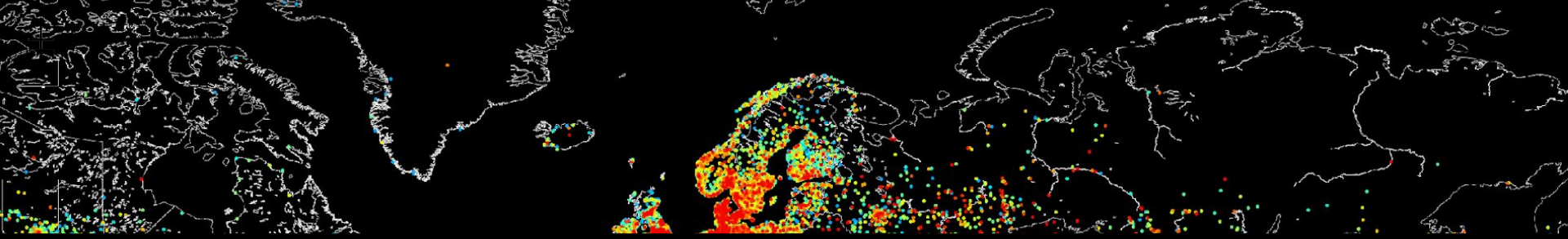

Cleaning Up the Internet of Evil Things: Real-World Evidence on ISP and Consumer Efforts to Remove Mirai

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Mirai: The IoT Bot that Took Down Krebs and Launched a Tbps Attack on OVH

ARTICLE • 6 min. read

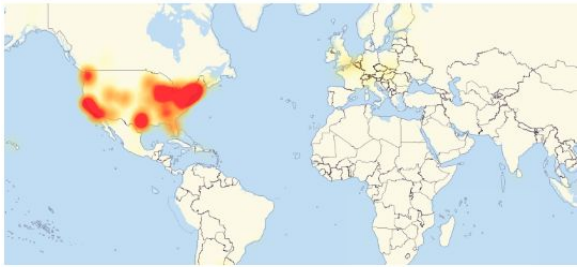
By Liron Segal

Briton who knocked Liberia offline with cyber attack jailed

Dominic Casciani
Home affairs correspondent
@BBCDomC

Massive Mirai DDoS Attack 'Breaks The Internet'

Posted on October 24, 2016 by Jeff Edwards in Endpoint Security News



Outage map via downdetector.com

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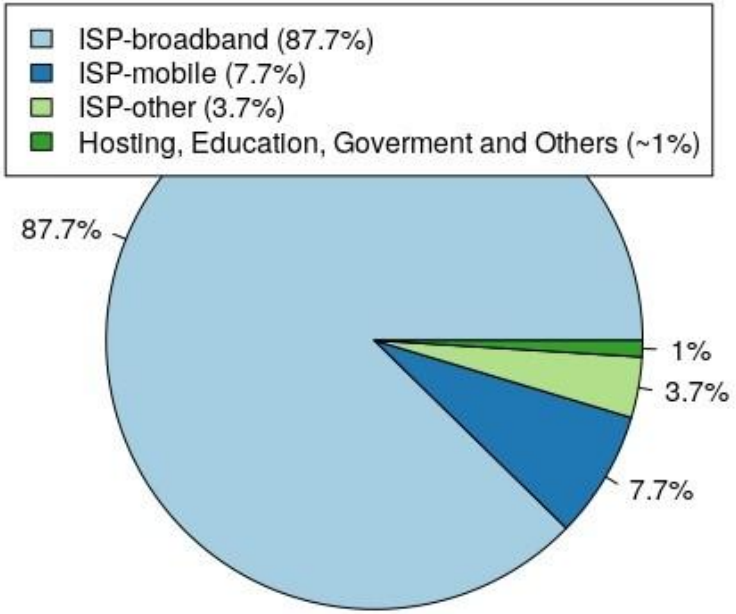
Where Are These Mirai Infected Devices?

- Majority of these of the infected devices (87.61%) are located in ISP broadband networks
- Only 1% reside in other types of networks including hosting, education or governmental networks

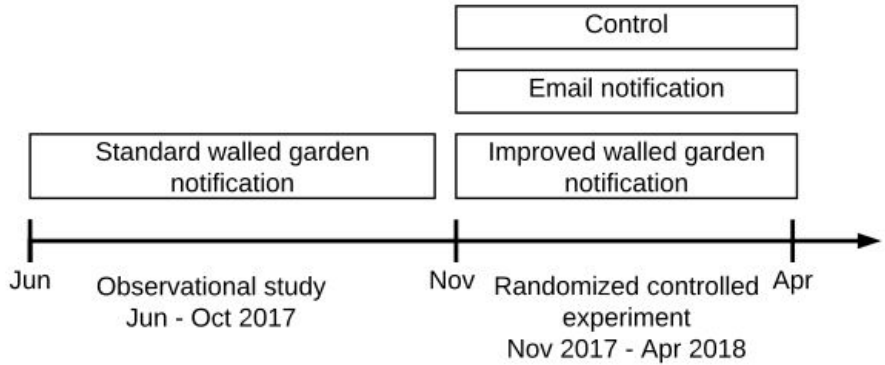


How Can We Remediate Compromised IoT devices?

- There are 3 critical challenges:
  - no public information to identify the owner of the device
  - no established communication channel to reach the owner
  - no clear and simple remediation path or notification
- ISPs can identify and notify the customers who own vulnerable and compromised devices
- But how effective would this be ?

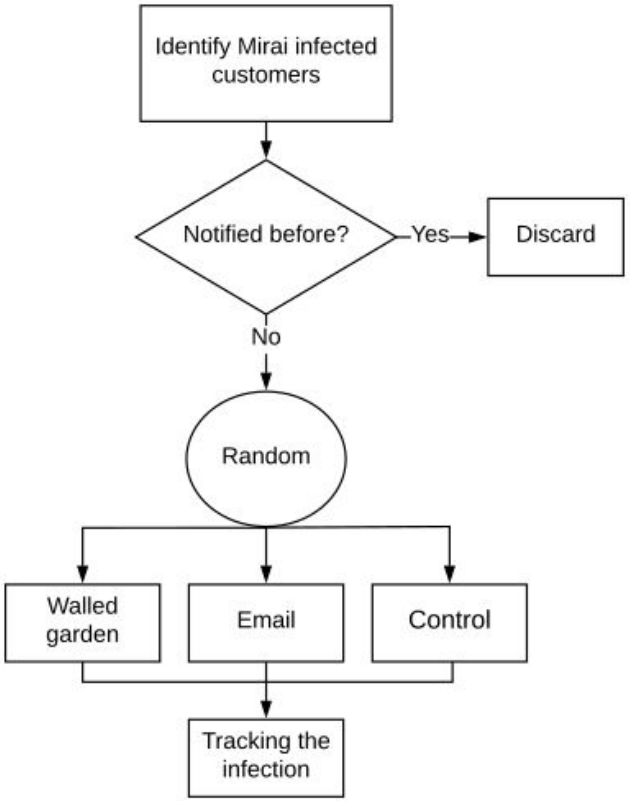
ISP IoT Cleanup Experiments

- Mid-size European ISP
- Two type of studies
  - Observational study
  - Randomized control experiment
- 220 customers



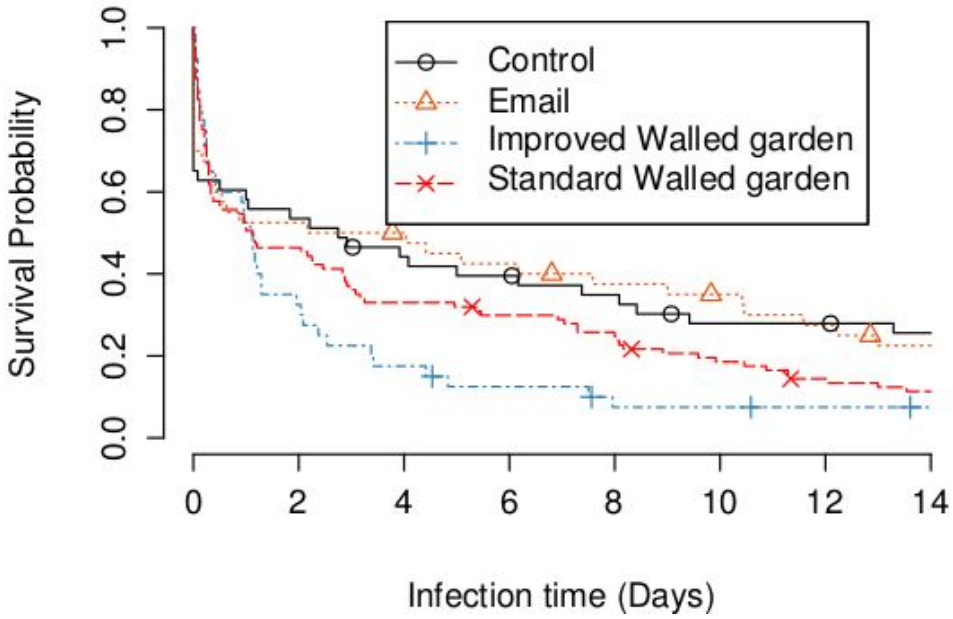
Randomized Control Experiment

- 2 Type of notifications
  - Email
  - Walled garden
- Detecting infections
  - Shadowserver drone feed
  - IoT honeypot
- Tracking infections
  - Darknet
  - Shadowserver drone feed
  - IoT honeypot



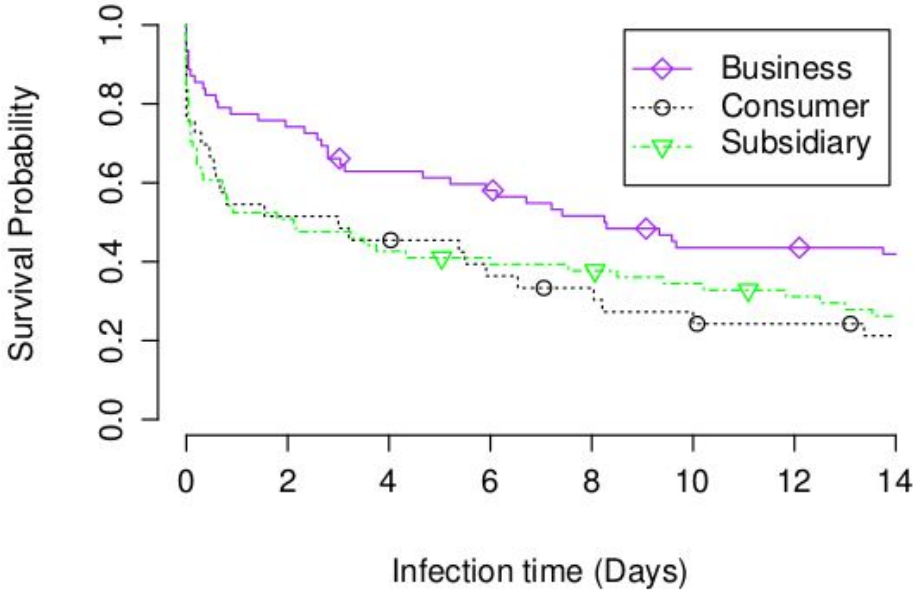
Impact of the Notifications

- Improved walled garden achieved 92% remediation
- Standard walled garden achieved 88% remediation
- Email has no observable impact



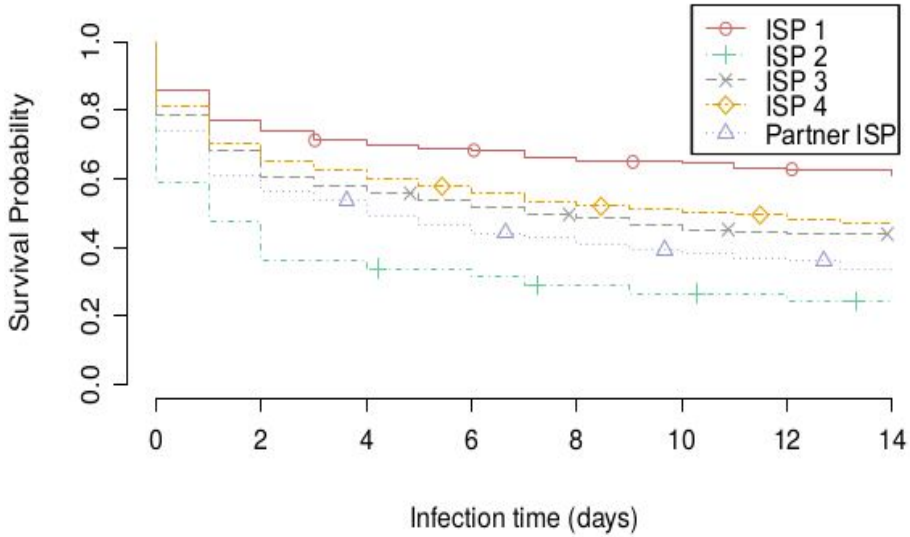
Natural Remediation In Other Networks

- No notifications are made
- Natural remediation is present in all other networks
- Infections live longer in business network



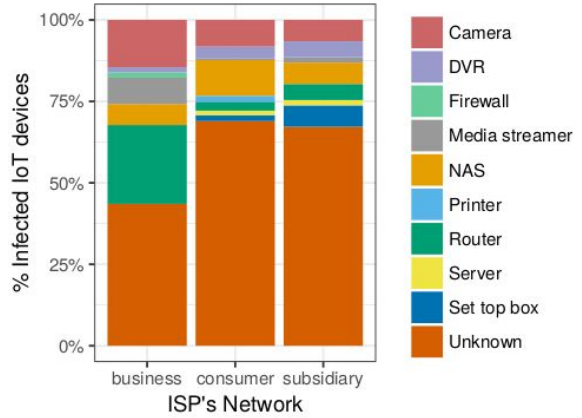
Natural Remediation In Other ISPs

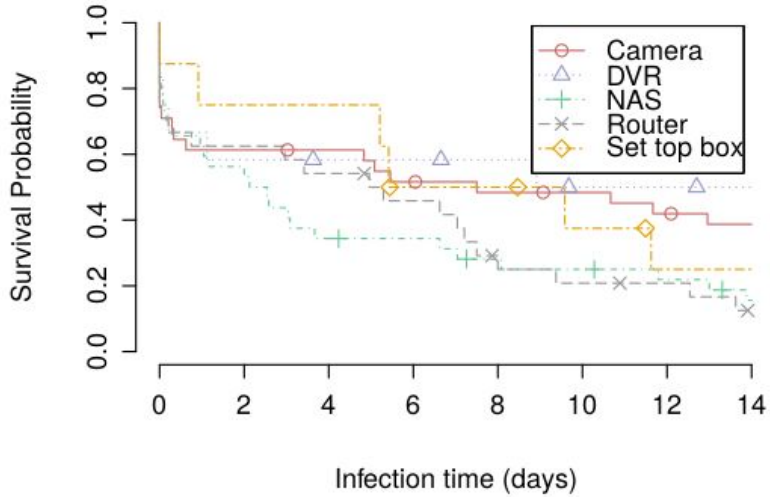
- 4 randomly chosen ISPs within the same country
- Natural remediation is visible in all ISPs



Impact of Device Type

- Not many devices are identified via scans
- Routers cleanup faster than DVRs and cameras





User experience - Phone interviews

- 76 (44%) participants
- Only 50% of the email group remember receiving the notification
- All confirmed correct email address used
- No distrust towards Improved walled garden notifications

Experimental group	Total	Received		Read		Distrust	
Email-only	16	8	(50.00 %)	6	(37.50 %)	2	(12.50 %)
Walled garden (improved)	18	18	(100 %)	18	(100 %)	0	(0.00 %)
Walled garden (standard)	42	40	(95.20 %)	36	(85.70 %)	6	(14.80 %)

User experience - Communication logs

- Only 7.5% of the email group contacted help desk
- Versus 45-52% for walled garden groups
- Lower or higher rate of seeking help is related to clean up action

Experimental group	n	email	contact form	helpdesk
Email-only	40	16 (40.0%)	–	3 (7.5%)
Walled garden (improved)	40	23 (57.5%)	31 (77.5%)	21 (52.5%)
Walled garden (standard)	97	67 (69.1%)	59 (60.8%)	44 (45.4%)

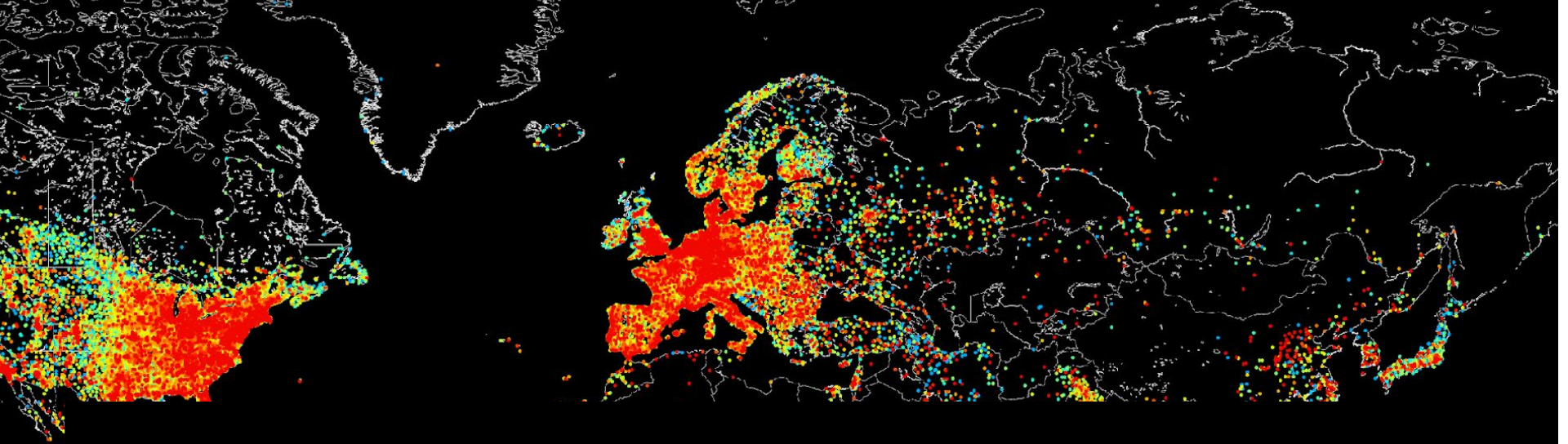
User experience - Communication logs

- Incorrect mental model of the problem
- Improved walled garden reduced the need for additional help
- Less complaints while in improved wall garden

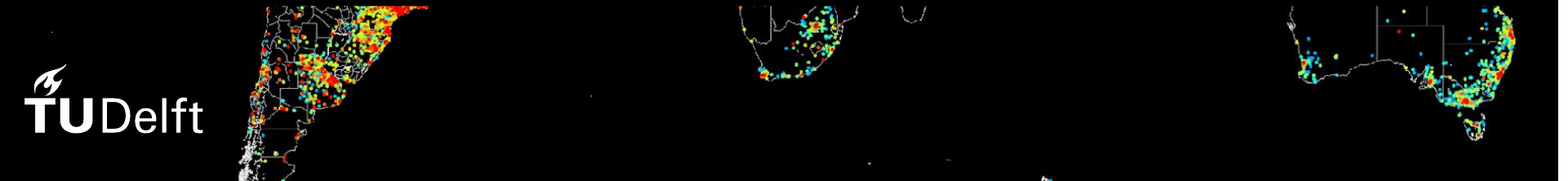
	Email-only	Walled garden (improved)	Walled garden (standard)
	n=40	n=40	n=97
Runs a virus scanner	7 (17.5%)	12 (30.0%)	32 (33.0%)
Identifies IoT device	9 (22.5%)	17 (42.5%)	58 (59.8%)
Requests additional help	2 (5.0%)	8 (20.0%)	41 (42.3%)
Wants possibility to call the abuse team	0 (0.0%)	2 (5.0%)	16 (16.5%)
Requests paid technician	0 (0.0%)	4 (10.0%)	11 (11.3%)
Disconnects device	3 (7.5%)	15 (37.5%)	42 (43.3%)
Cannot work due to quarantine	0 (0%)	4 (10.0%)	18 (18.6%)
Complaints over disruption of service	0 (0%)	1 (2.5%)	13 (13.4%)
Threatens to terminate contract	0 (0%)	1 (2.5%)	5 (5.2%)

Conclusions

- Improved walled garden remediates 92%
- Email has no observable impact above natural remediation
- High natural remediation across ISPs and networks
- Improving the content reduces the complaints to small but vocal minority that was angry or frustrated
- As more people will become aware of the threats to their IoT devices, ISP mitigation might become more accepted – or even expected



Thank you for listening!
Any questions?
Contact: f.o.cetin@tudelft.nl | f.o.cetin@kent.ac.uk



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