Zero Trust & RBAC Trends & Vendors

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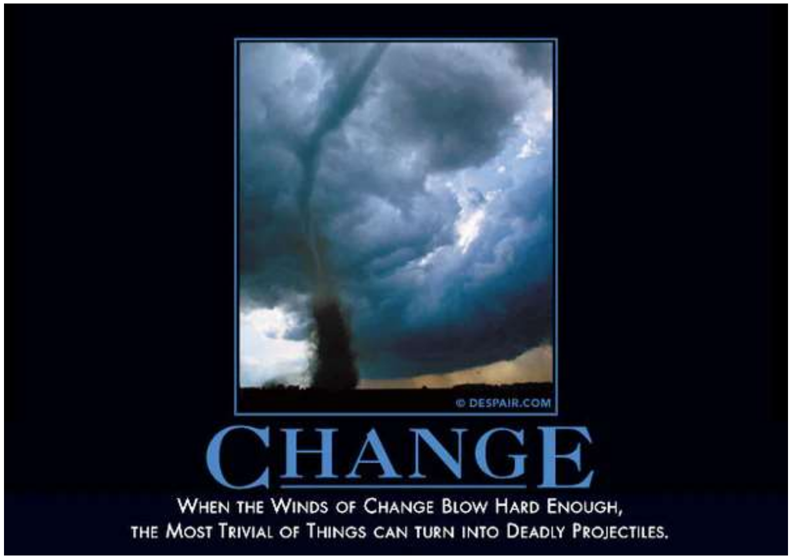
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CHANGE
When the Winds of Change Blow Hard Enough,
the Most Trivial of Things can turn into Deadly Projectiles.

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CONSULTING
If You're Not a Part of the Solution,
There's Good Money to be Made in Prolonging the Problem.

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University of Illinois Chicago

Public, Research I Institution, $460M

34,000 Students, 16 Colleges, Hospital

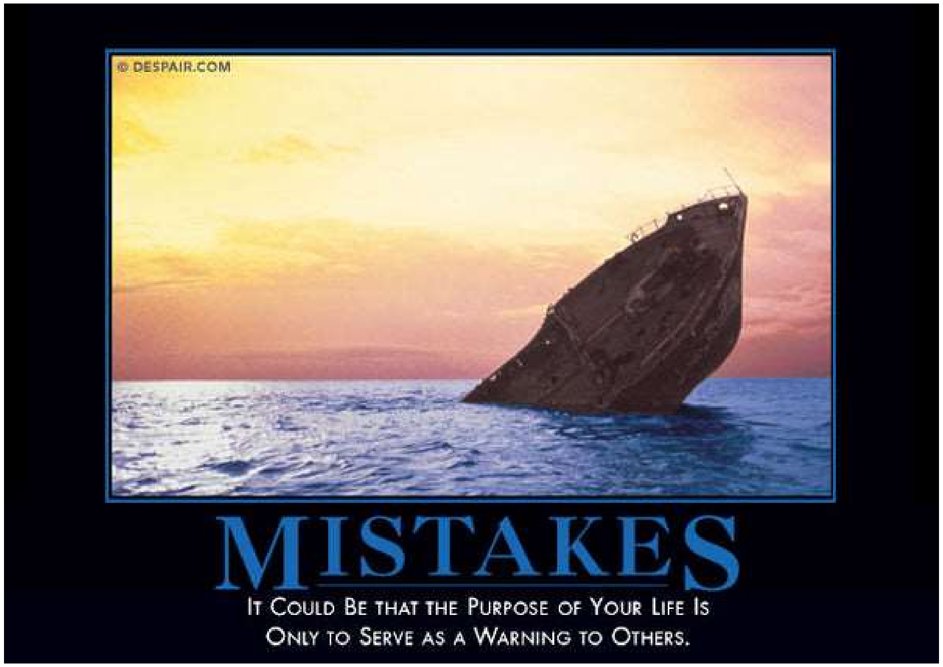
Among most culturally & ethnically diverse

Downtown Chicago, 1 mile from Willis Tower

UIC TECHNOLOGY SOLUTIONS

Today’s conversation

- What is ZT, RBAC, ABAC?
- Why should I care?
- NIST 800-207
- Overview of the various vendor approaches
- Next-gen ideas
- What UIC chose and why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MISTAKES
It Could Be that the Purpose of Your Life Is Only to Serve as a Warning to Others.

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Born out of frustration and filled with unicorn farts

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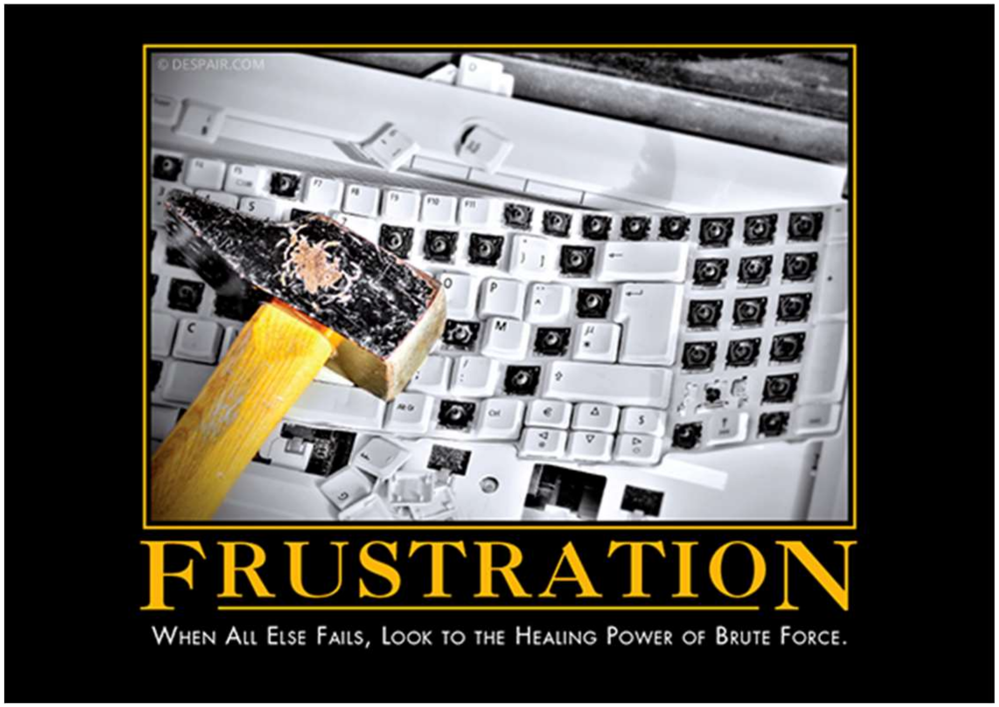
EXPERTS
We've got a Talent for Explaining Tomorrow
Why the Predictions We Made Yesterday Didn't Come True Today.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FRUSTRATION
When All Else Fails, Look to the Healing Power of Brute Force.

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Overall Network Statistics

322 Elevator Call Buttons

2,000+ Network Switches

3 Data Centers

220 Silent Startel Buttons

7,700 VoIP phones

700 Remaining Centrex Lines to convert to VoIP

18,500 sq. ft. Data Center Space

~6,000 Access Points

110+ Buildings

108 Routers

~41,000 VPN Authentication in 1 year

800+ Network closets

~32,000 peak concurrent wireless devices

1,100 Telephone repairs/adds/moves/ changes this year

1900 Daily VPN Users

1700+ Emergency Startel circuits

700 Softphone Clients

2300 Active Centrex Remaining

~64,000 Network Ports

WW

What led UIC to modernize their network?

- Technical debt
- Deferred maintenance
- Leadership concerns about technology choices
- Historical outages
- Stuck in firefighting mode and challenged to step back and think strategically
- Institutional change with new goals that everyone was concerned might not be met by the existing approach

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INNOVATION
We Regret to Inform You that the Flying Cars We Promised Aren't Feasible, But We Do Hope You'll Enjoy the Spying Vacuums.

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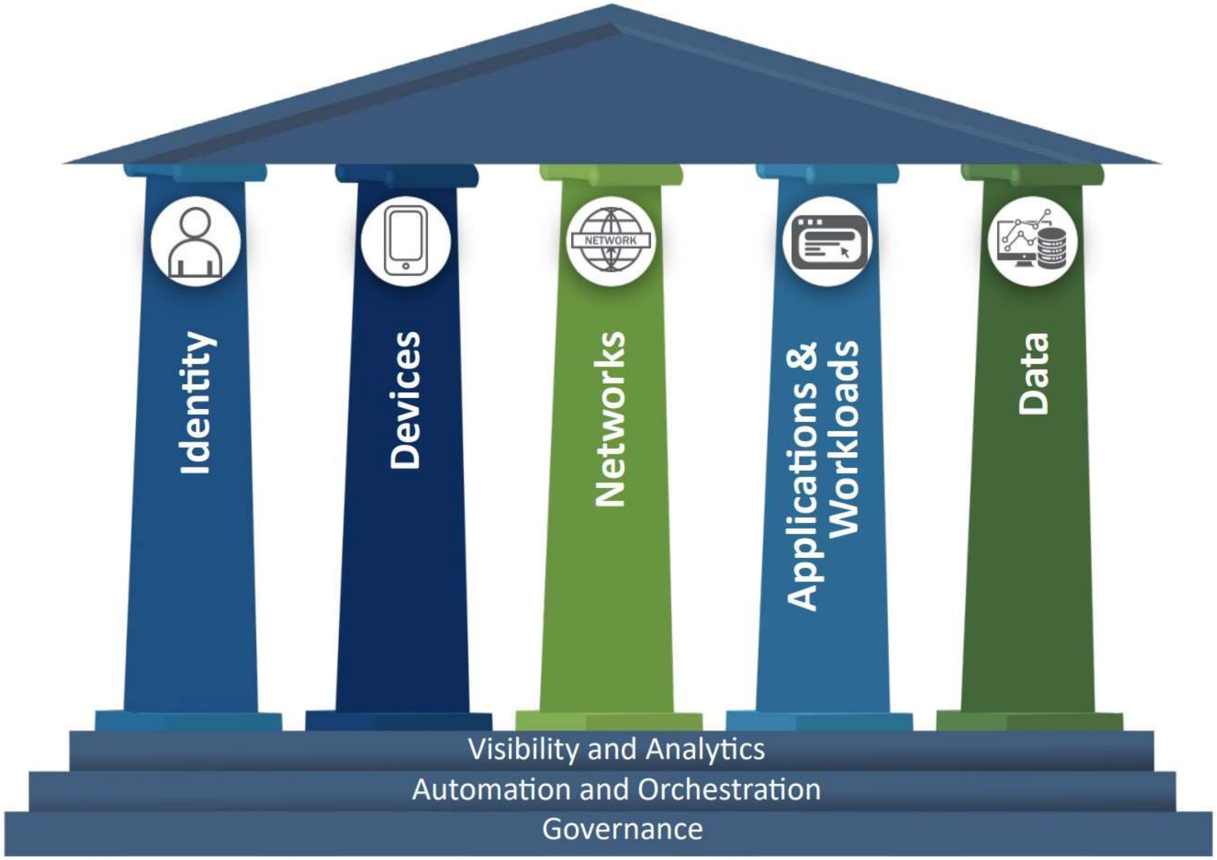
ZT vs ZTA vs ZTNA

Zero trust (ZT) provides a collection of concepts and ideas designed to minimize uncertainty in enforcing accurate, least privilege per-request access decisions in information systems and services in the face of a network viewed as compromised. Zero trust architecture (ZTA) is an enterprise's cybersecurity plan that utilizes zero trust concepts and encompasses component relationships, workflow planning, and access policies. Therefore, a zero trust enterprise is the network infrastructure (physical and virtual) and operational policies that are in place for an enterprise as a product of a zero trust architecture plan.

- NIST SP 800-207

CISA's ZTMM is one of the many paths to support the transition to zero trust



CISA Zero Trist Maturity Model v2 Figure 1: ZTMM Pillars

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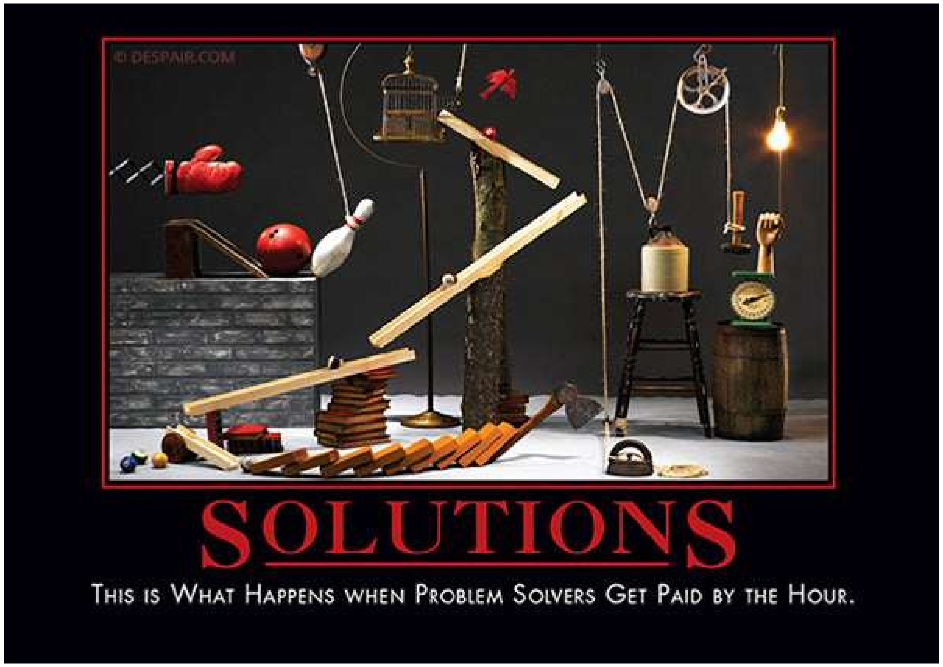
Focus on the network

Other mechanisms to consider

- WebAuthn
- XDR
- HTTPS
- So many others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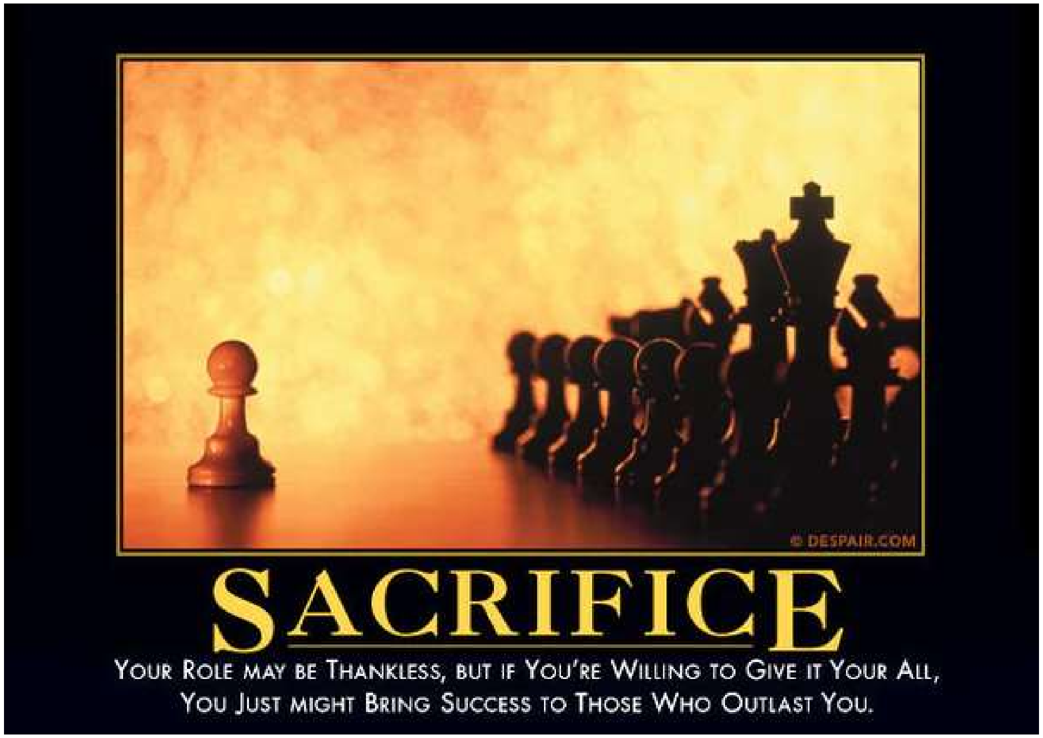
SOLUTIONS
This is What Happens when Problem Solvers Get Paid by the Hour.

Why Should I Care?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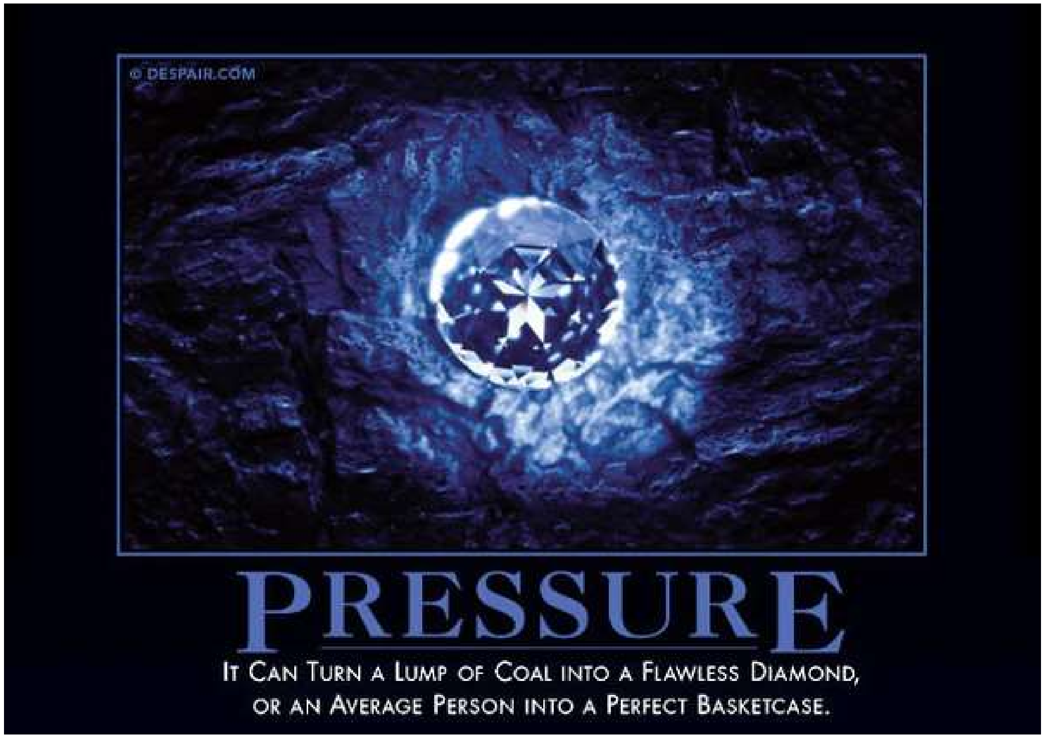
SACRIFICE
YOUR ROLE MAY BE THANKLESS, BUT IF YOU'RE WILLING TO GIVE IT YOUR ALL, YOU JUST MIGHT BRING SUCCESS TO THOSE WHO OUTLAST YOU.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PRESSURE
IT CAN TURN A LUMP OF COAL INTO A FLAWLESS DIAMOND, OR AN AVERAGE PERSON INTO A PERFECT BASKETCASE.

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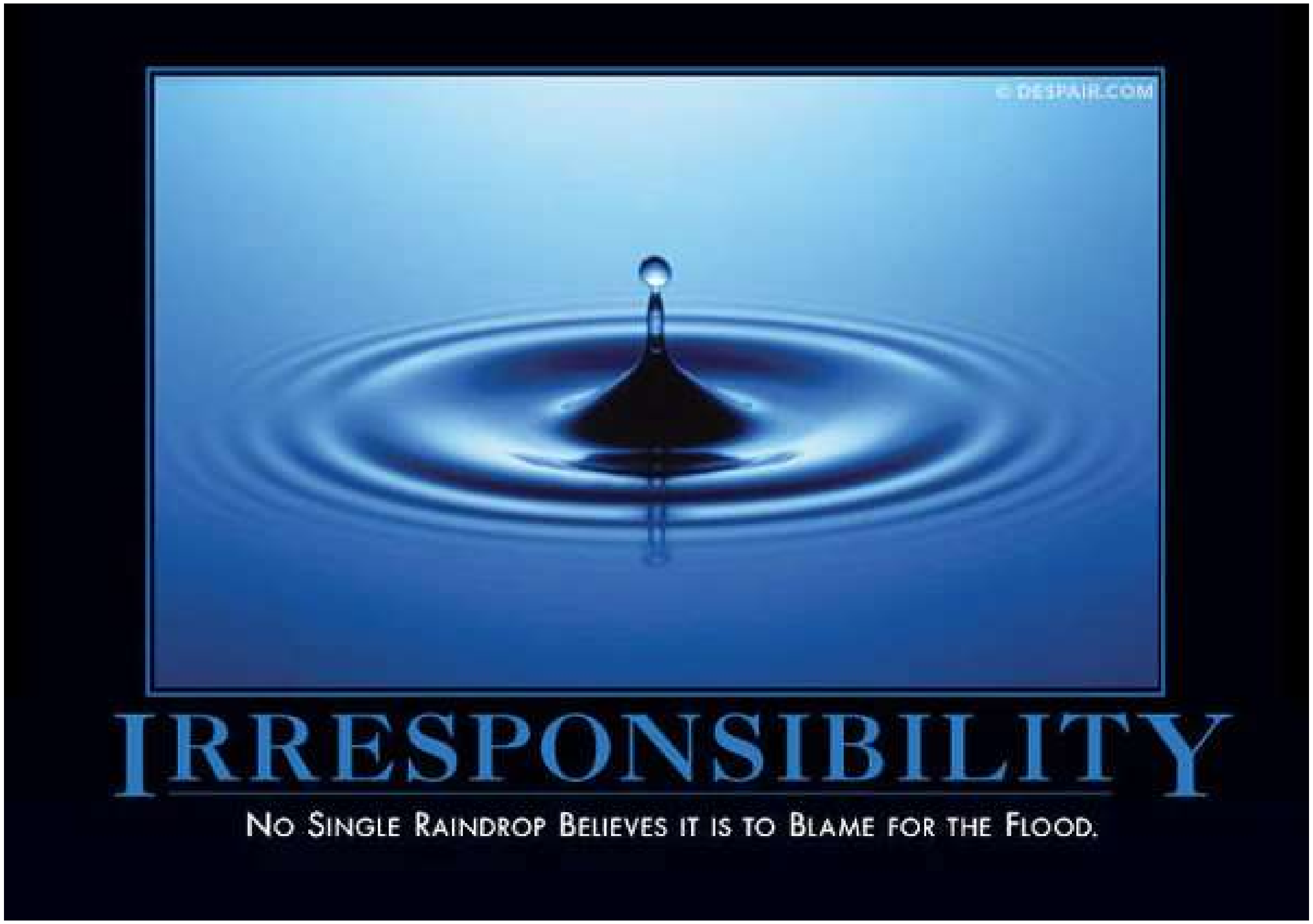
Major Element Design Goals

When You Wish Upon a Falling Star, Your Dreams Can Come True. Unless it's Really a Meteor Hurtling to the Earth Which Will Destroy All Life. Then You're Pretty Much Hosed No Matter What You Wish For. Unless it's Death By Meteorite.

- Automation & Orchestration
- Analytics (not just metrics)
- Identity-aware, dynamic segmentation (RBAC/ZT)
- Policy decision and enforcement points + device profiling
- Security fully integrated and meets compliance needs
- Easy to add performance
- Everything everywhere, all at once!
  - Wi-Fi and wired (and remote??) are a seamless experience
  - Cloud extensible



What is Zero Trust? 800-207 elements

- Authentication
- Authorization
- Shrinking implicit trust zones
- Maintaining service availability
- Minimizing temporal delays in authentication mechanisms
- Access rules are made as granular as possible to enforce least privileges required

NIST SP 800-207: Zero Trust Architecture, page 4

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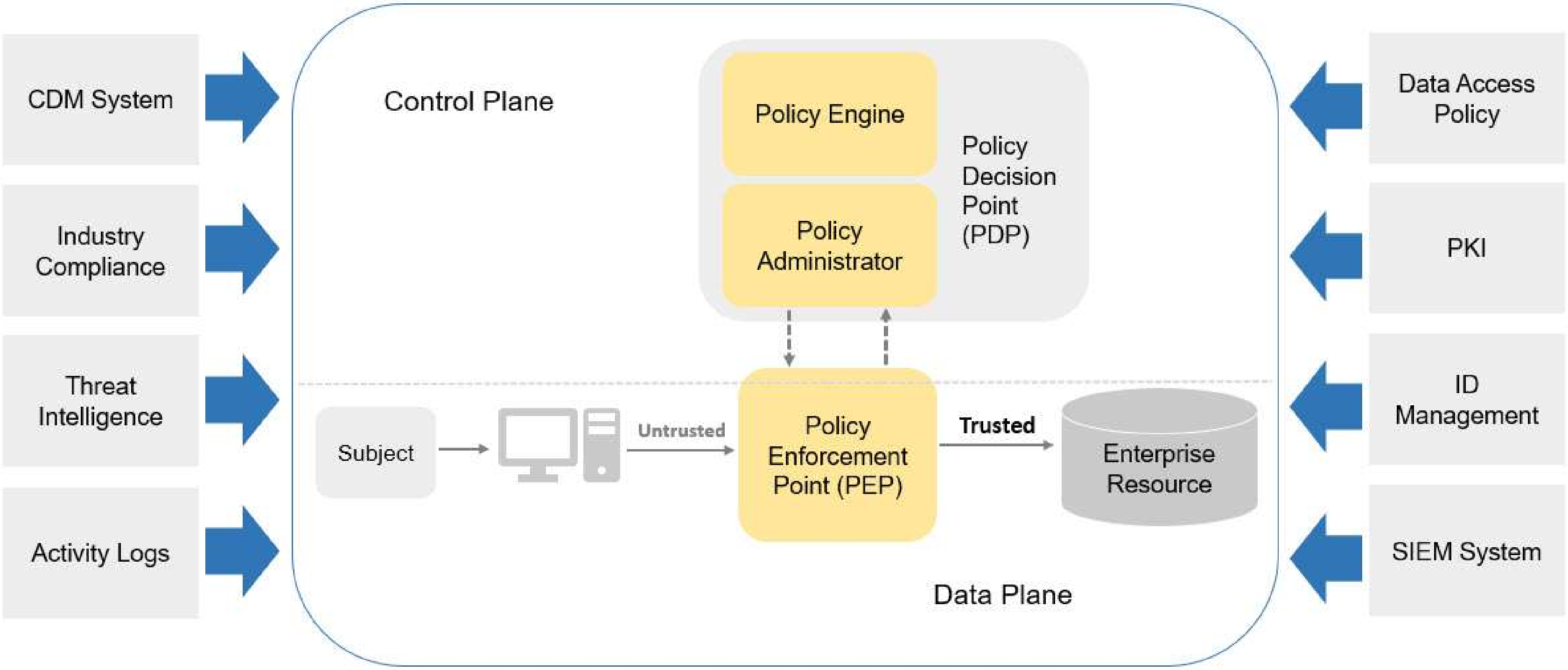

Core Zero Trust logical components; Source: NIST SP 800-207, Zero Trust Architecture, Figure 2.

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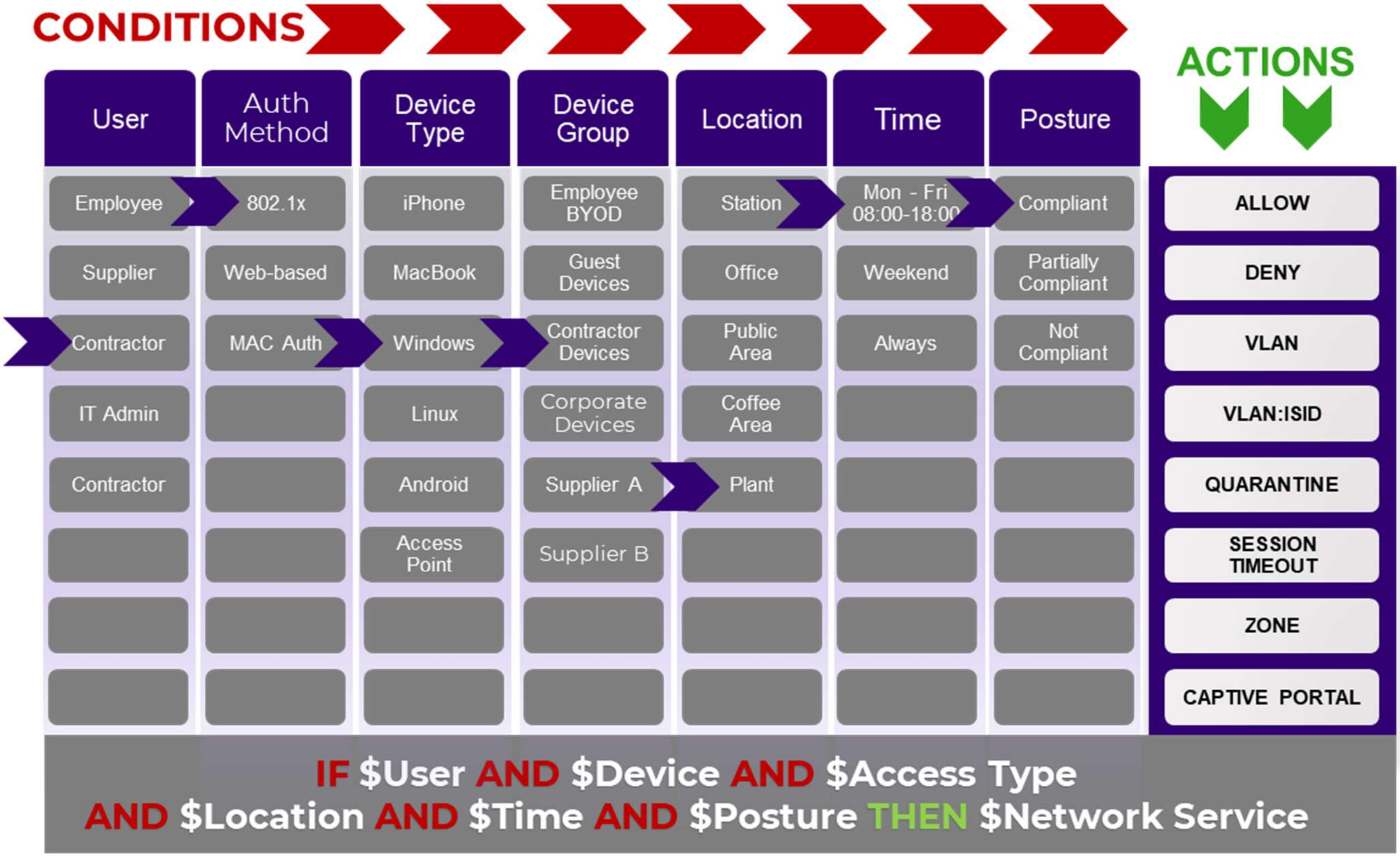

CONDITIONS

User	Auth Method	Device Type	Device Group	Location	Time	Posture
Employee	802.1x	iPhone	Employee BYOD	Station	Mon - Fri 08:00-18:00	Compliant
Supplier	Web-based	MacBook	Guest Devices	Office	Weekend	Partially Compliant
Contractor	MAC Auth	Windows	Contractor Devices	Public Area	Always	Not Compliant
IT Admin		Linux	Corporate Devices	Coffee Area		
Contractor		Android	Supplier A	Plant		
		Access Point	Supplier B			

ACTIONS

- ALLOW
- DENY
- VLAN
- VLAN:ISID
- QUARANTINE
- SESSION TIMEOUT
- ZONE
- CAPTIVE PORTAL

IF $User AND $Device AND $Access Type AND $Location AND $Time AND $Posture THEN $Network Service

P

Graphics credit: Extreme Networks

Options we’ll discuss

Solution Type	Vendor Exemplars of Type
Standards-based	• Any. This is traditional RBAC
Sophisticated DACL	• Cisco (Trustsec) • Alcatel-Lucent • Extreme
Hairpins	• Aruba • Firewall vendors
Proxy	• Saife Continuum • Zscaler • Firewall vendors acting as VPN concentrators
Next-gen ideas **(shadow/overlay networks)**	• Tailscale • OpenZiti • Zero Tier

* We are over-simplifying this heavily.

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PRO	CON
• Provides comfort to people with a more conventional mindset. • In most topologies, can function with distributed depts on campus • Vendor agnostic • Doesn’t usually require a forklift	• May not be able to achieve true micro-segmentation. • E-W Firewall is doing a lot of work. • Difficult to fit well with geographically distributed roles.

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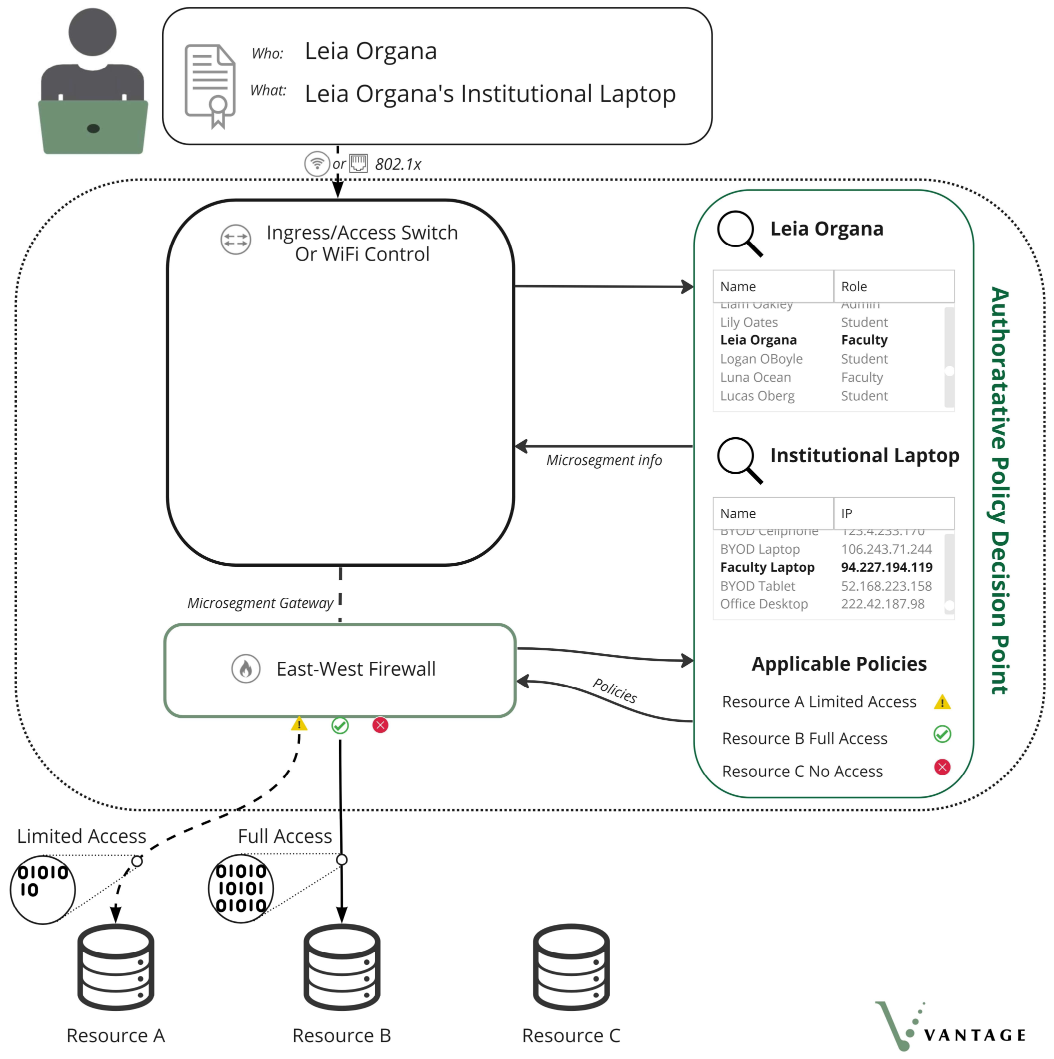
Standard East-West Firewall RBAC



Leia Organa

Name	Role
Liam Oakley	Admin
Lily Oates	Student
Leia Organa	**Faculty**
Logan OBoyle	Student
Luna Ocean	Faculty
Lucas Oberg	Student

Institutional Laptop

Name	IP
BYOD Cellphone	123.4.233.170
BYOD Laptop	106.243.71.244
Faculty Laptop	**94.227.194.119**
BYOD Tablet	52.168.223.158
Office Desktop	222.42.187.98

Applicable Policies

Resource A Limited Access ⚠

Resource B Full Access ✓

Resource C No Access ✗

PRO	CON
• Can *usually* achieve micro-segmentation. • Well-provisioned to manage IoT endpoints. • Reduces traffic filtering load off the E-W Firewall. • Enables opportunities for additional network analytics.	• If you don’t already have the right switches deployed, a lot of network equipment needs to be replaced to achieve the fabric across the distribution layer to the edge. • Learning curve for DACL creation and management may not be quick to achieve. • Usually not vendor agnostic (i.e., you need to be ok with vendor lock). • Some implementations don’t do multicast well. • No real firewalling • DACL management has major limitations

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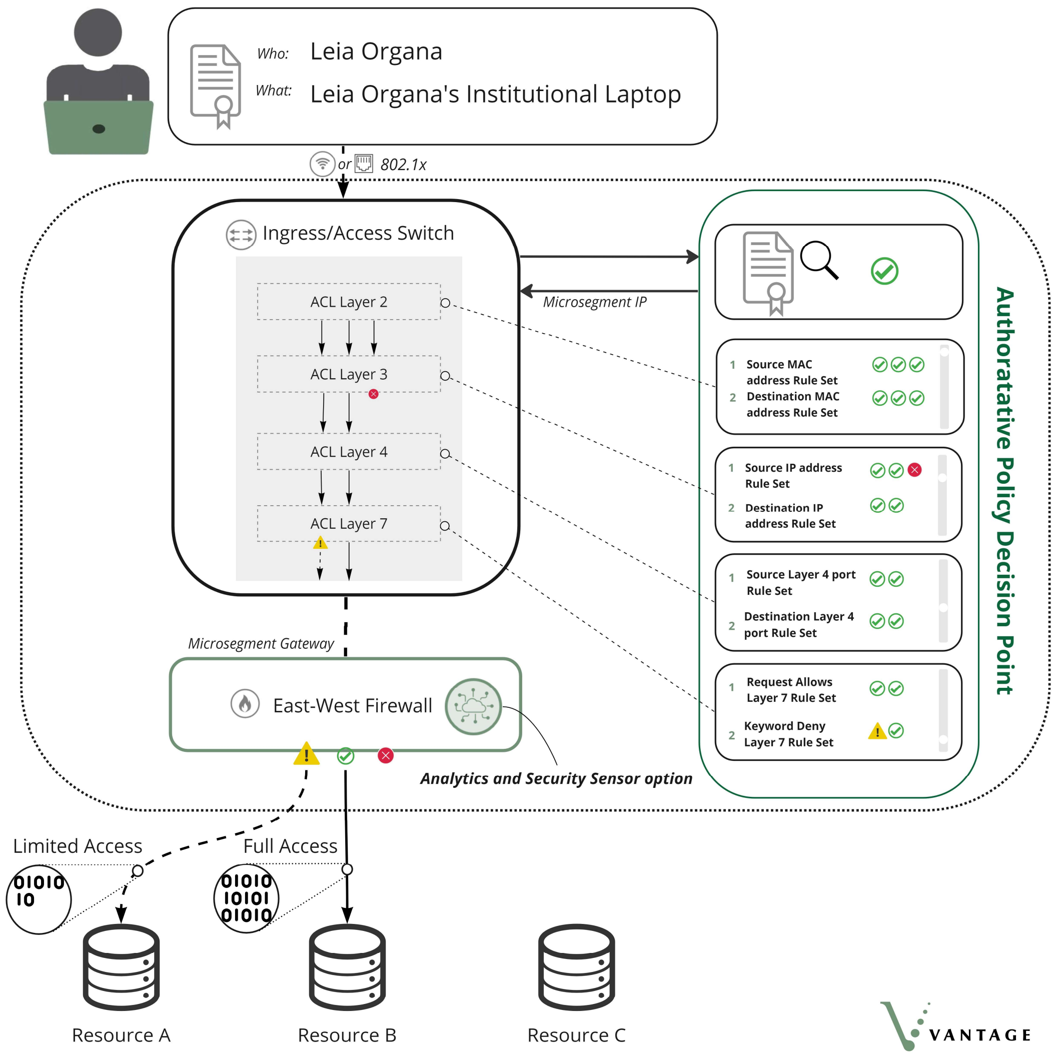
Sophisticated DACL RBAC


Who: Leia Organa
What: Leia Organa's Institutional Laptop
or 802.1x
Ingress/Access Switch
ACL Layer 2
ACL Layer 3
ACL Layer 4
ACL Layer 7
Microsegment IP
Microsegment Gateway
East-West Firewall
Analytics and Security Sensor option
1 Source MAC address Rule Set
2 Destination MAC address Rule Set
1 Source IP address Rule Set
2 Destination IP address Rule Set
1 Source Layer 4 port Rule Set
2 Destination Layer 4 port Rule Set
1 Request Allows Layer 7 Rule Set
2 Keyword Deny Layer 7 Rule Set
Authoratative Policy Decision Point
Limited Access
Full Access
01010 10
01010 10101 01010
Resource A
Resource B
Resource C
VANTAGE

PRO

- Endpoint doesn’t require a client.
- Can achieve micro-segmentation.
- Well-provisioned to manage IoT endpoints.
- Physical network topology irrelevant to RBAC functionality.
- Network topology provides the opportunity for a small number of useful security sensors.

CON

- Concentrator is doing all the heavy traffic filtering.
- Throughput is limited, elephant flows must be routed another way.
- Traffic may need to traverse campus infrastructure multiple times for service access (path not optimized).

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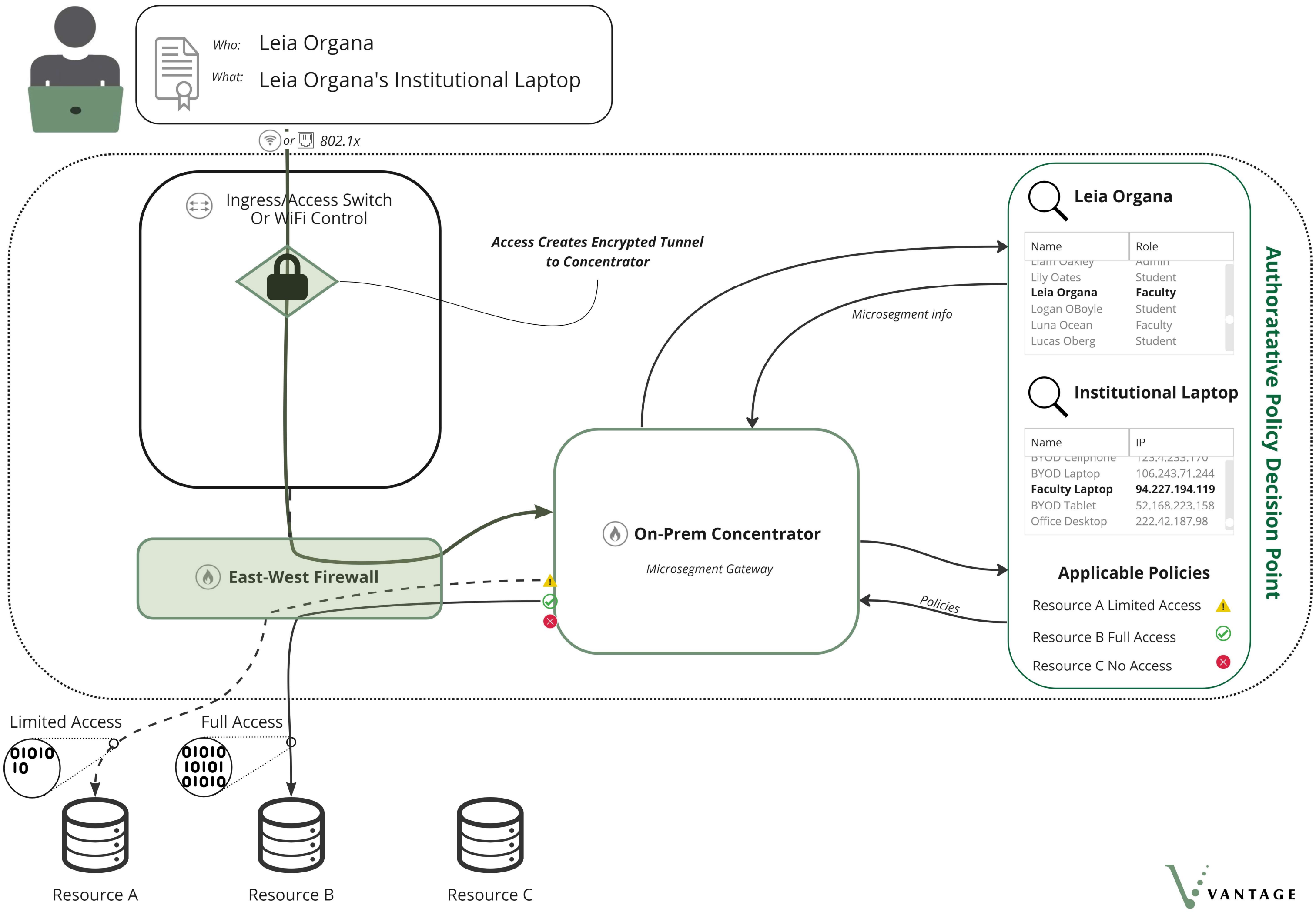
Hairpin RBAC



Name	Role
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Faculty Laptop	**94.227.194.119**
BYOD Tablet	52.168.223.158
Office Desktop	222.42.187.98

Applicable Policies	
Resource A Limited Access	⚠
Resource B Full Access	✓
Resource C No Access	✗

Proxy RBAC
Overlay with Client

PRO	CON
• Easily scalable to add services or users. • Physical network topology irrelevant to RBAC functionality. • Quick to provision new services behind. • Moving a service from on-prem to cloud can become trivial and transparent to users. • For compatible endpoints, achieves micro-segmentation. • As a MitM proxy, can perform security and analytics on traffic.	• Throughput is limited, elephant flows must be routed another way. • Traffic may need to traverse campus infrastructure multiple times for service access (path not optimized). • One more client on the endpoint. • Not all endpoints necessarily supported by client. • Licensing structure may limit supported application max.

Google
CNN
Office 365
now
box
Azure
aws
IoT
ZERO TRUST EXCHANGE
OT
Factory
Data Center
Workforce
Customers

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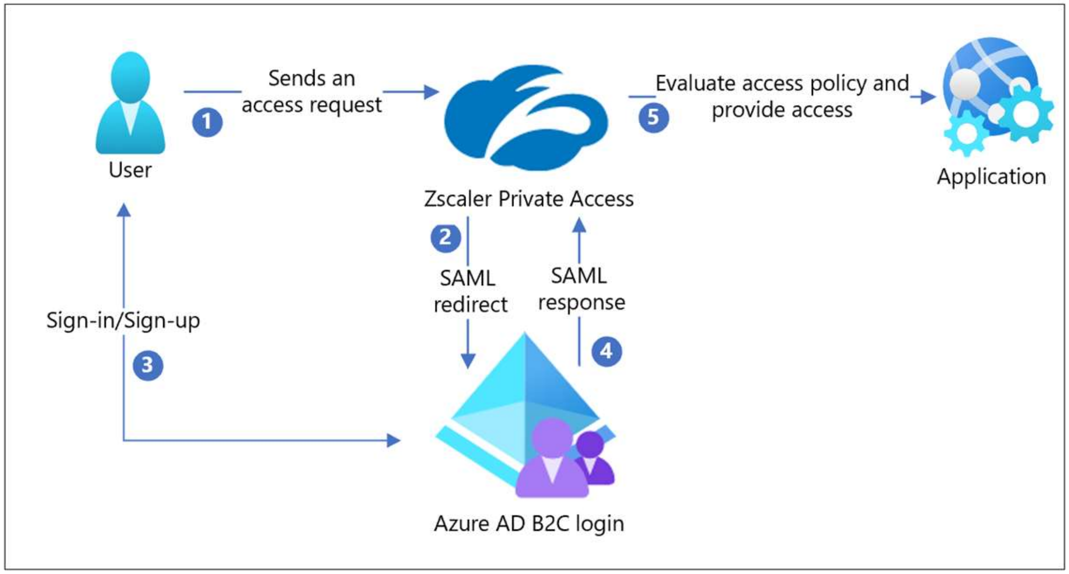

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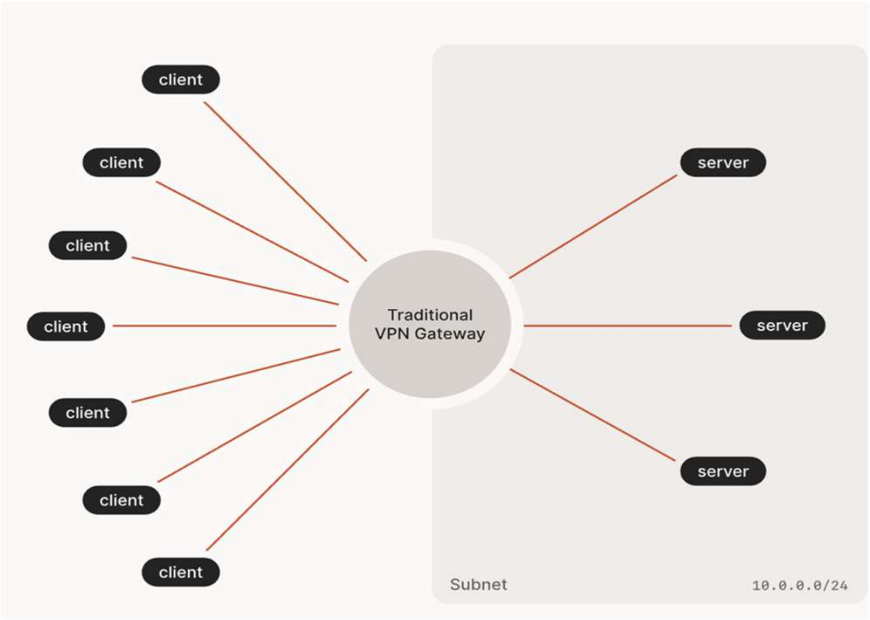
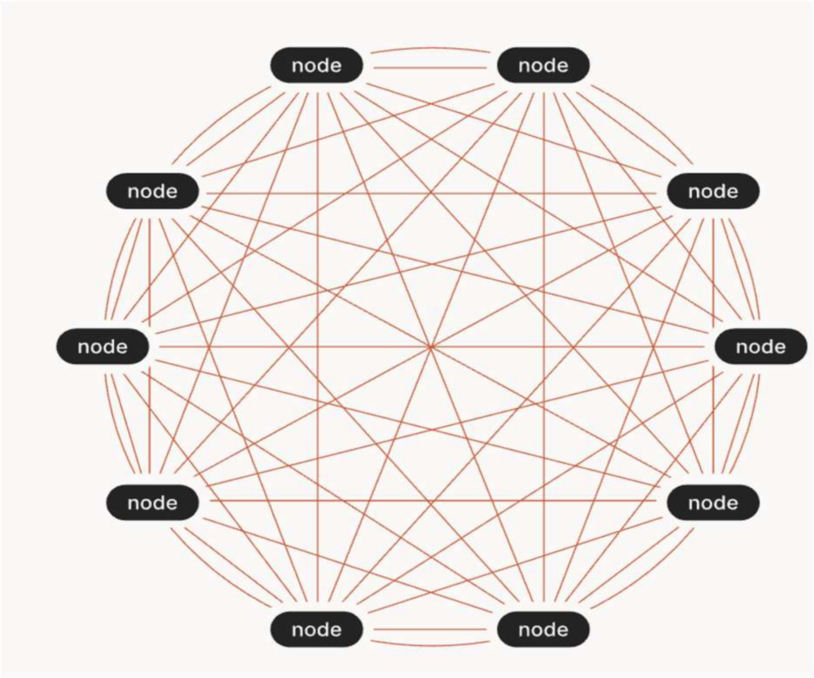
What is Tailscale?





Traditional hub and spoke VPN compared with
Tailscale fully meshed, Layer 3, point-to-point solution

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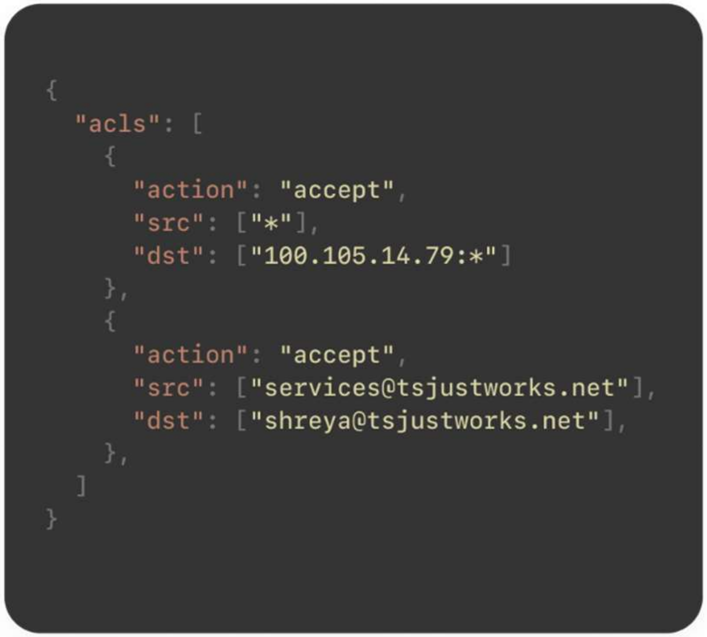
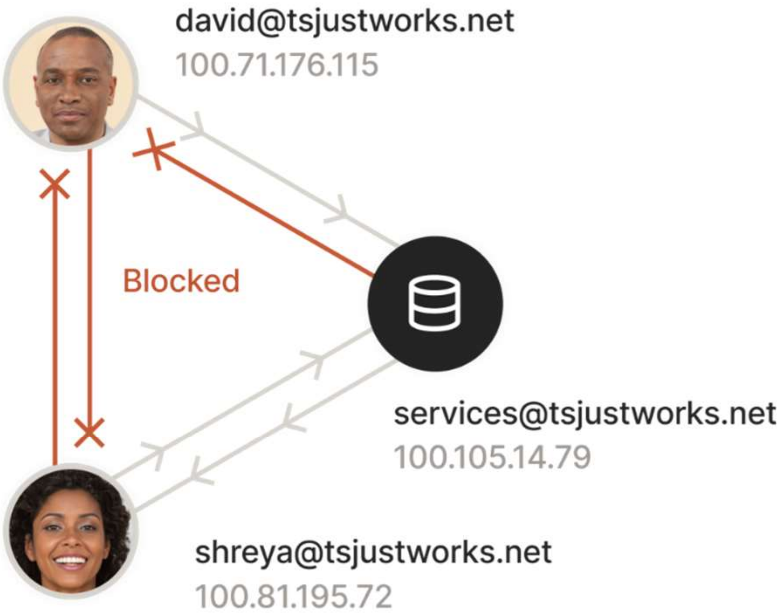
Access Control Lists (ACLs)

Tailscale restricts access by SSO users, devices, and groups — not by hostname.
A central role-based access policy determines who is allowed to connect.



```
{
  "acls": [
    {
      "action": "accept",
      "src": ["*"],
      "dst": ["100.105.14.79:*"]
    },
    {
      "action": "accept",
      "src": ["services@tsjustworks.net"],
      "dst": ["shreya@tsjustworks.net"],
    },
  ]
}
```



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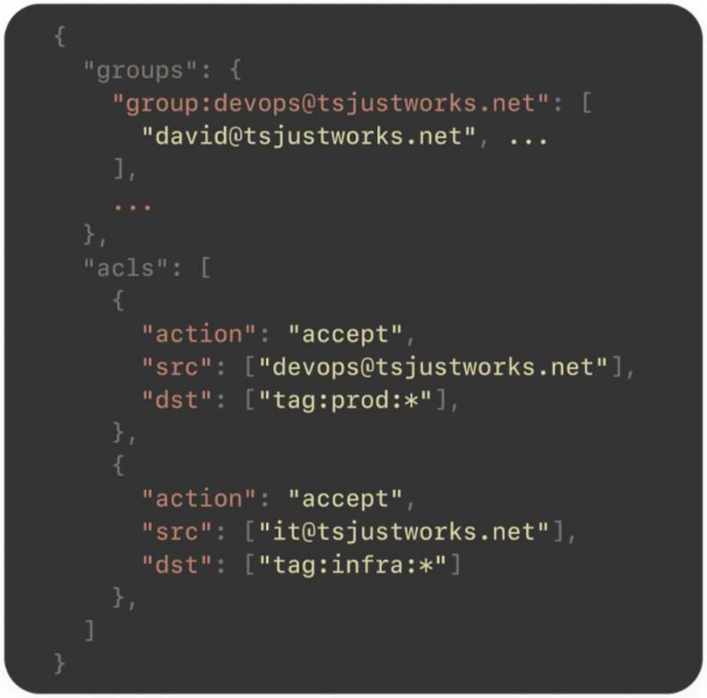
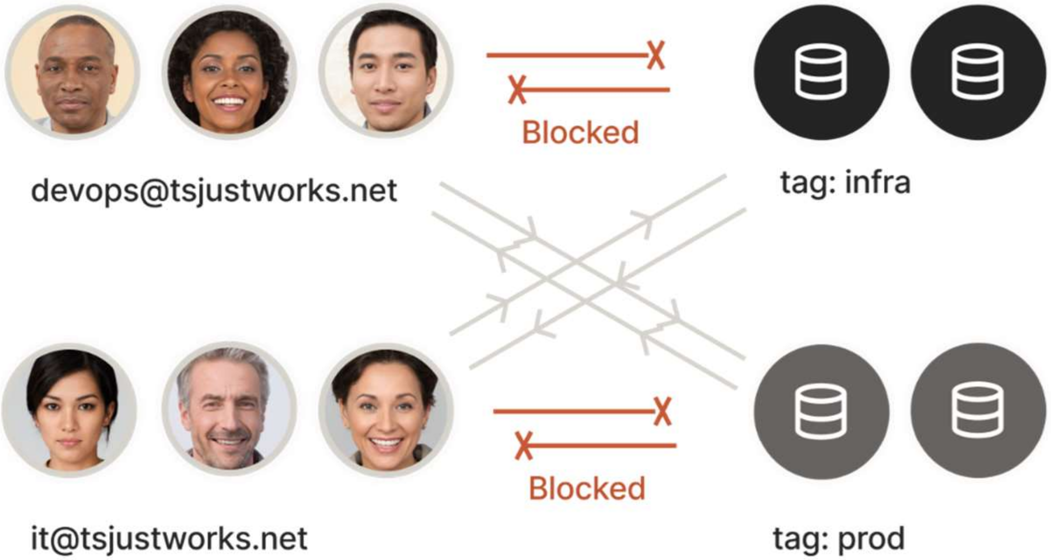
Access Control Lists (ACL) Tags

Tags let you assign an identity to a device that is separate from human users.
Use that identity as part of an ACL to restrict access.



```
{
  "groups": {
    "group:devops@tsjustworks.net": [
      "david@tsjustworks.net", ...
    ],
    ...
  },
  "acls": [
    {
      "action": "accept",
      "src": ["devops@tsjustworks.net"],
      "dst": ["tag:prod:*"],
    },
    {
      "action": "accept",
      "src": ["it@tsjustworks.net"],
      "dst": ["tag:infra:*"]
    },
  ]
}
```



devops@tsjustworks.net

Blocked

tag: infra

it@tsjustworks.net

Blocked

tag: prod

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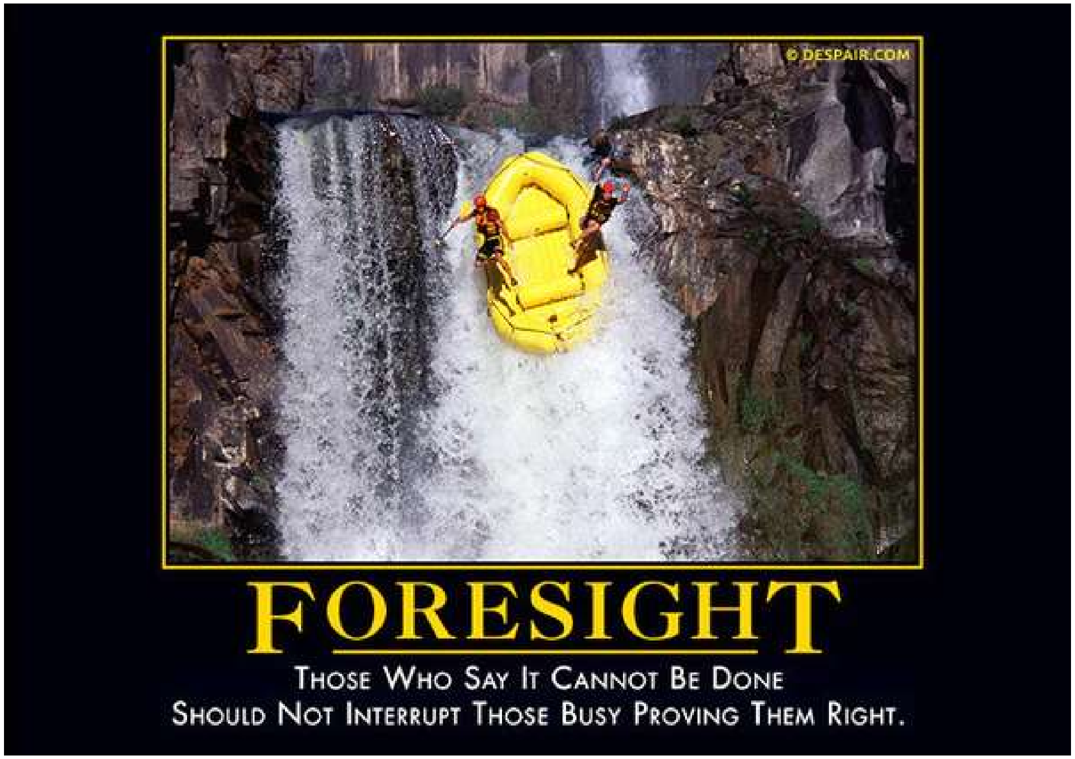
PEP Location per Vendor Solution	Secure Overlay	Proxy	Main Firewall (N/S)	ACL on fabric ingress	NG E/W Firewall	on-prem Concentrator	Distributed Firewall at Service edge	IoT friendly	Security Sensor Friendly
Cisco Firepower			X		X	X	X	X	X
Cisco TrustSec/SDA			X	X				X	X
Fortinet			X		X	X	X	X	X
Palo Alto Network			X		X	X	X	X	X
Extreme Networks			X	X				X	X
Alcatel Lucent (ALE)			X	X				X	X
Zscaler (multiple solutions)		X				X			
Netskope (proxy)		X							
Aruba - Gateway Based			X			X		X	X
Tailscale/Headscale	X							via gateway	Limited
Open ZiTi	X							via gateway	
ZeroTier	X							via gateway	

Why UIC chose the vendor agnostic approach

- Continue to get value for existing investment
- Slower migration, don't need to replace the access layer first
- Rapid time to value
- Future flexibility
- Chose to avoid vendor-lock over the long haul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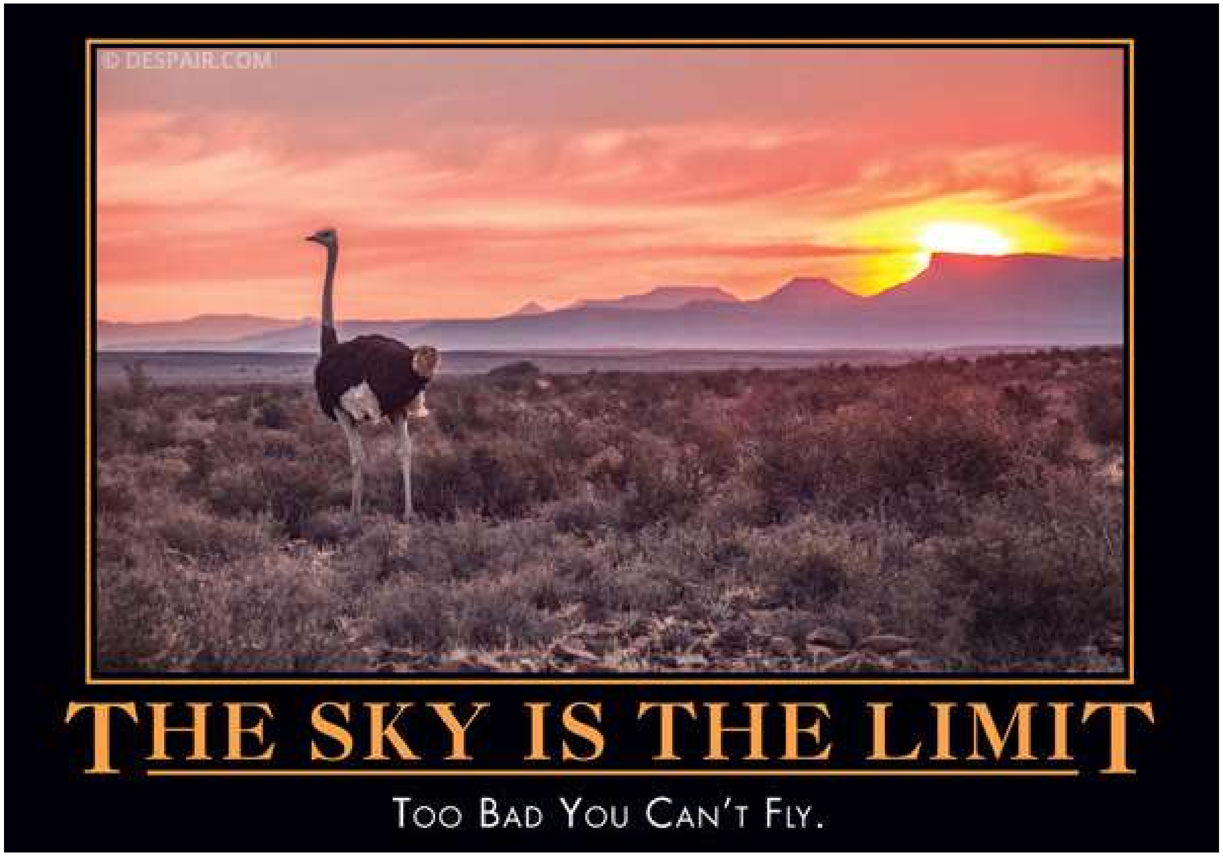
FORESIGHT
Those Who Say It Cannot Be Done
Should Not Interrupt Those Busy Proving Them Right.

WW



Biggest challenges

- ○ PKI (if EAP-TLS)
- ○ Transition planning
- ○ Role definitions and associated firewall rules
- ○ Business/security analyst and scaling

○ Priority: IoT

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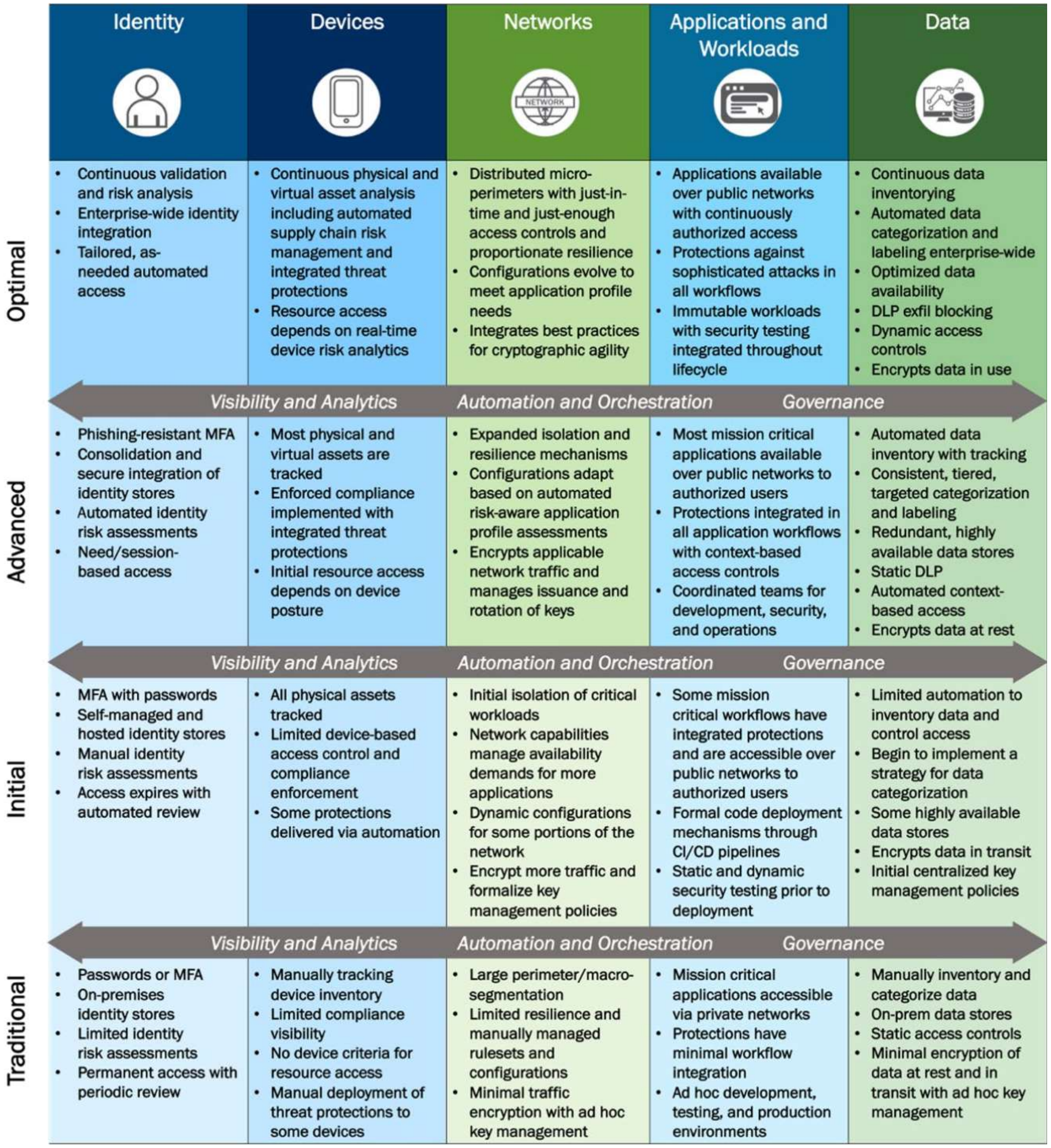

	Identity	Devices	Networks	Applications and Workloads	Data
Optimal	• Continuous validation and risk analysis • Enterprise-wide identity integration • Tailored, as-needed automated access	• Continuous physical and virtual asset analysis including automated supply chain risk management and integrated threat protections • Resource access depends on real-time device risk analytics	• Distributed micro-perimeters with just-in-time and just-enough access controls and proportionate resilience • Configurations evolve to meet application profile needs • Integrates best practices for cryptographic agility	• Applications available over public networks with continuously authorized access • Protections against sophisticated attacks in all workflows • Immutable workloads with security testing integrated throughout lifecycle	• Continuous data inventorying • Automated data categorization and labeling enterprise-wide • Optimized data availability • DLP exfil blocking • Dynamic access controls • Encrypts data in use
	Visibility and Analytics		*Automation and Orchestration*		*Governance*
Advanced	• Phishing-resistant MFA • Consolidation and secure integration of identity stores • Automated identity risk assessments • Need/session-based access	• Most physical and virtual assets are tracked • Enforced compliance implemented with integrated threat protections • Initial resource access depends on device posture	• Expanded isolation and resilience mechanisms • Configurations adapt based on automated risk-aware application profile assessments • Encrypts applicable network traffic and manages issuance and rotation of keys	• Most mission critical applications available over public networks to authorized users • Protections integrated in all application workflows with context-based access controls • Coordinated teams for development, security, and operations	• Automated data inventory with tracking • Consistent, tiered, targeted categorization and labeling • Redundant, highly available data stores • Static DLP • Automated context-based access • Encrypts data at rest
	Visibility and Analytics		*Automation and Orchestration*		*Governance*
Initial	• MFA with passwords • Self-managed and hosted identity stores • Manual identity risk assessments • Access expires with automated review	• All physical assets tracked • Limited device-based access control and compliance enforcement • Some protections delivered via automation	• Initial isolation of critical workloads • Network capabilities manage availability demands for more applications • Dynamic configurations for some portions of the network • Encrypt more traffic and formalize key management policies	• Some mission critical workflows have integrated protections and are accessible over public networks to authorized users • Formal code deployment mechanisms through CI/CD pipelines • Static and dynamic security testing prior to deployment	• Limited automation to inventory data and control access • Begin to implement a strategy for data categorization • Some highly available data stores • Encrypts data in transit • Initial centralized key management policies
	Visibility and Analytics		*Automation and Orchestration*		*Governance*
Traditional	• Passwords or MFA • On-premises identity stores • Limited identity risk assessments • Permanent access with periodic review	• Manually tracking device inventory • Limited compliance visibility • No device criteria for resource access • Manual deployment of threat protections to some devices	• Large perimeter/macro-segmentation • Limited resilience and manually managed rulesets and configurations • Minimal traffic encryption with ad hoc key management	• Mission critical applications accessible via private networks • Protections have minimal workflow integration • Ad hoc development, testing, and production environments	• Manually inventory and categorize data • On-prem data stores • Static access controls • Minimal encryption of data at rest and in transit with ad hoc key management

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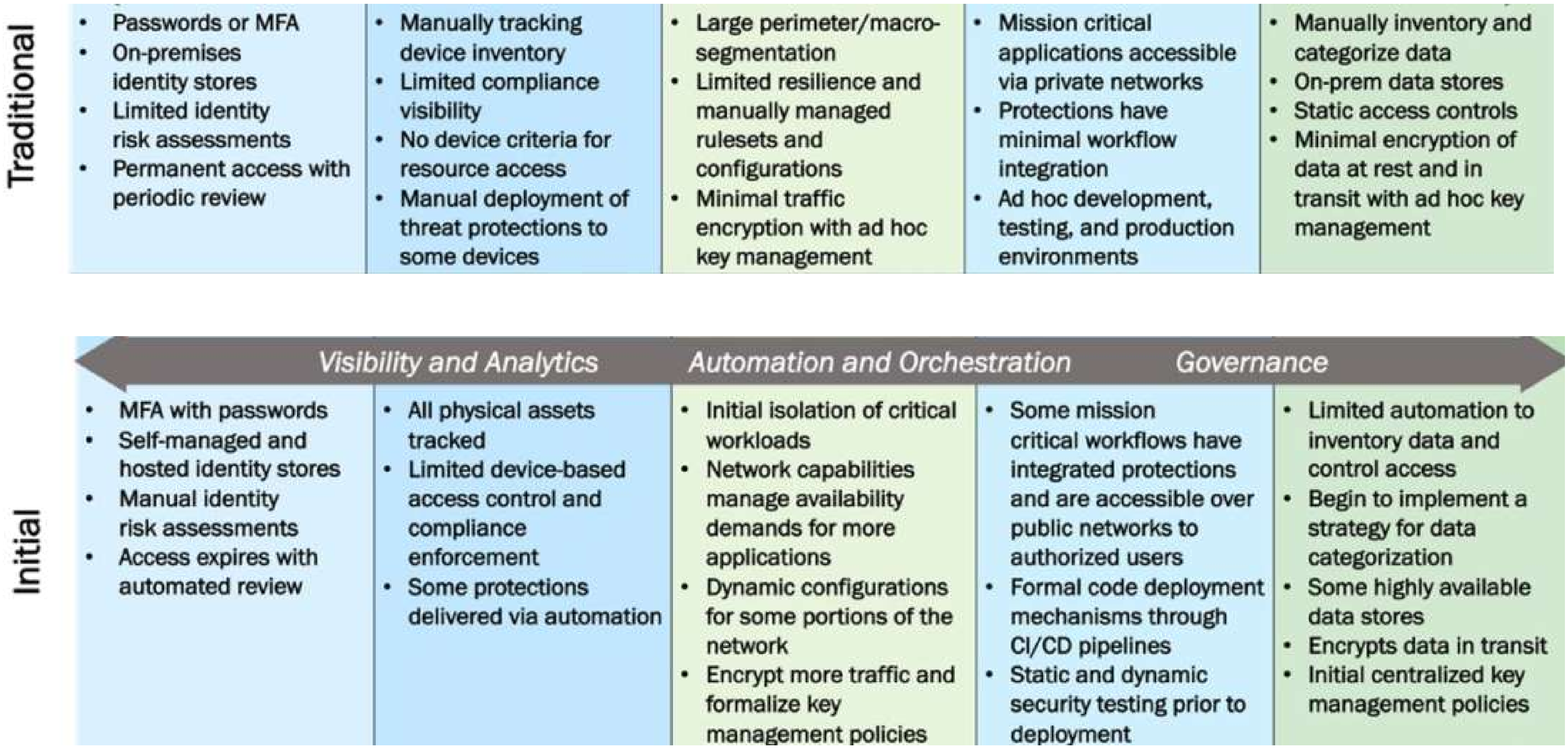

Traditional	- Passwords or MFA - On-premises identity stores - Limited identity risk assessments - Permanent access with periodic review	- Manually tracking device inventory - Limited compliance visibility - No device criteria for resource access - Manual deployment of threat protections to some devices	- Large perimeter/macro-segmentation - Limited resilience and manually managed rulesets and configurations - Minimal traffic encryption with ad hoc key management	- Mission critical applications accessible via private networks - Protections have minimal workflow integration - Ad hoc development, testing, and production environments	- Manually inventory and categorize data - On-prem data stores - Static access controls - Minimal encryption of data at rest and in transit with ad hoc key management
		Visibility and Analytics	*Automation and Orchestration*	*Governance*	
Initial	- MFA with passwords - Self-managed and hosted identity stores - Manual identity risk assessments - Access expires with automated review	- All physical assets tracked - Limited device-based access control and compliance enforcement - Some protections delivered via automation	- Initial isolation of critical workloads - Network capabilities manage availability demands for more applications - Dynamic configurations for some portions of the network - Encrypt more traffic and formalize key management policies	- Some mission critical workflows have integrated protections and are accessible over public networks to authorized users - Formal code deployment mechanisms through CI/CD pipelines - Static and dynamic security testing prior to deployment	- Limited automation to inventory data and control access - Begin to implement a strategy for data categorization - Some highly available data stores - Encrypts data in transit - Initial centralized key management policies

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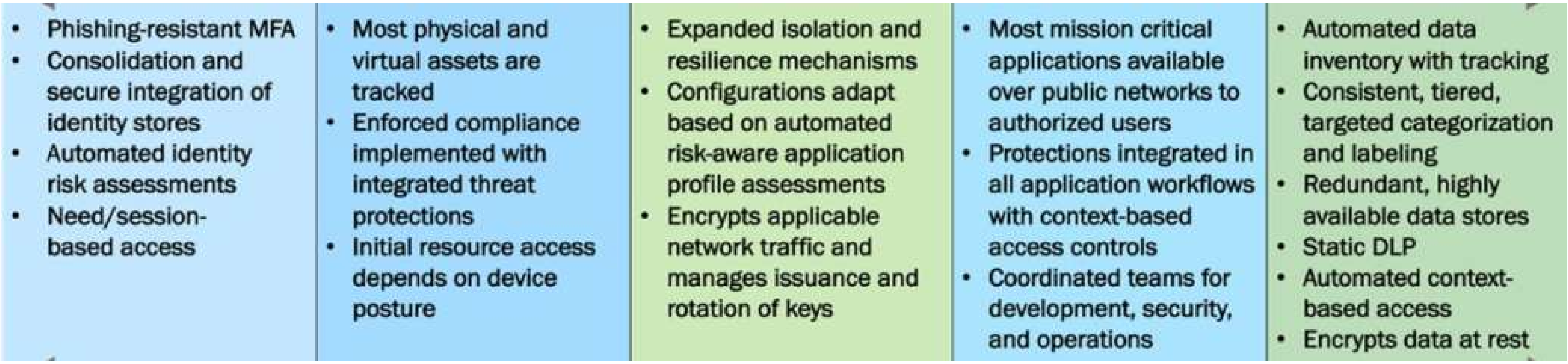
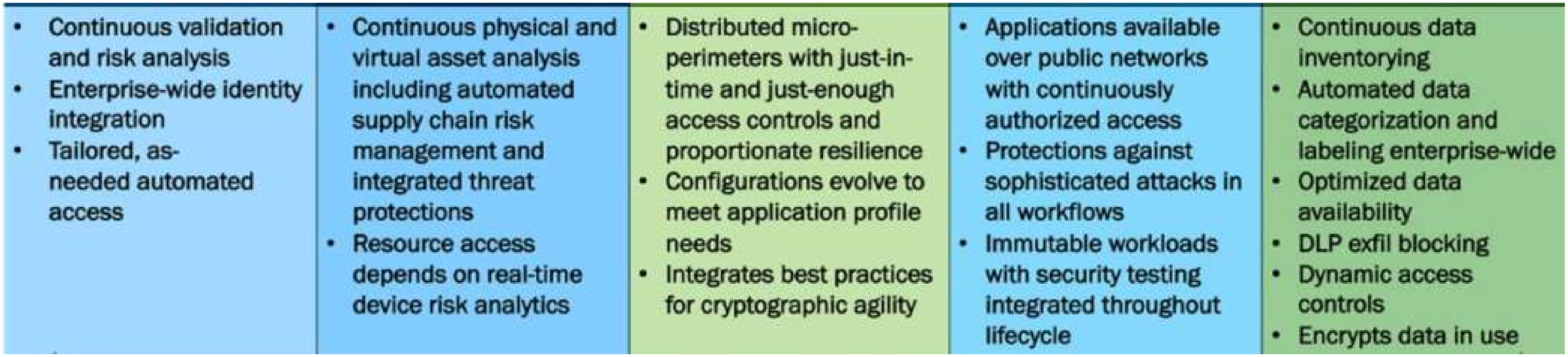
Advanced



- Phishing-resistant MFA - Consolidation and secure integration of identity stores - Automated identity risk assessments - Need/session-based access	- Most physical and virtual assets are tracked - Enforced compliance implemented with integrated threat protections - Initial resource access depends on device posture	- Expanded isolation and resilience mechanisms - Configurations adapt based on automated risk-aware application profile assessments - Encrypts applicable network traffic and manages issuance and rotation of keys	- Most mission critical applications available over public networks to authorized users - Protections integrated in all application workflows with context-based access controls - Coordinated teams for development, security, and operations	- Automated data inventory with tracking - Consistent, tiered, targeted categorization and labeling - Redundant, highly available data stores - Static DLP - Automated context-based access - Encrypts data at rest

Optimal



- Continuous validation and risk analysis - Enterprise-wide identity integration - Tailored, as-needed automated access	- Continuous physical and virtual asset analysis including automated supply chain risk management and integrated threat protections - Resource access depends on real-time device risk analytics	- Distributed micro-perimeters with just-in-time and just-enough access controls and proportionate resilience - Configurations evolve to meet application profile needs - Integrates best practices for cryptographic agility	- Applications available over public networks with continuously authorized access - Protections against sophisticated attacks in all workflows - Immutable workloads with security testing integrated throughout lifecycle	- Continuous data inventorying - Automated data categorization and labeling enterprise-wide - Optimized data availability - DLP exfil blocking - Dynamic access controls - Encrypts data in use

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References

UIC

- UIC IT Website
- Forward Initiative

Industry

- NIST 800-207 (Zero Trust Architecture)
- CISA Zero Trust Maturity Model v2
- CISA Executive Order on Improving the Nation's Cybersecurity
- NIST 800-207A (Cloud extensible ZTA)
- Finney, George, *Project Zero Trust: A Story About a Strategy for Aligning Security and the Business*, Wiley, October 2022

Vantage

- Vantage/UIC Internet2 network modernization webinar 2023
- Vantage/UIC EDUCAUSE network modernization webinar 2021
- Paths to Zero Trust (blog, June 2023)
- The Vantage Vision for a Modernized Network (blog)
- EDUCAUSE Community Group Recording on Network Architecture (netman/commtech/wireless, facilitated by Jon) (Passcode: tV9zq!Cr)

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Any questions? Presenter Contact Information

PDF of Slides:

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