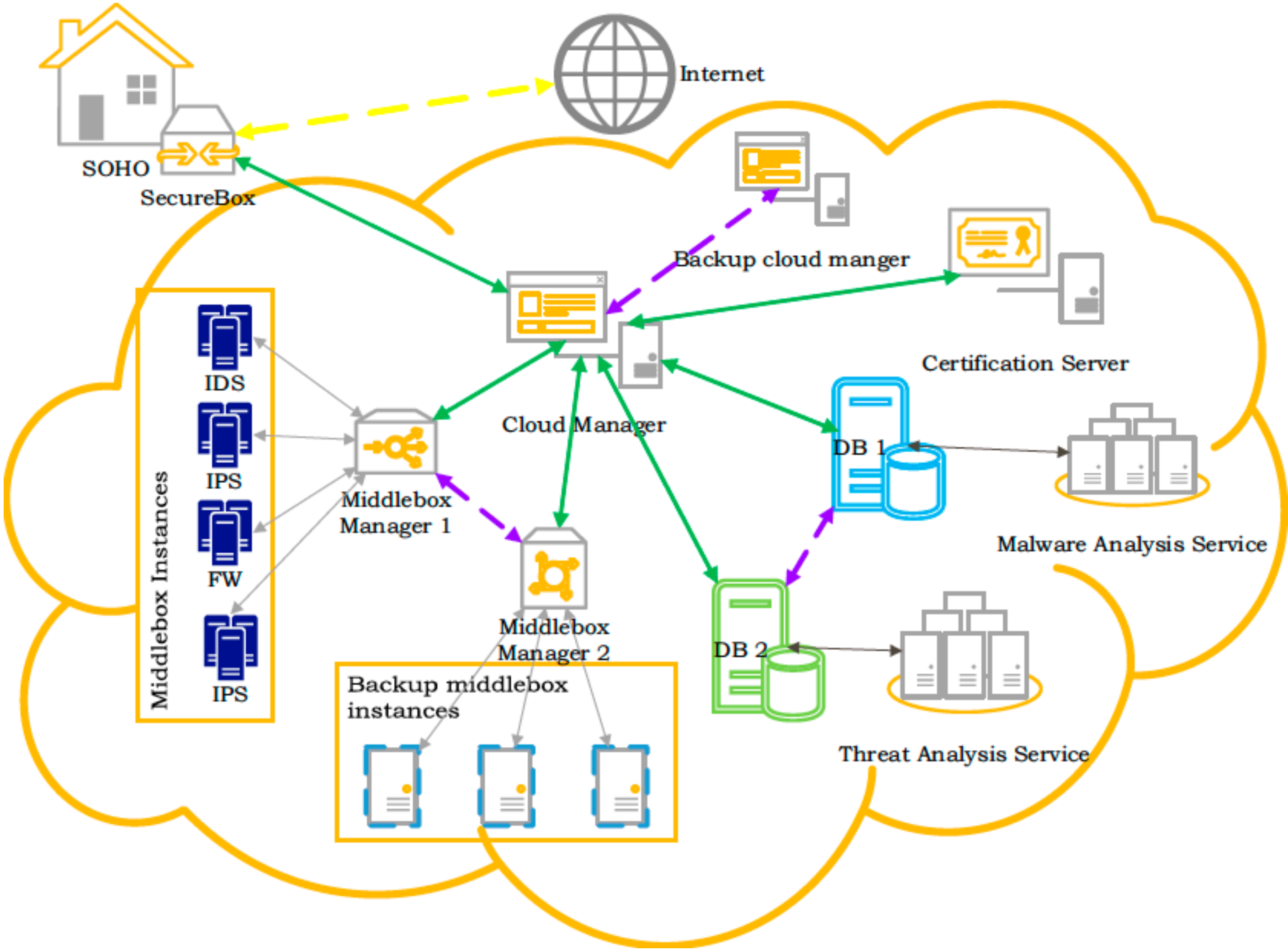
- Frontend
  - Floodlight
  - OVS



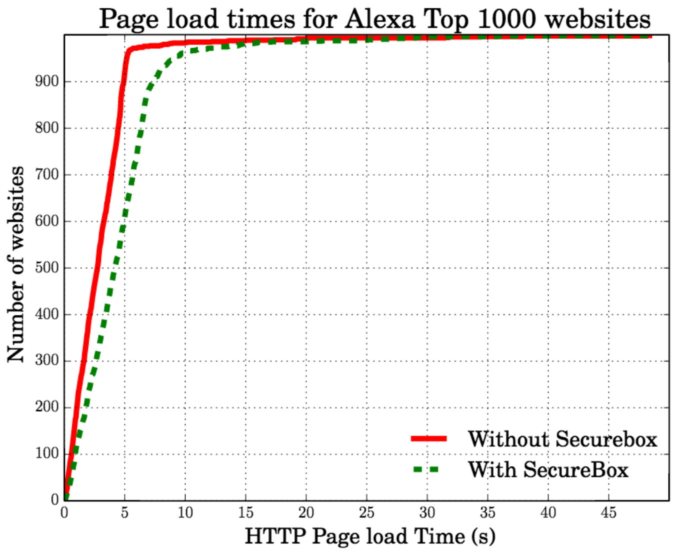


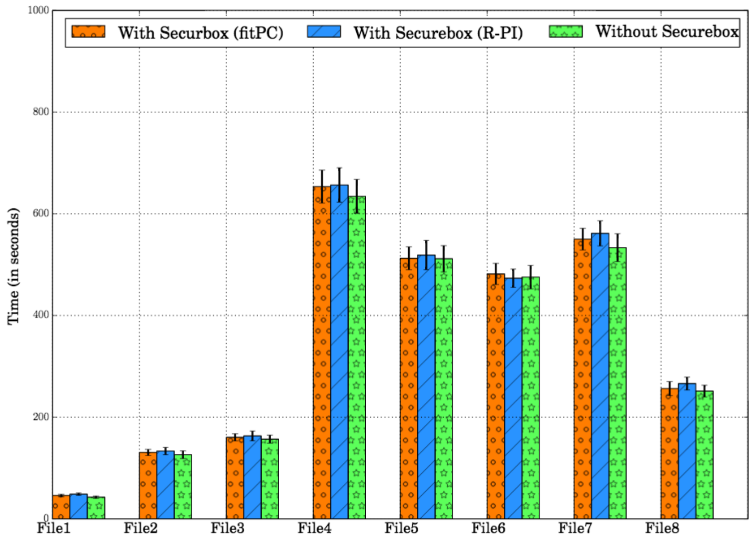
Securebox

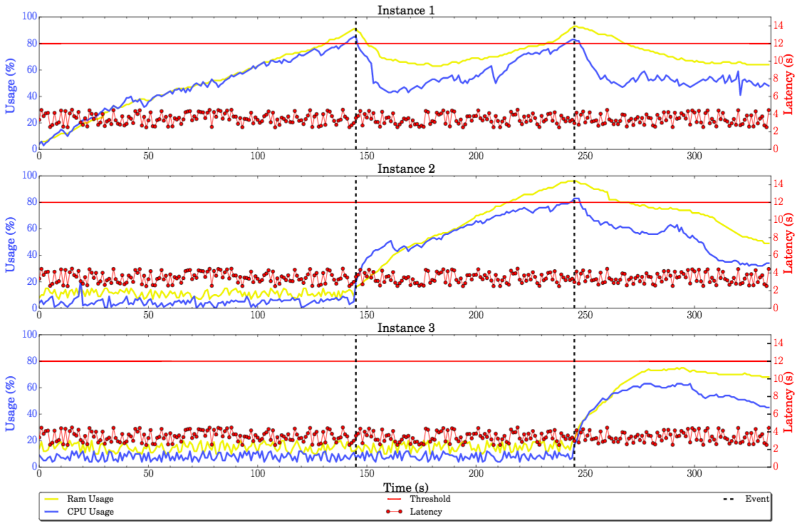
- Backend
  - Docker-based
  - Kubernetes

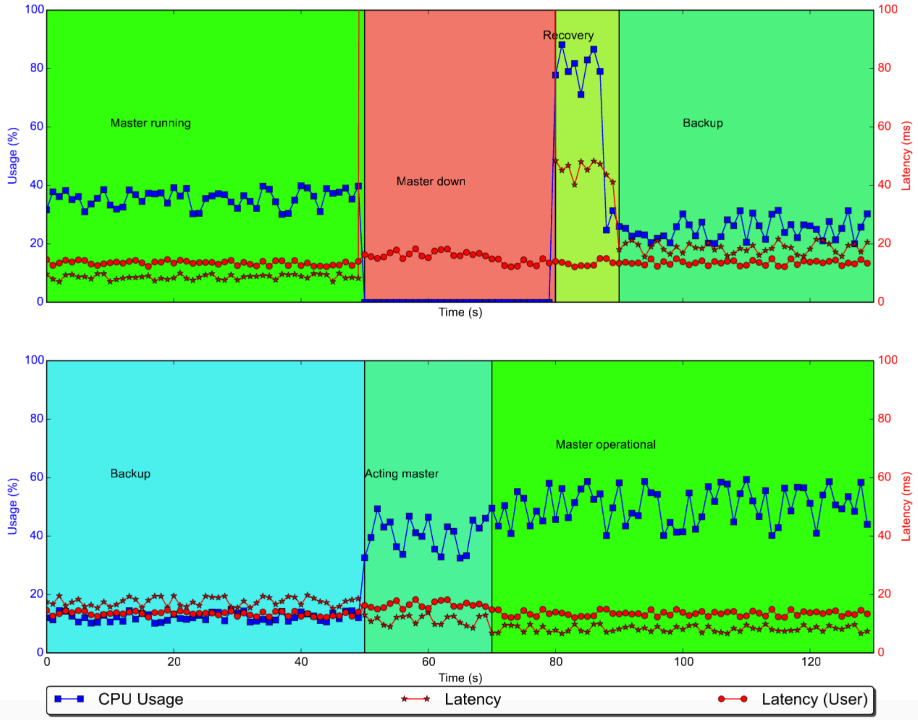


Performance









Latency concern

$$L = \sum_{i=1}^{n} l_i + bl$$

$$L = \lceil C \rceil + \sum_{j=k}^{n} l_j$$

$$L = \sum_{i=1}^{k} l_i + \sum_{j=k}^{n} l_j$$

$$L = l_1 + l_2 + l_3 + \ldots + l_k + \sum_{j=k}^{n} l_j$$

Related Work

- Research papers
  - **Remote deployment of middleboxes**
    - J. Sherry, et al., (SIGCOMM 2012); C. Lan, et al., (NSDI 2016); SENSS (SIGCOMM 2014)
  - **Middlebox as a service**
    - Blindbox (SIGCOMM 2015); DPI as a service (CoNEXT 2014)
  - **Improving home networks**
    - N. Feamster (HomeNets 2010); T. Yu (HotNets 2015), T. Zachariah (HotMobile 2015), uCap (CHI 2015), SpaceHub (HotNets 2015), Contextual Router (SOSR 2016)
  - **IoT Security**
    - K. Zhang, et al., (Wireless Comm. 2015); FlowFence (USENIX Security, 2016)

Related Products

Bitdefender Box $399
http://www.bitdefender.com/box/

F-Secure Sense
$199 (inc. 12 month membership)
https://sense.f-secure.com/

Google onHub $199
https://on.google.com/hub/

Dojo $99
https://www.dojo-labs.com/product/dojo/#

Summary

- IoT Security needs a new service model

- Lessons
  - Programmable design does help
  - Extensible and open – deployability
  - Deal with the cloud, utilize the edge

- On-going work
  - Backend system and features
  - F-Secure Sense integration