geoff.thorpe@nxp.com:/Microcontrollers/R&D/Security

Software

- Involvement in open source around security and networking (OpenSSL member)
- Interests in security scalability
- Member of Zephyr governance board

Hardware

- “Datapath” architecture for QorIQ and Layerscape SoCs (Networking)
- i.MX apps processors and Kinetis microcontrollers

Focused on new security problems (and solutions) brought on by the emergence of IoT

Based in Québec City, originally from Wellington, New Zealand. (Was *not* in LoTR)

Agenda

Zephyr

- What, where and why
- Status

IoT security

- Terminology
- Disruption
- Observations
- Where does Zephyr fit into this?

Agenda

Zephyr

- What, where and why
- Status

See recording of Anas Nashif's Zephyr talk from Monday

IoT security

- Terminology
- Disruption
- Observations
- Where does Zephyr fit into this?

What is Zephyr?

Small Footprint RTOS for IoT

- As small as 8KB
- Enables applications code to scale

Truly Open Source

- Apache 2.0 License
- Hosted by Linux Foundation
- Transparent development

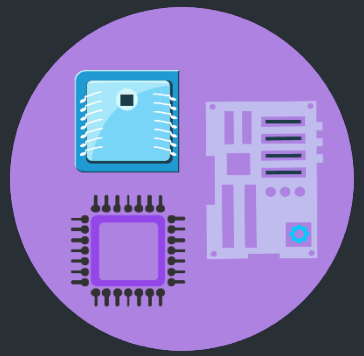
Cross Architecture

- ARM
- x86
- ARC
- Others

Zephyr’s core values

Modularity

Security

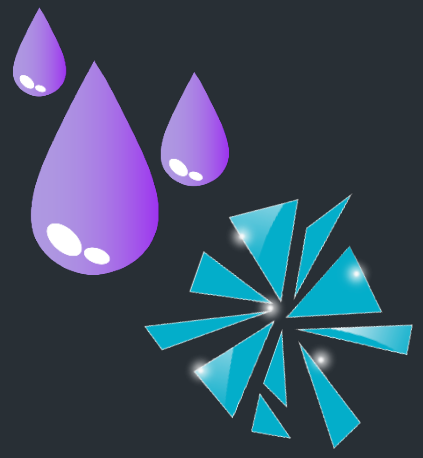


Cross Architecture

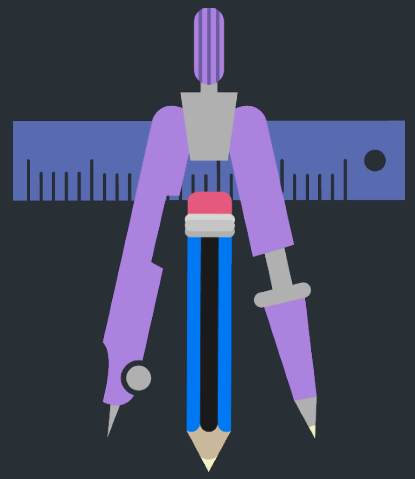
Connectivity

Community Developed

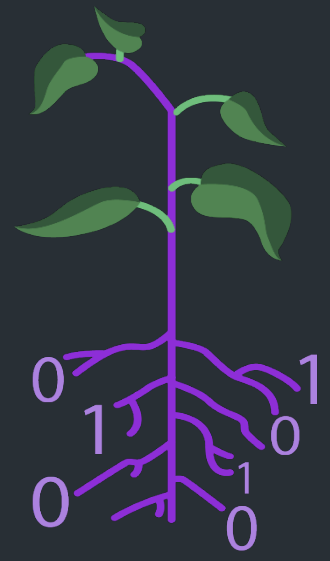
Small OS & RTOS market analysis



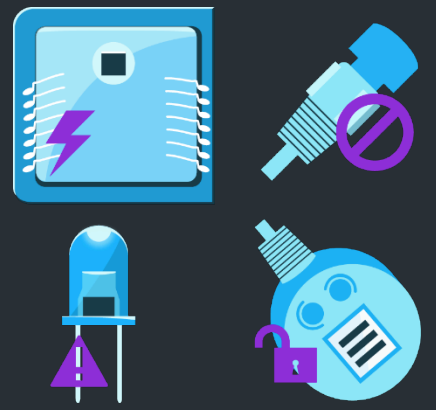
Saturated RTOS/
Fragmentation



Roll Your Own/No OS



Adoption growth in
IoT development



Compromised
Devices

Opportunity to build a leading IoT OS

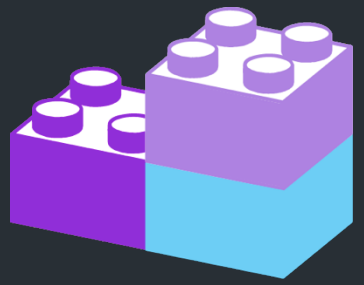
Why Zephyr?

Strategic Investment

Best-of-Breed RTOS for IoT

True Open Source Development and Governance

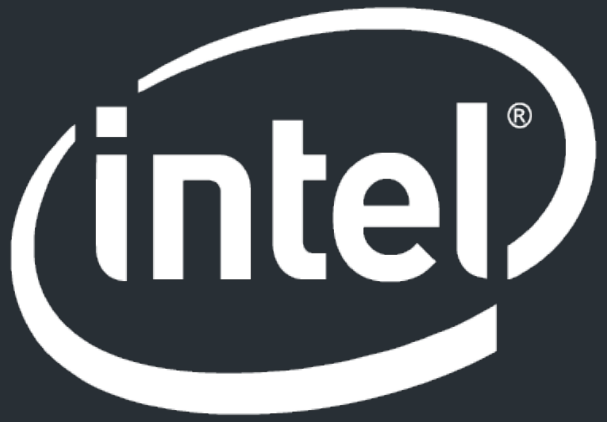
Permissively Licensed



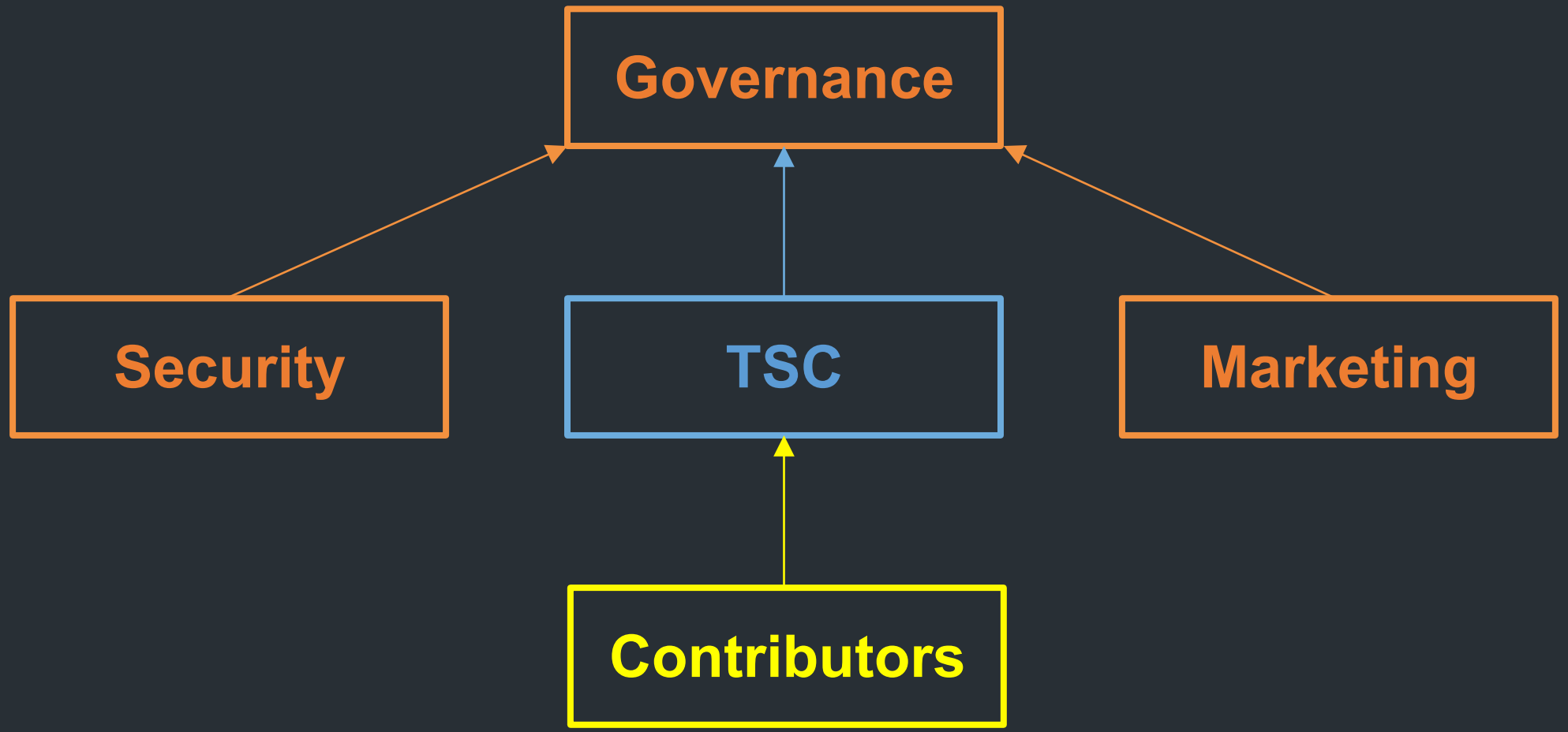
Modular

Established Code Base

Current platinum members

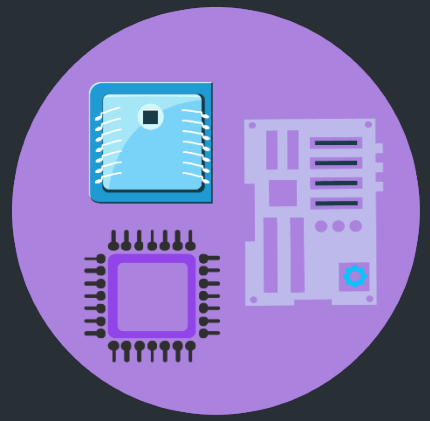


Zephyr project governance



Participate!

Benefits of early participation:



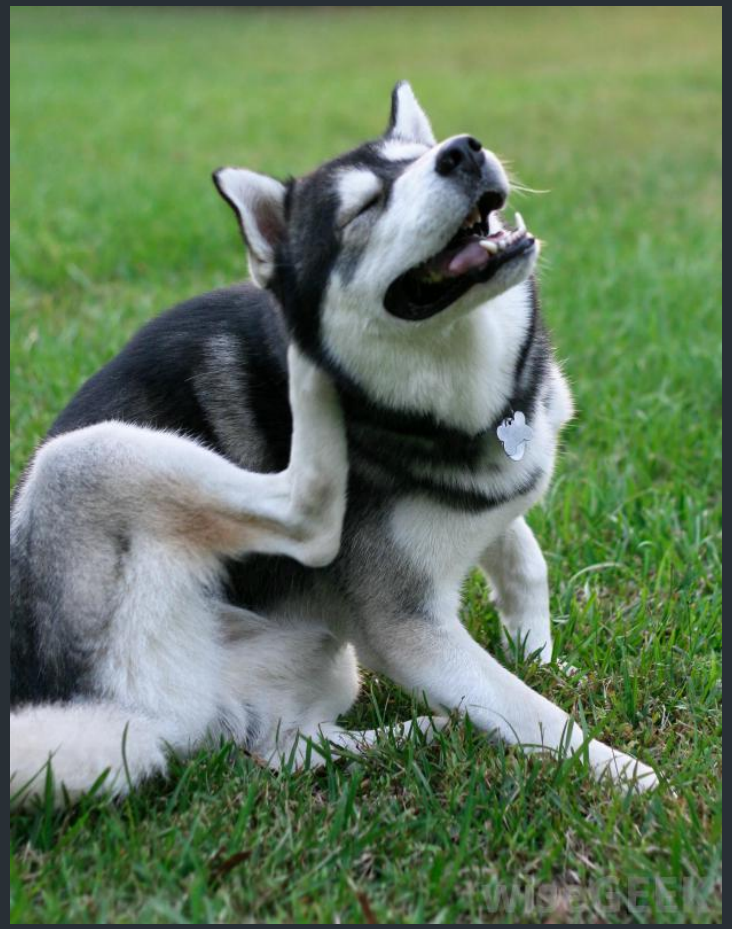
Impact architecture

Direction

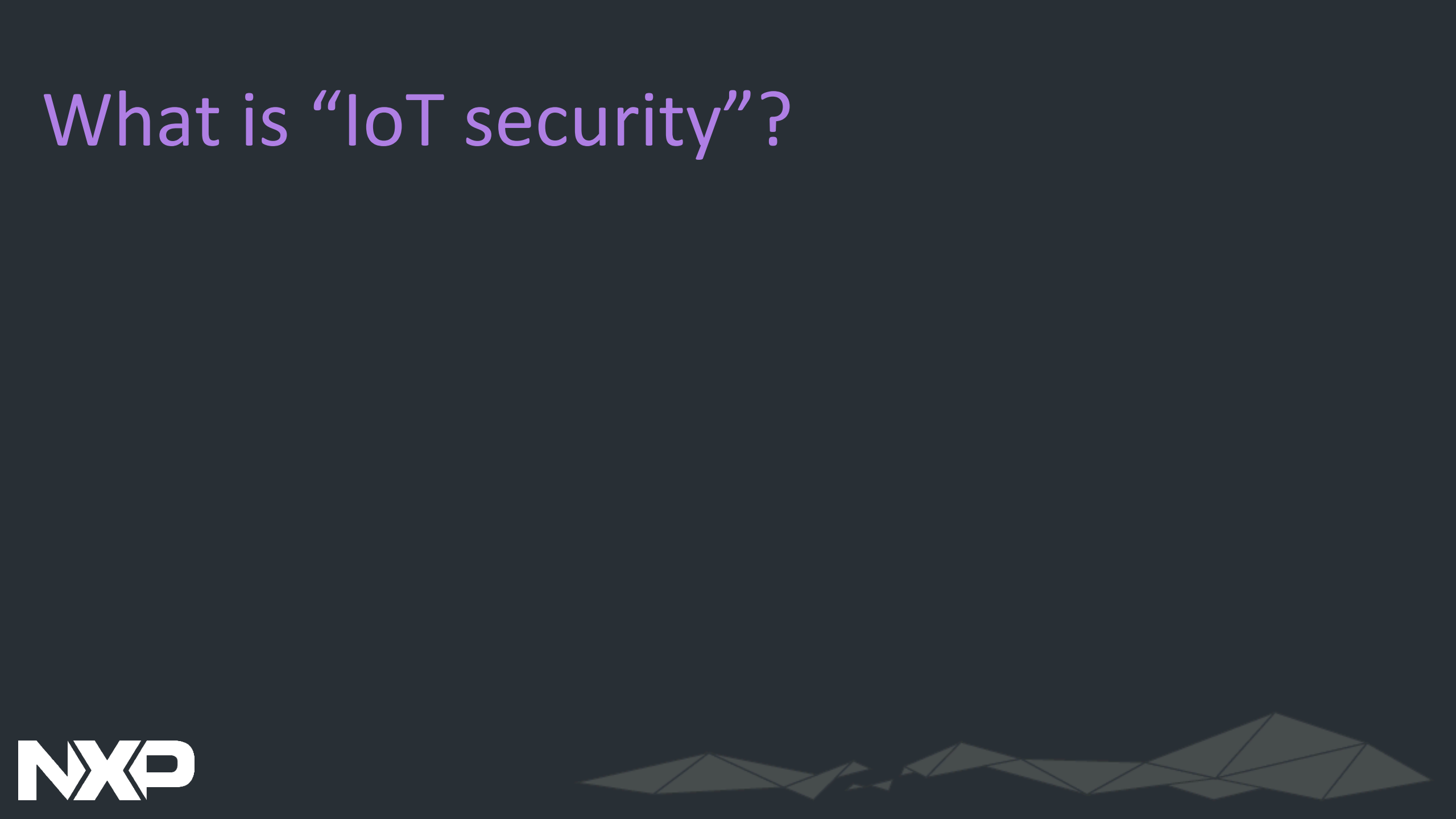
Marketing / Advocacy

Decision making

… and scratch that itch



What is “IoT security”?

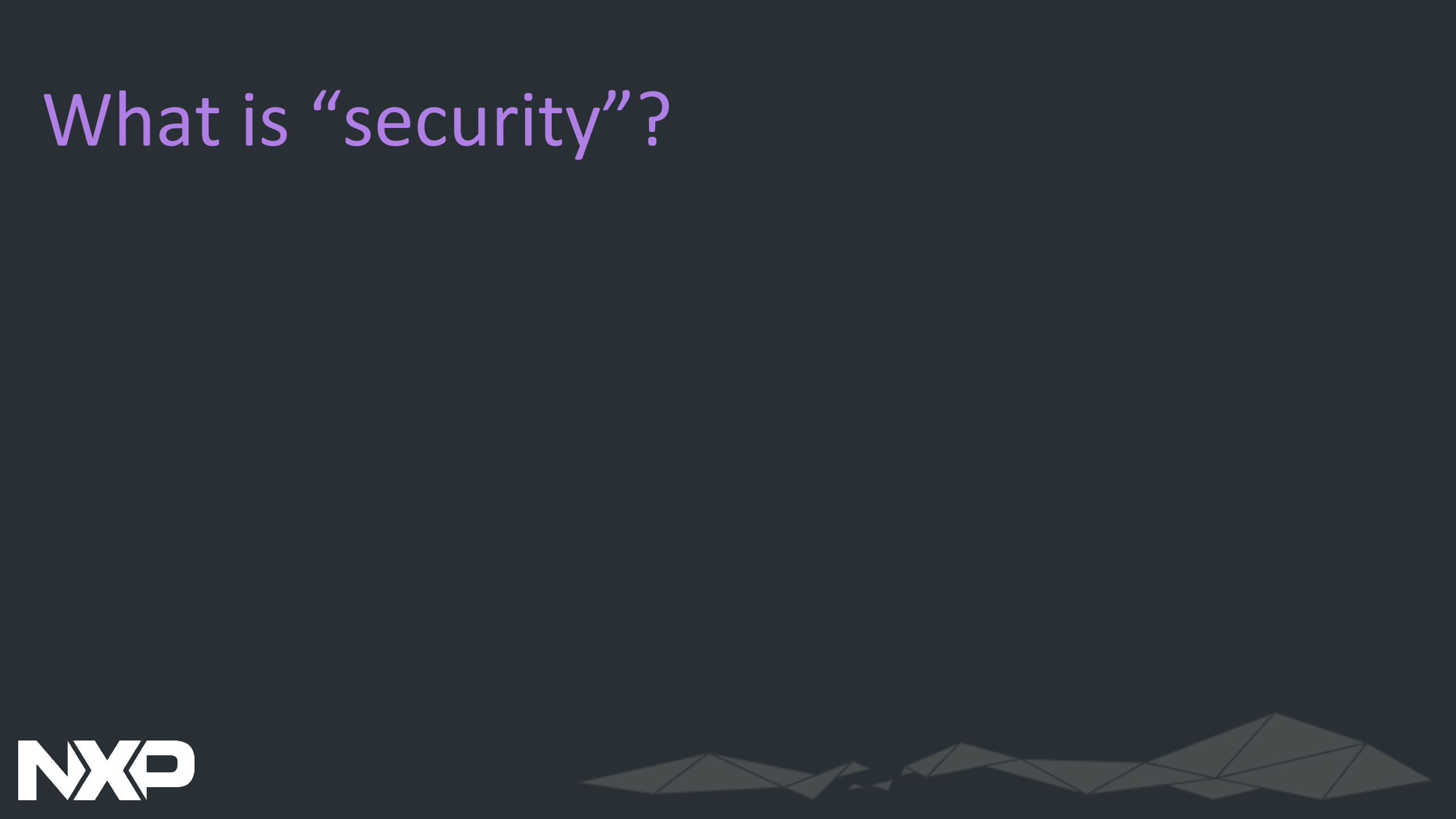


What is “IoT”?

What is “IoT”?

- Traditionally-offline “things” → going online

What is “security”?



Usage

"Add security to the product"

"Secure the edge-node"

"Integrated security, because security is important"

Abusage

"Add security to the product"

"Secure the edge-node"

"Integrated security, because security is important"

And by security you mean … ***what* exactly**?

Does “security” mean…

- Tamper-proof?
- Resistant to side-channel attack?
- Able to perform cryptographic operations fast/efficiently?
- Key-protection and other logical separation?
- Supports secure network protocols?
- Protects content restrictions against misuse?
- Is kept up-to-date through patch updates?
- Reliable/robust in the face of adversarial RF?
- You did some code reviews (this time round)?

Security facets, a less incomplete list

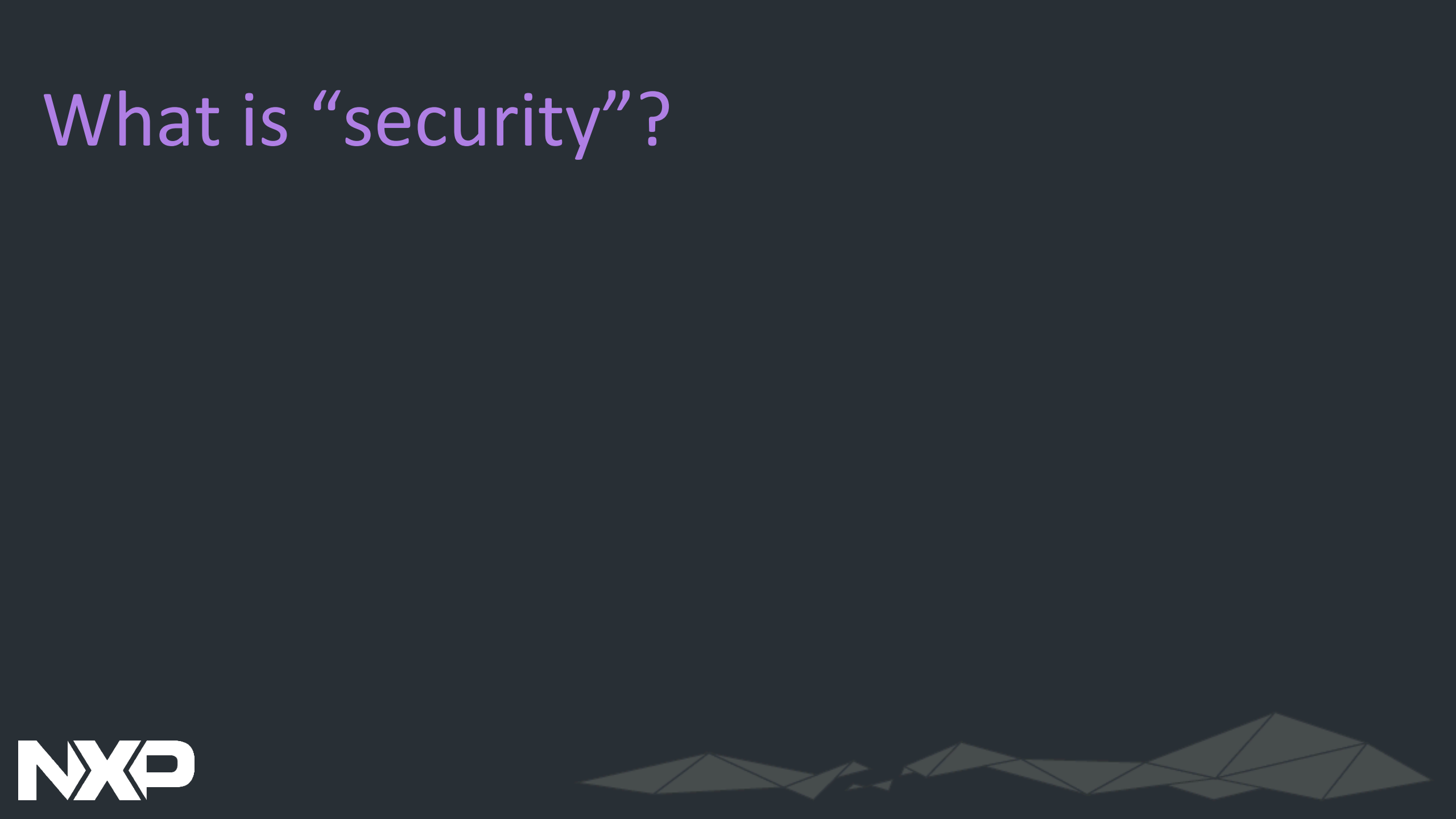
Cryptography;
- Software optimization
- Hardware IP
- Protocol security, interoperability
- Privacy, authentication, non-repudiation

Secure non-volatile storage
Inline encryption (memory, flash, …)
Trusted execution (secure boot, …)
Key management and protection
Certification
Code quality and review
Vulnerability analysis
Best practice

Process and production security
Compartmentalization/isolation
Digital Rights Management
IP protection (anti-cloning, …)
Resistance to side-channel attacks
- Power
- Timing
- Electromagnetic emissions

Emergency response
Security maintenance
Attack detection
Reliability (quality-of-service, stability, …)

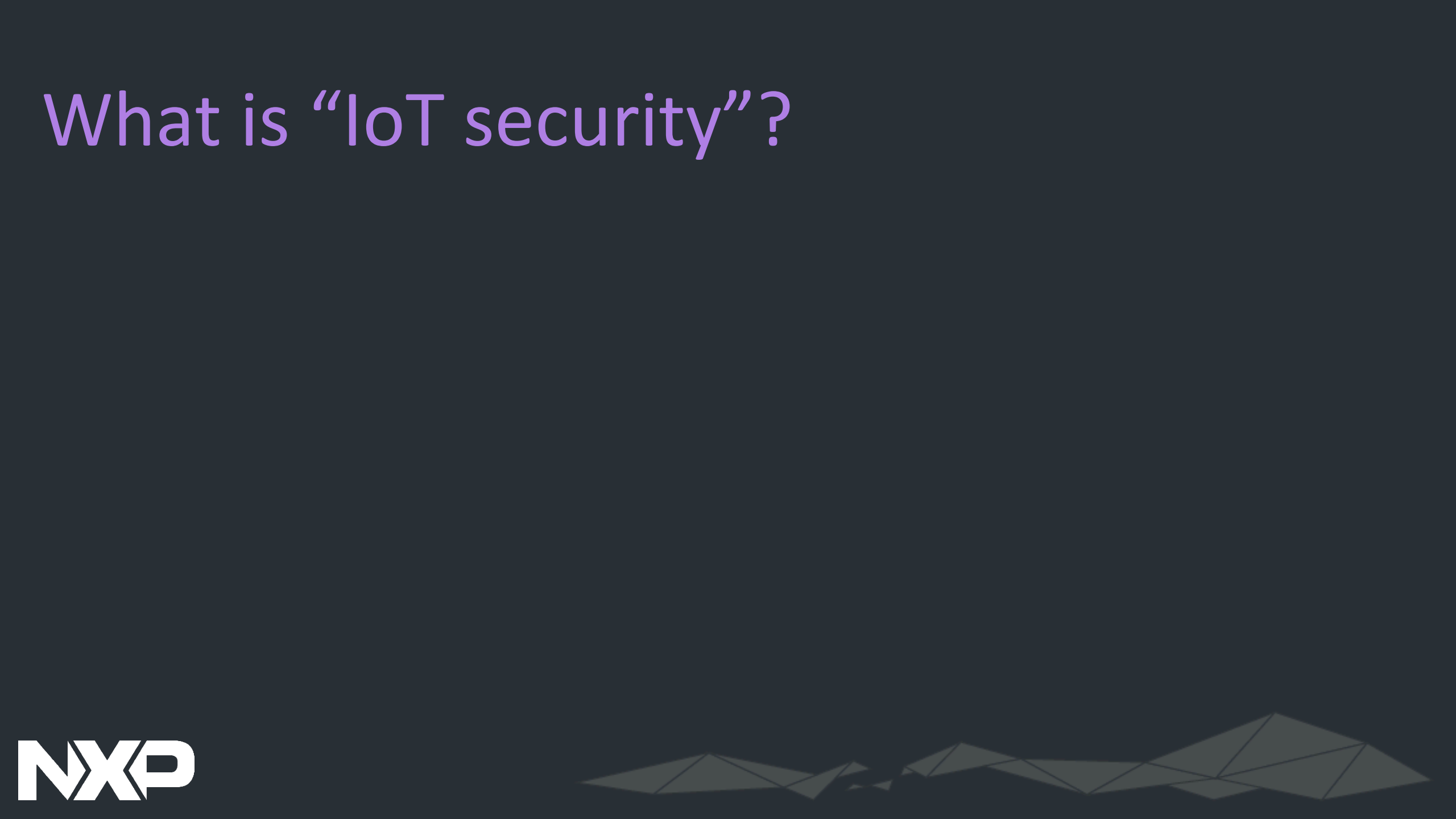
What is “security”?



What is “security”?

- “Security” on its own can mean almost anything
  “Security” on its own means almost nothing
- It’s almost always context-dependent, in terms of interpretation and importance of those different facets.
- “The minimization of insecurity (or ‘threats’)” ?

What is “IoT security”?



What is “IoT security”?

The meeting (perfect storm) of two domains;

- Device security
- Network and logical security

What is “IoT security”?

Device Security	Network Security
Secure non-volatile storage	Cryptographic s/w and h/w
Inline encryption (memory, flash, …)	Protocol security & interoperability
Trusted execution (secure boot, …)	Usability and clarity
Key management and protection	Code quality and review
Certification	Best practice
Vulnerability analysis	Emergency response
Process and production security	Security maintenance
DRM & IP protection (anti-cloning, …)	Attack detection
Resistance to side-channel attacks	Reliability (quality-of-service, stability, …)

IoT Security – when assumptions collide

Device security

- Implementation + certification are static
- Threat model is physical

Network security

- Patched early and often, via network
- Threat model is “the network”

Risk multipliers

- Widely deployed
- Physical and network accessibility
  - ➢ Large attack surface
  - ➢ High attack incentive

Defense de-multipliers

- Commodity pricing
- Finding and fixing bugs will be hard
  - ➢ Minimization of engineering investment
  - ➢ Reactive security down, zombies up

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Traditional MCU-based engineering

Oriented around device-security (if at all);

- Industrial, medical, automotive, …
- Non-networked
- Heavily engineered for a static state of optimal security
- Once that's done, ship it!

(And then move on to something else…)

Conventional computing complexity

AP-based and even MCU-based systems are more and more complex, resembling server, network, and smartphone systems.

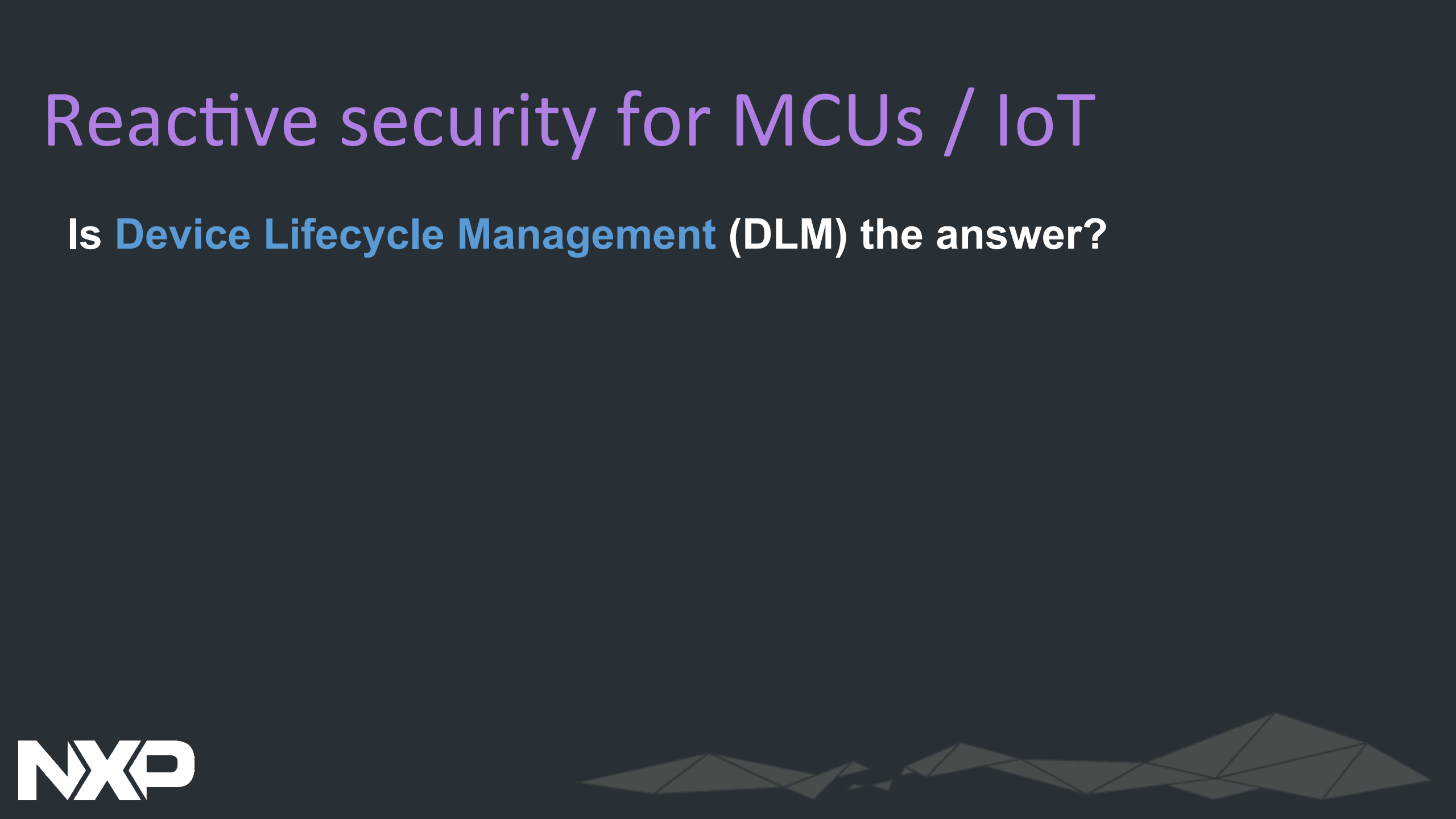
Conventional computing complexity

MPU-based and even MCU-based systems are more and more complex, resembling server, network, and smartphone systems.

Things will go wrong! Reactive security (vulnerability handling, incident response) is needed in the microcontroller/ IoT ecosystem.

Reactive security for MCUs / IoT

Is Device Lifecycle Management (DLM) the answer?



Reactive security for MCUs / IoT

Is Device Lifecycle Management (DLM) the answer?

Not really, that's mostly limited to;

- Installing a vendor's "Root of Trust" (RoT)
- Being locked-in to that vendor's code/patch-signing services
- The mechanics of deploying updates "Over The Air" (OTA)

Reactive security for MCUs / IoT

Reactive security is well-understood in traditional networked computing;

- Servers
- High-end networking
- Smart-phones
- Desktops
- […]

Can we adopt the same methods?

Reactive security for MCUs / IoT

There are some complications with conventional vulnerability-handling (CVE, CPE, etc.)

- The MCU/MPU and its software is often “hardware” to a host
- SoC subsystems often contain firmware too
- One product’s host OS is another product’s subsystem firmware
- CPE isn’t flexible about this hierarchical view
- Multiple vendors involved, supply-chain complexities

Certification for IoT?

Various things have been proposed, but;

- Limit themselves to evaluating the implementation
- Don’t account for the (post-production) process
- Works against responsible code maintenance
- Collapse the supply-chain

Certification for IoT?

Various things have been proposed, but;

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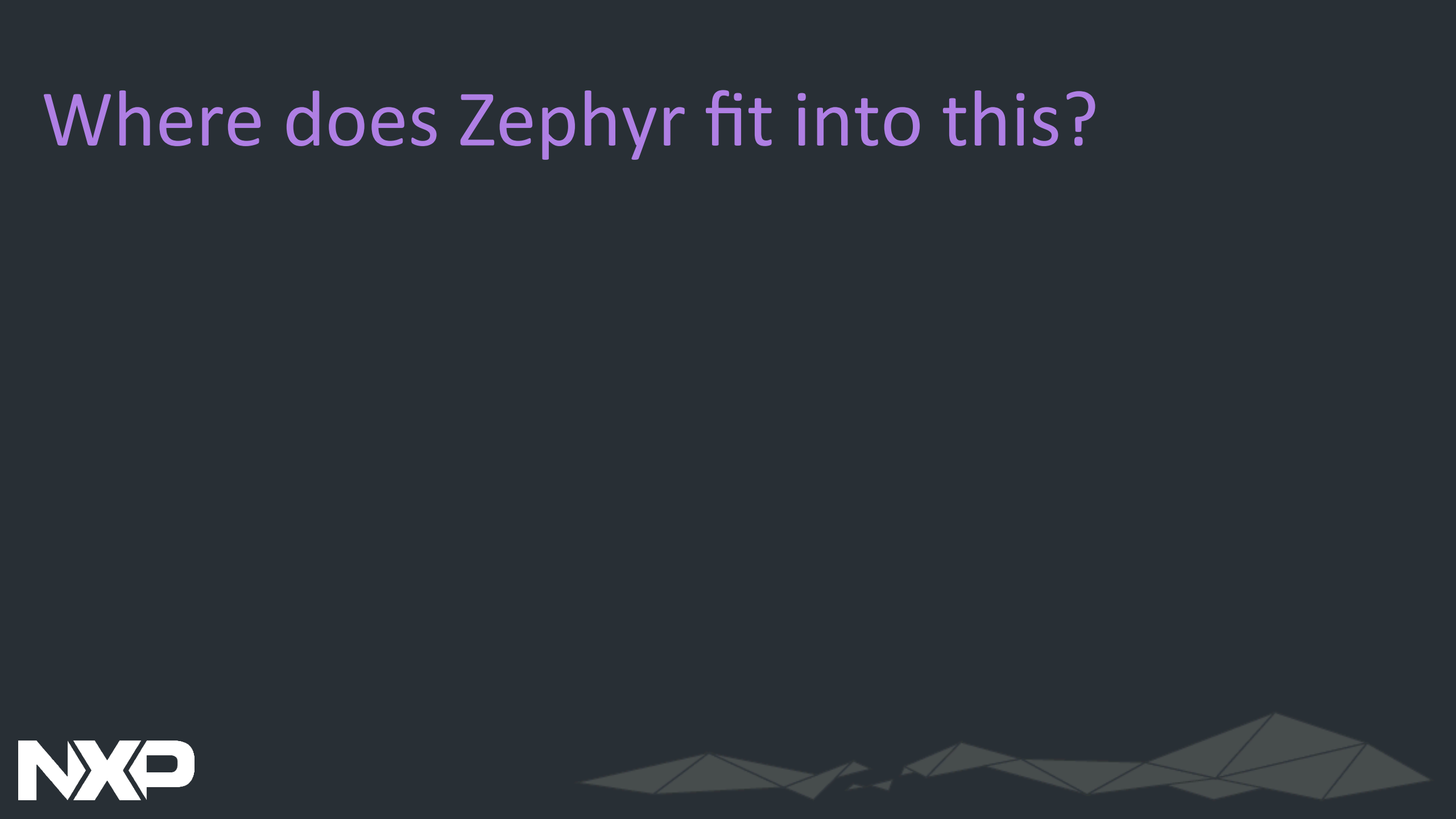
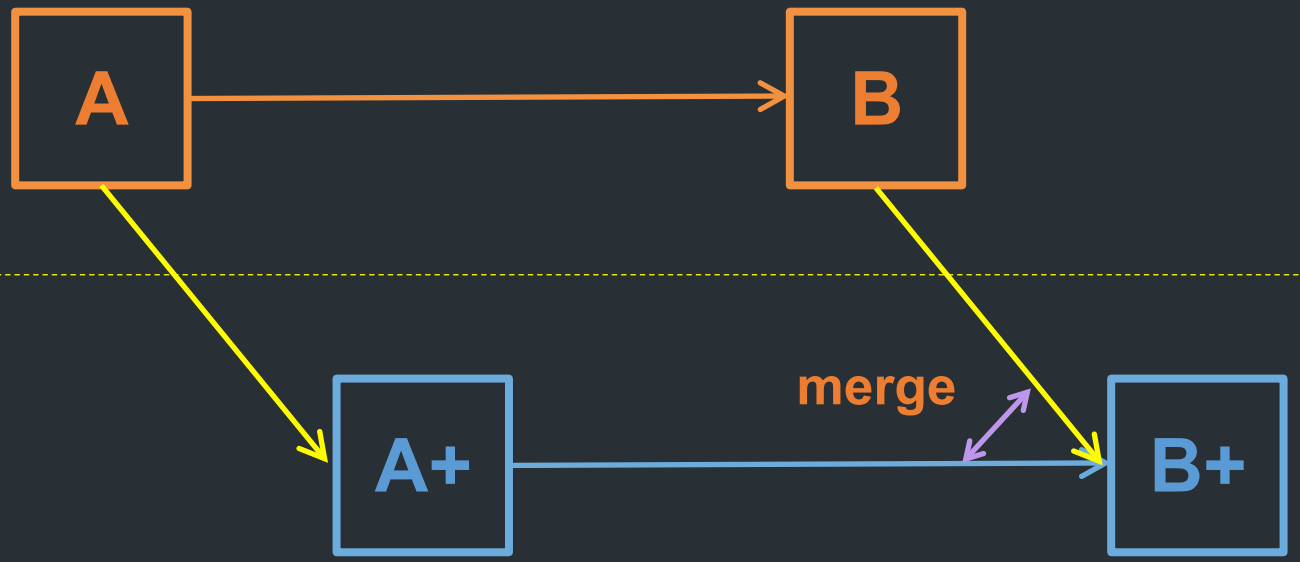
And if we certified the software process?

Where does Zephyr fit into this?



Certified/certifiable (audited/auditable, …)

Upstream



Downstream

- Users
- OEMs
- Certified products

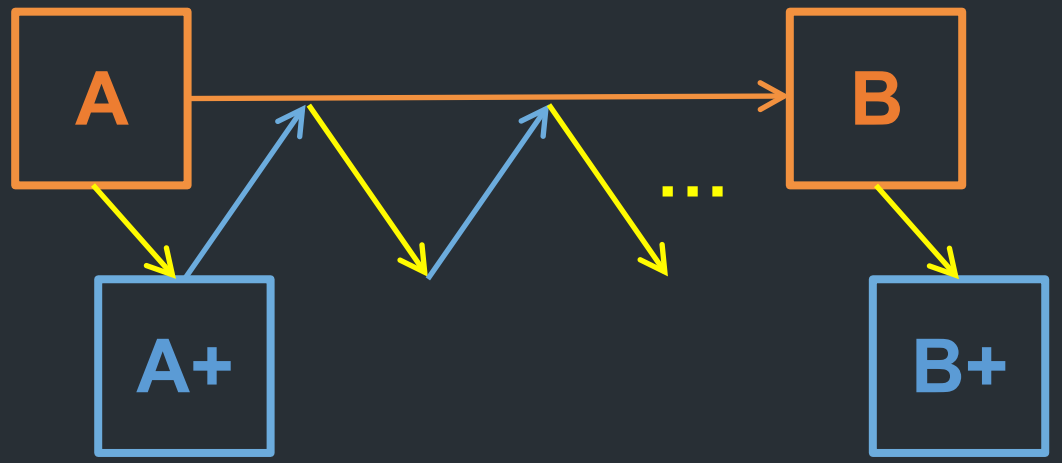
Merge is usually hard and expensive;

- Upstream doesn't minimize diff(A,A+)
- delta(A,B) doesn't account for re-certification difficulty

Certified/certifiable (audited/auditable, …)

Upstream

- Mainline devel
- Stable/LTS
- Hardened tree



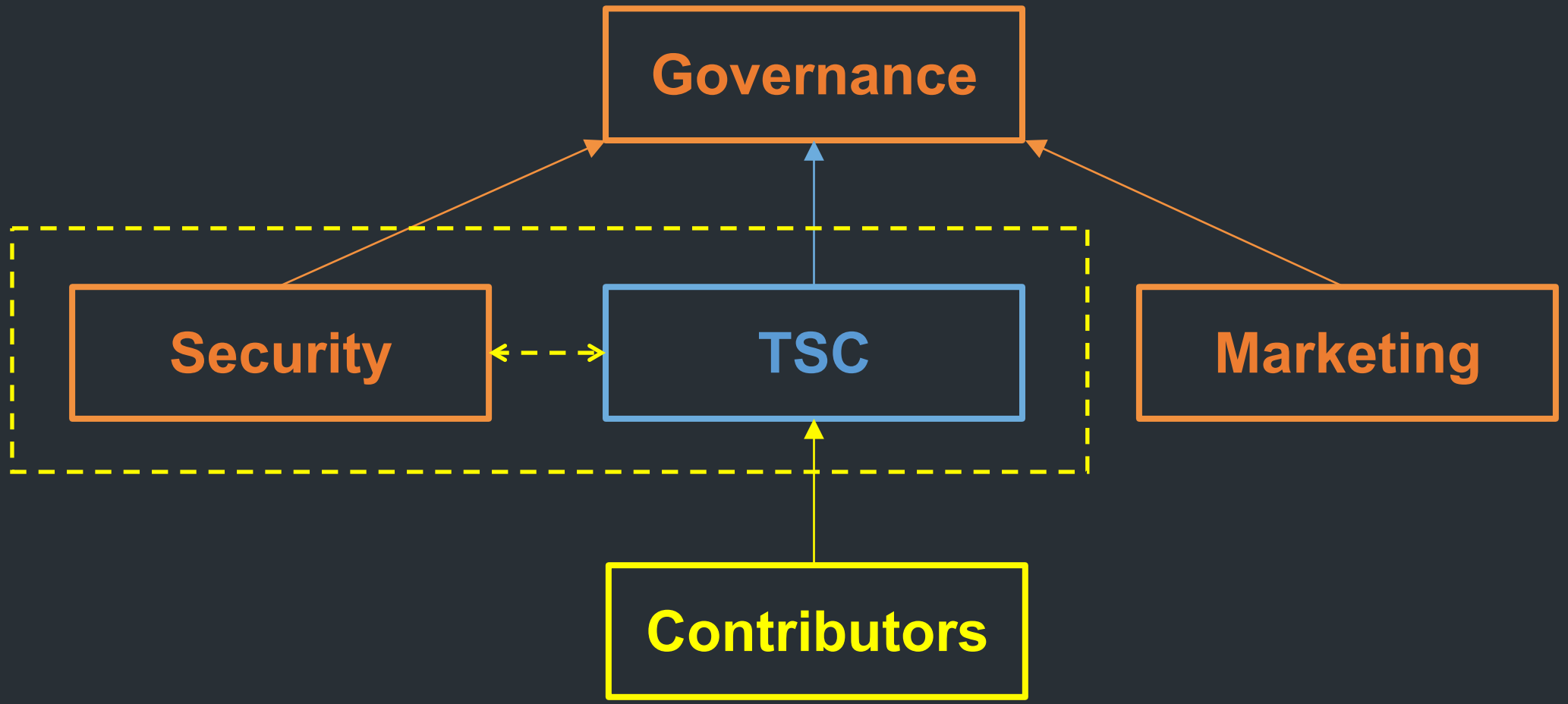
Downstream

Hardened "downstream" is coupled to mainline work

- Feedback for security impact of mainline changes
- Creates incentive for a better mainline
- Minimize throttling of mainline development

NXP

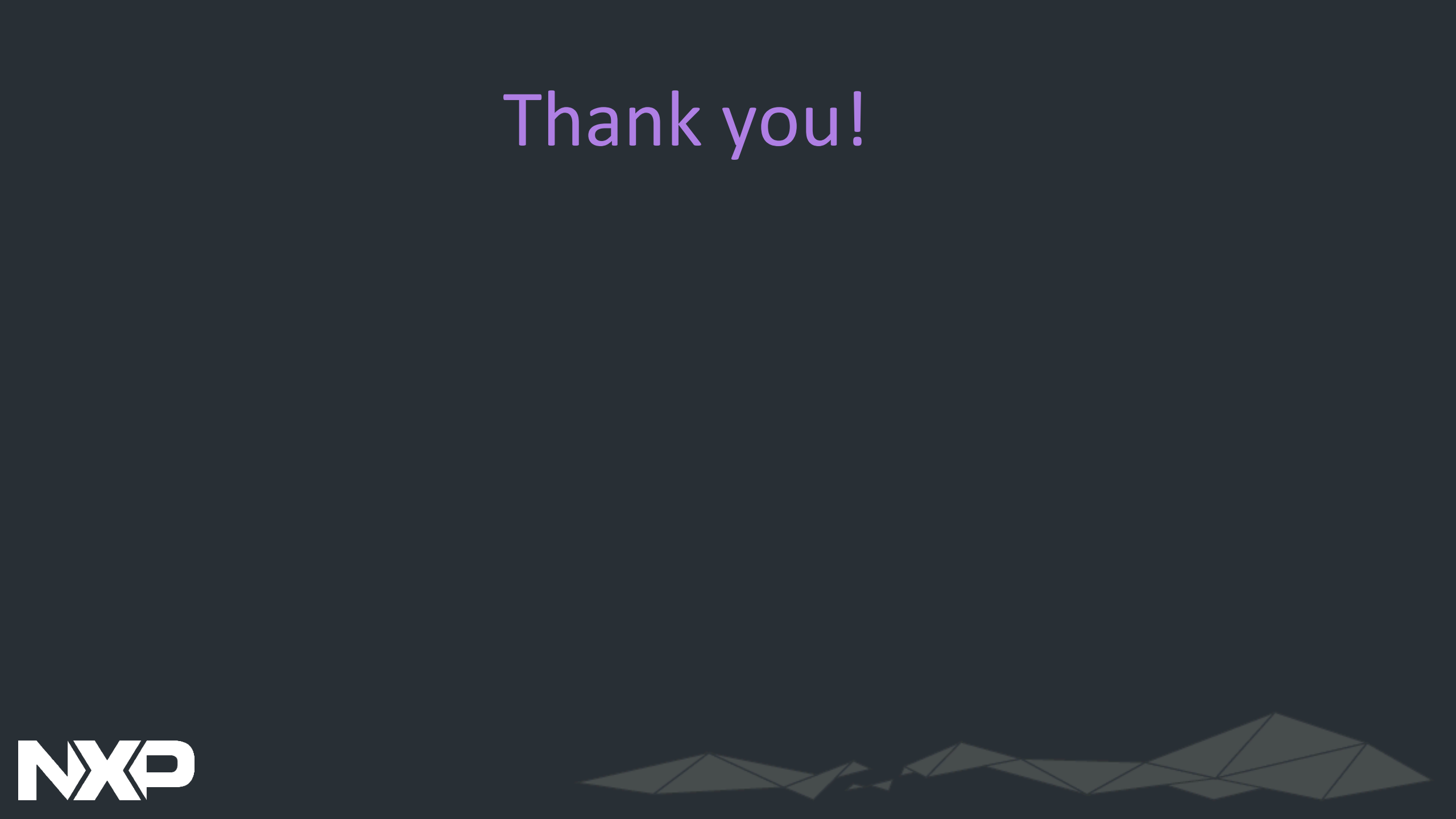
Where does this happen?



Summary

- RTOS upstream to be maintained as production-worthy and current, i.e. reactive security in “real time”.
- Vulnerability handling needs a refresh for “LITE”-type tech.
- Security quality (certifiability, auditability, safety, …) integrated into the project, without bogging down the mainline.
- Drive best-practice for IoT security, practicing what is preached.

Thank you!



Thank you!

(And don’t forget to scratch!)

SECURE CONNECTIONS
FOR A SMARTER WORLD