Securing Generative AI Applications

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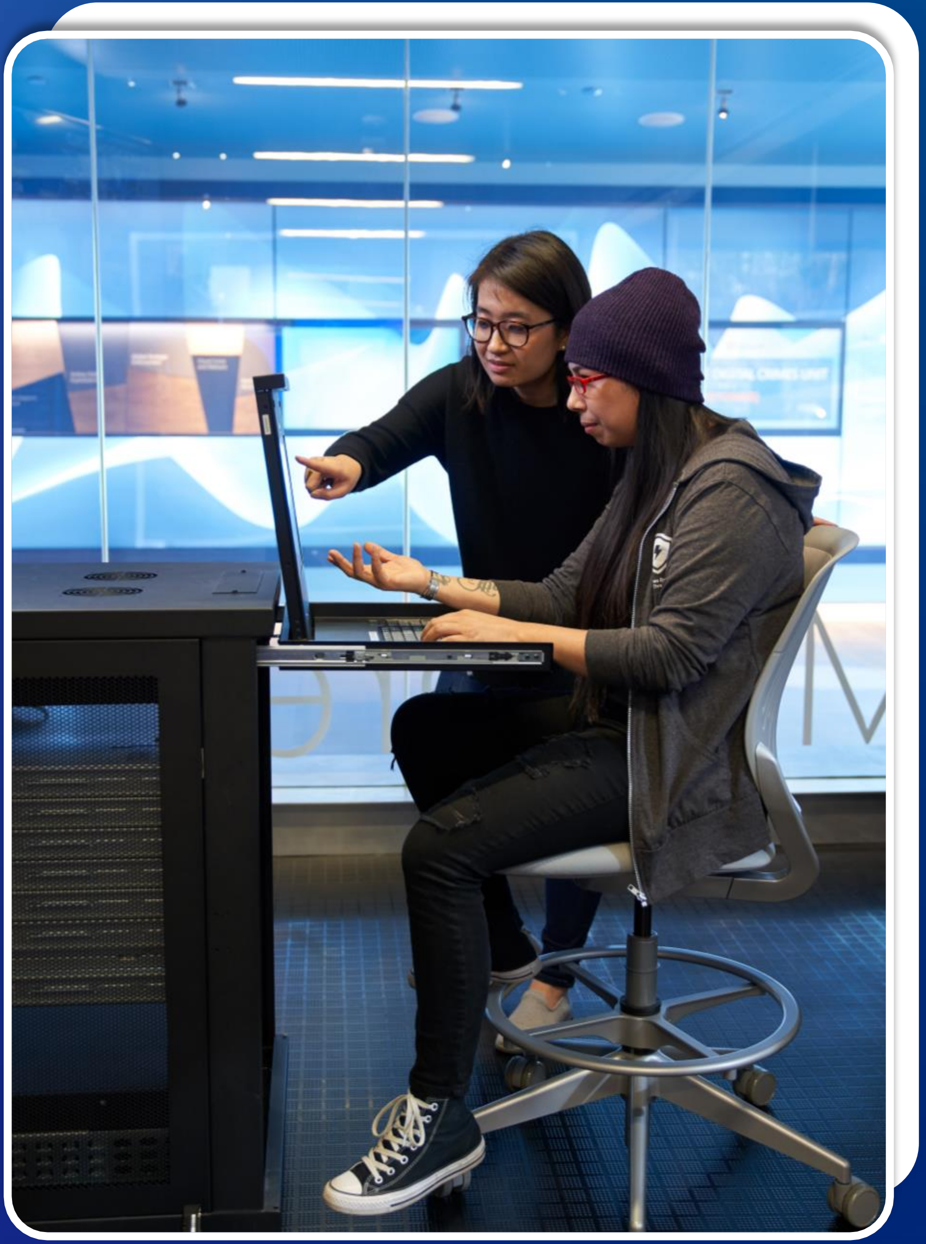
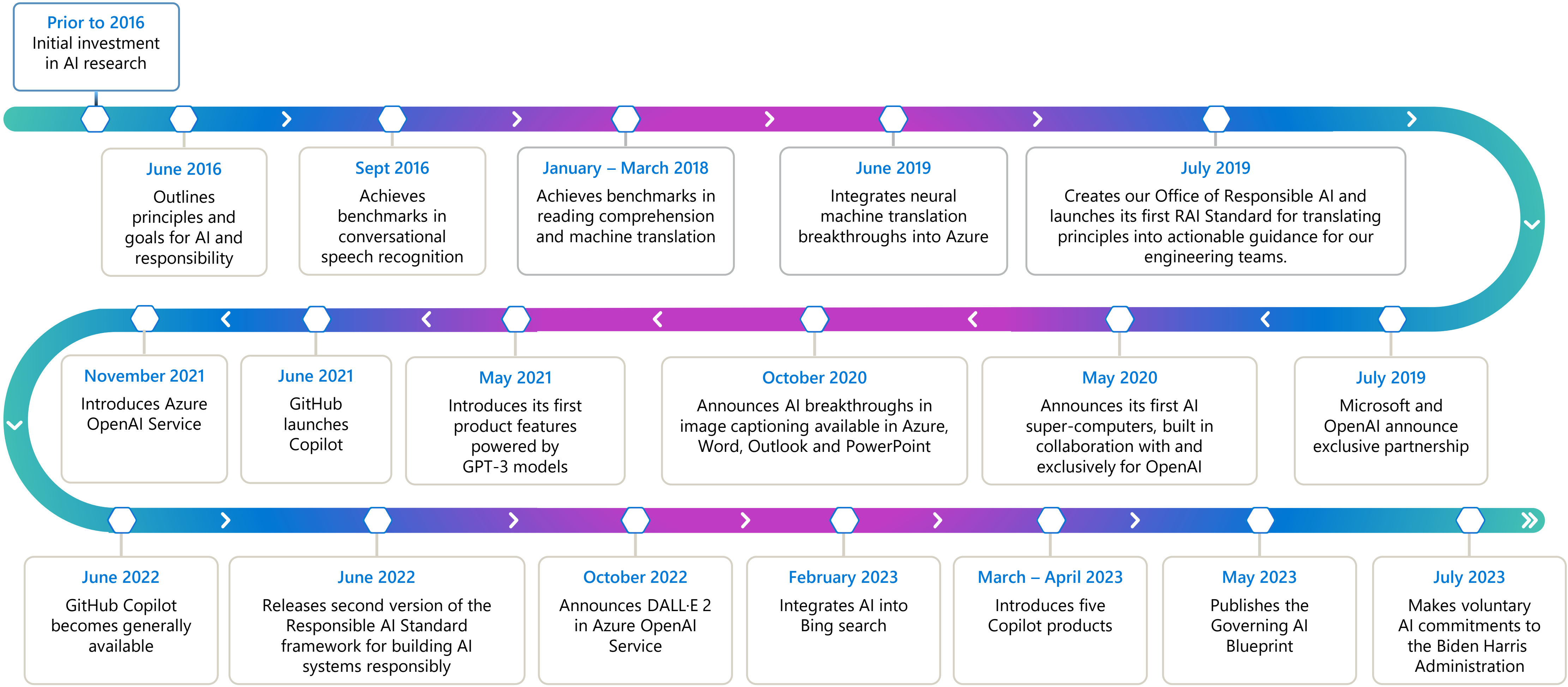
Agenda

- Introduction
- Understanding AI architecture in a security context
- The AI security threat landscape
- How Microsoft secures AI platforms
- Security controls for developers building AI-enabled applications

Introduction



Microsoft's Journey in AI



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Initial investment in AI research

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Outlines principles and goals for AI and responsibility

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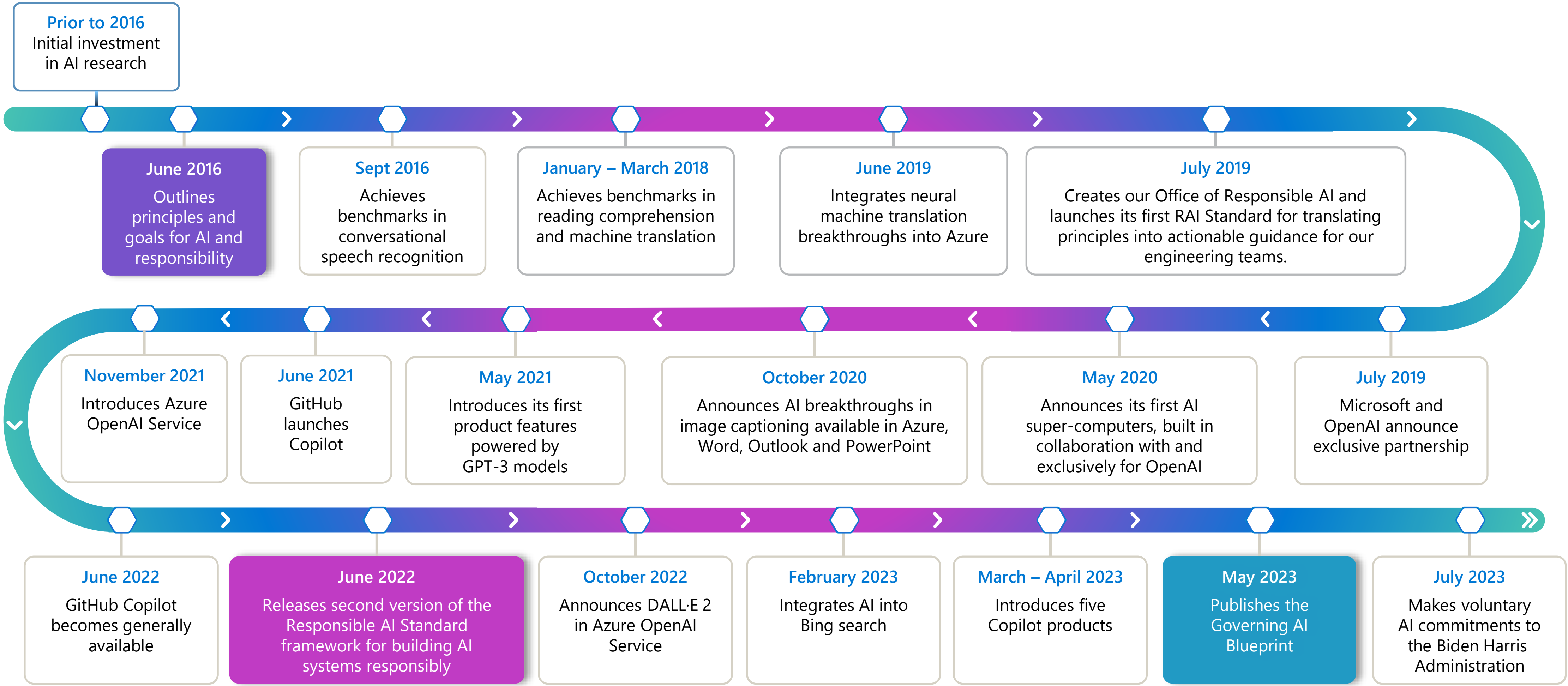

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Microsoft’s Responsible AI Framework

Fairness

AI systems should treat all people fairly.

Reliability & Safety

AI systems should perform reliably and safely.

Privacy & Security

AI systems should be secure and respect privacy.

Inclusiveness

AI systems should empower everyone and engage people.

Transparency

AI systems should be understandable.

Accountability

People should be accountable for AI systems.

Learn More

https://www.microsoft.com/en-us/ai/responsible-ai

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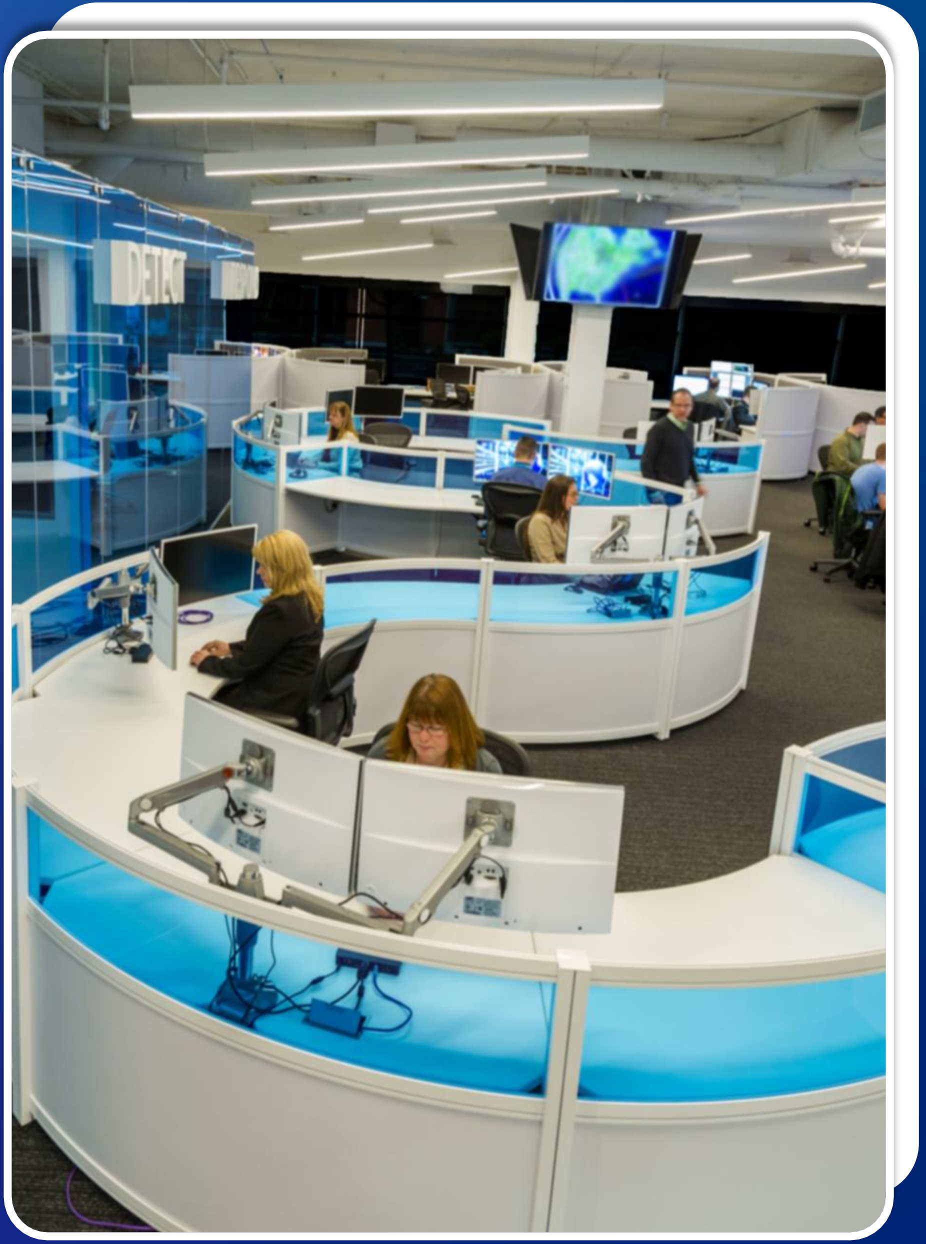
Understanding AI architecture in a security context



AI Architecture Overview

AI Usage

This layer focuses on the user interaction with the AI interface, either standalone or built into existing application UI.

Current Examples:

- Public Access (Bing Chat/ChatGPT/Bard)
- Code Development (GitHub Copilot)
- Microsoft Copilots (Office, Viva, Windows)

AI Application

Development of an AI-integrated application through secured software development practices (SDL). Additional plugins are enabled to provide specific functions and controls.

Current Examples:

- Microsoft development of Copilots
- Customers developing their own products
- 3rd party solution offerings running on Azure

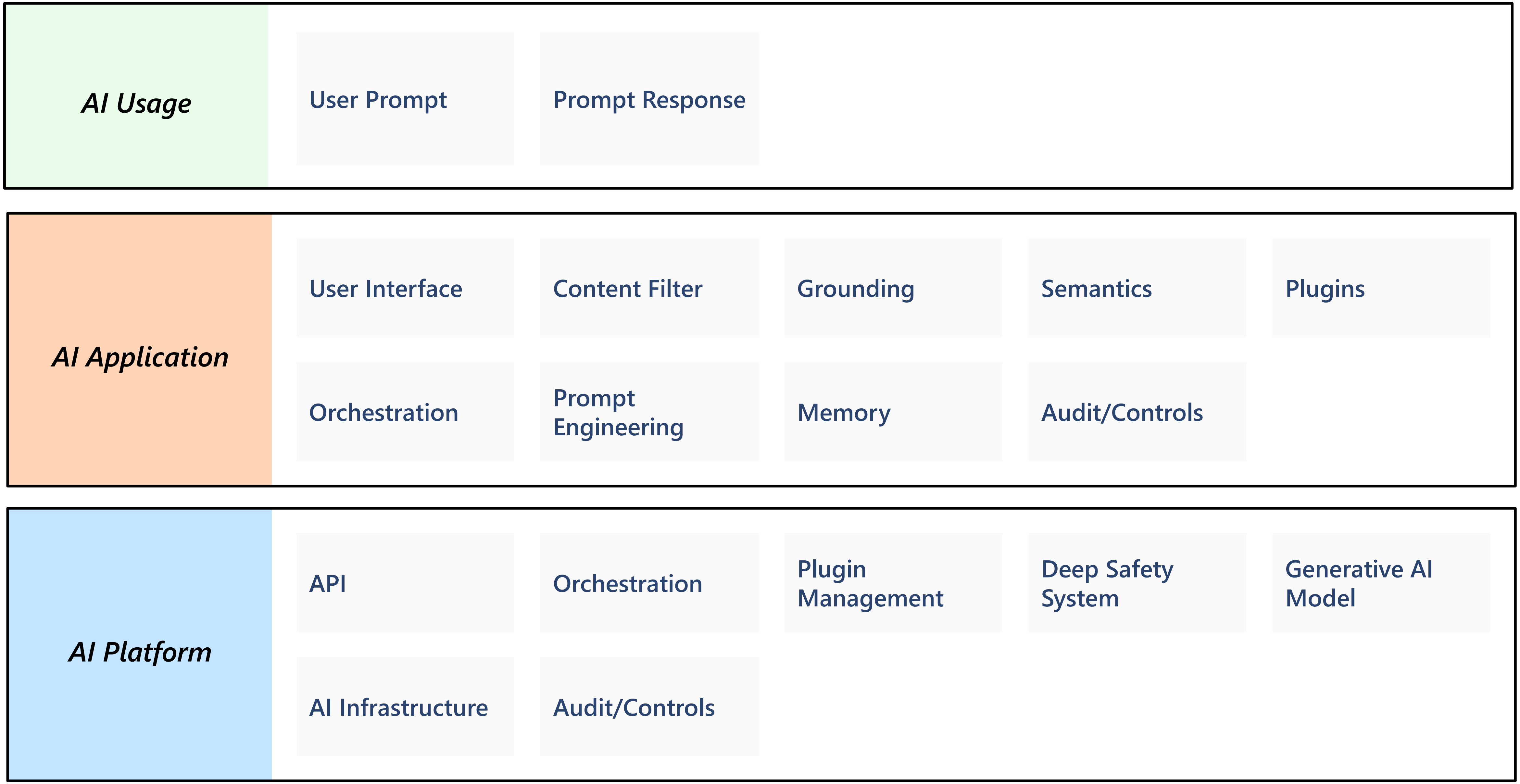
AI Platform

Access to traditional and generative AI models to build your own AI-integrated solutions, running in your compliance boundary on secure and reliable cloud infrastructure.

Current Examples:

- Azure ML Model Catalogue (Hugging Face, Llama 2)
- Azure OpenAI Service (GPT4, ChatGPT, DALL-E)

Detailed AI architecture breakdown



AI Usage

User Prompt

Prompt Response

AI Application

User Interface

Content Filter

Grounding

Semantics

Plugins

Orchestration

Prompt Engineering

Memory

Audit/Controls

AI Platform

API

Orchestration

Plugin Management

Deep Safety System

Generative AI Model

AI Infrastructure

Audit/Controls

AI Shared Responsibility Model

Illustrates which responsibilities are typically performed by an organization and application developer and which are performed by their AI provider (such as Microsoft)

		IaaS (BYO Model)	PaaS (Azure AI)	SaaS (Copilot)
AI Usage	User training and accountability	⬜	⬜	⬜
	Usage policy, admin controls	⬜	⬜	⬜
	Identity, device, and access management	⬜	⬜	◩
	Data governance	⬜	⬜	◩
AI Application	AI plugins and data connections	⬜	⬜	◩
	Application design and implementation	⬜	⬜	🟦
	Application infrastructure	⬜	⬜	🟦
	Application safety systems	⬜	◩	🟦
AI Platform	Model safety and security systems	⬜	◩	🟦
	Model accountability	⬜	⬛	🟦
	Model tuning	⬜	⬛	🟦
	Model design and implementation	⬜	⬛	🟦
	Model Training Data Governance	⬜	⬛	🟦
	AI Compute Infrastructure	◩	🟦	🟦

🟦 Microsoft

⬛ Model Dependent

◩ Shared

⬜ Customer

AI Pain Points

Integration

New technologies and design decisions introduce new risks and vulnerabilities.

User training needs to be adapted to the new capabilities of the AI solutions selected for use by the organization.

Data & Privacy

Sensitive data access and processing via AI systems creates new risks.

Transparency and control needs to be established and maintained through out the lifecycle.

AI Supply Chain

Increased focus on potentially vulnerable or malicious code or 3rd party components.

Lack of compliance standards and rapidly developing best practices.

Trusted AI

Very similar to the early days of BYOD: Employees likely already using GenAI to achieve their tasks.

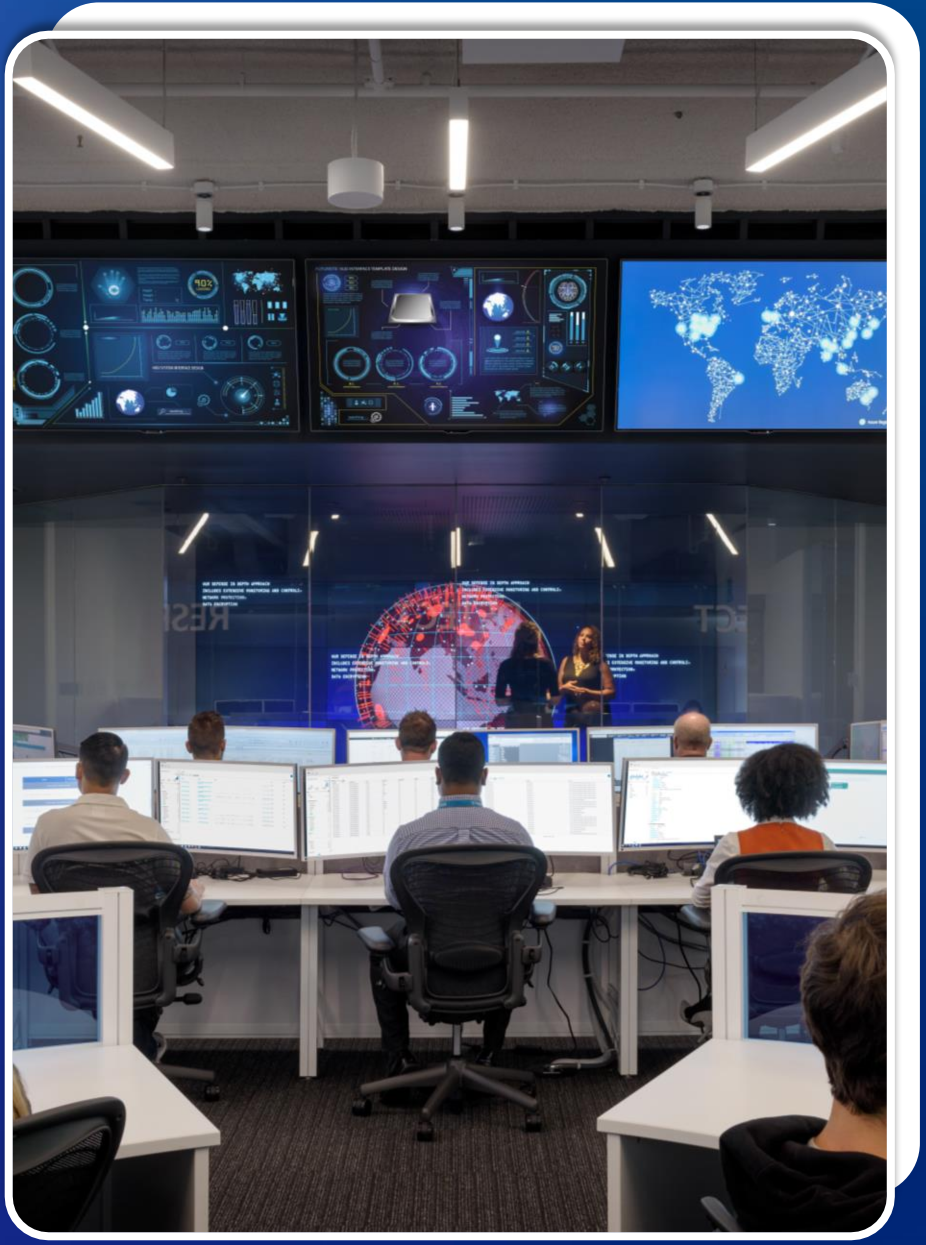
Leaders must establish a trusted pathway to GenAI integrated applications to protect the organization.

The Unknowns

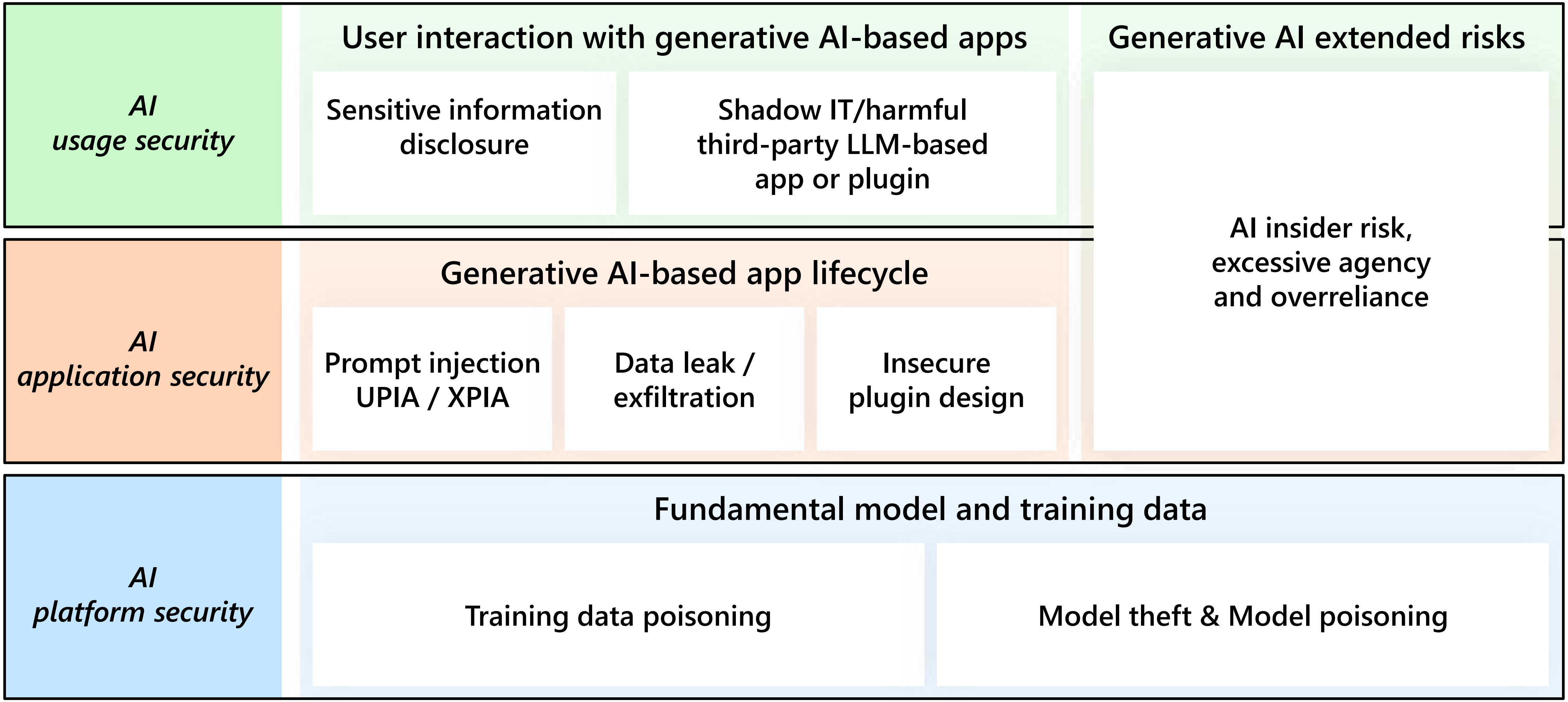
GenAI is new and brings unique challenges such as AI Hallucinations.

Exciting prospects of the potential, the ROI is not yet proven in real-world scenarios.

The AI security threat landscape



Generative AI threat map



AI usage security

User interaction with generative AI-based apps

Sensitive information disclosure

Shadow IT/harmful third-party LLM-based app or plugin

Generative AI extended risks

AI insider risk, excessive agency and overreliance

AI application security

Generative AI-based app lifecycle

Prompt injection UPIA / XPIA

Data leak / exfiltration

Insecure plugin design

AI platform security

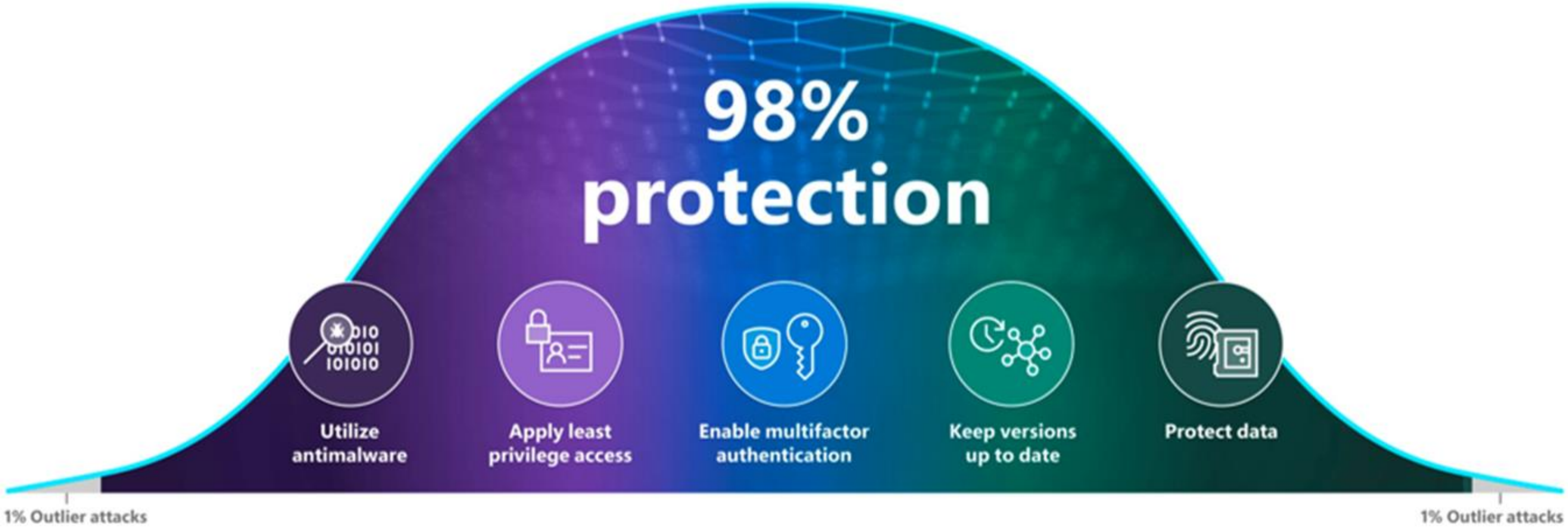
Fundamental model and training data

Training data poisoning

Model theft & Model poisoning

The cybersecurity bell curve

Basic security hygiene still protects against 98% of attacks[1]



Enable multifactor authentication

Make it harder for bad actors to utilize stolen or phished credentials by enabling multifactor authentication. Always authenticate and authorize based on all available data points, including user identity, location, device health, service or workload, data classification, and anomalies.

Apply least privilege access

Prevent attackers from spreading across the network by applying least privilege access principles, which limits user access with just-in-time and just-enough-access (JIT/JEA), risk-based adaptive polices, and data protection to help secure both data and productivity.

Keep up to date

Mitigate the risk of software vulnerabilities by ensuring your organization's devices, infrastructure, and applications are kept up to date and correctly configured. Endpoint management solutions allow policies to be pushed to machines for correct configuration and ensure systems are running the latest versions.

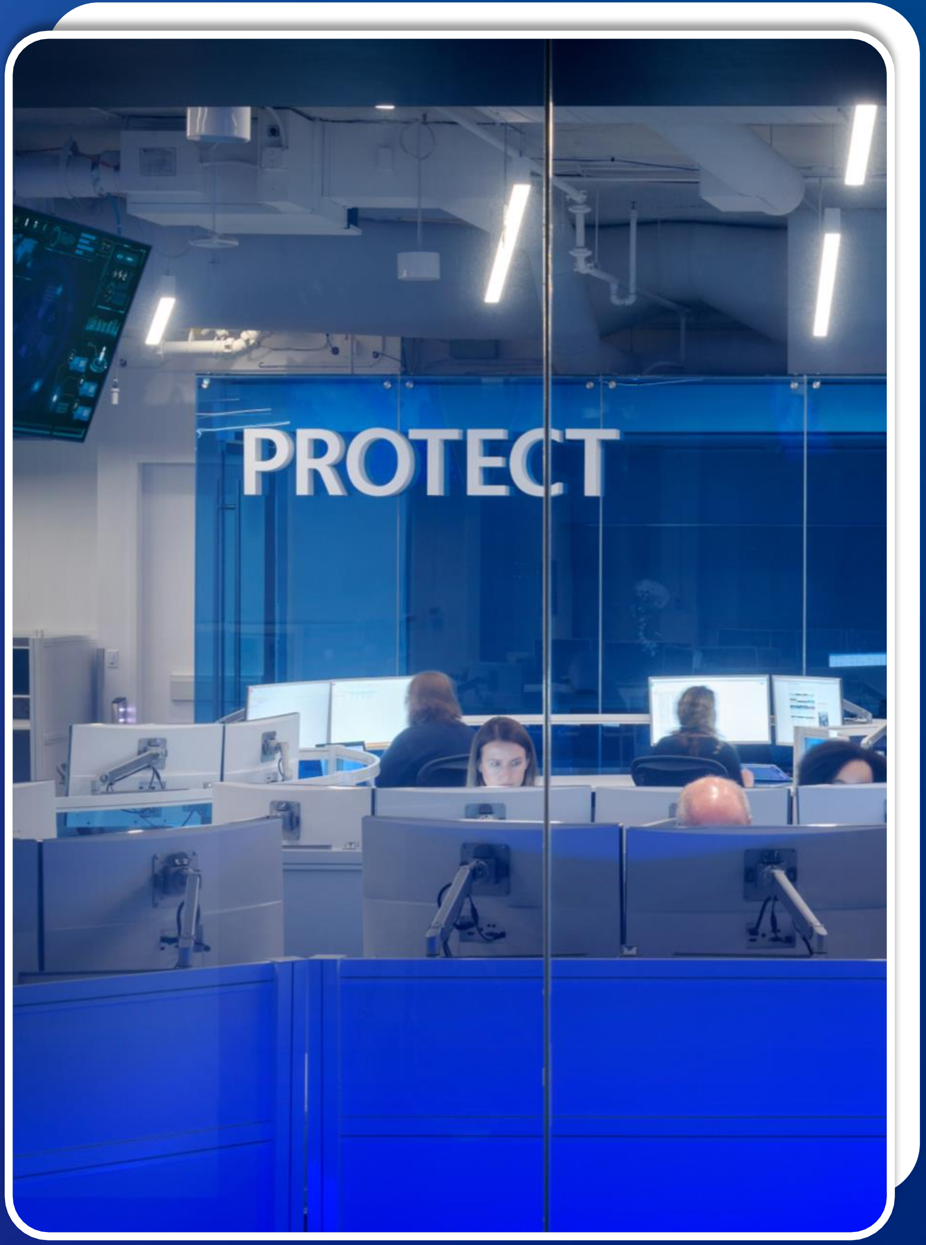
Utilize antimalware

Stop malware attacks from executing by installing and enabling antimalware solutions on endpoints and devices. Utilize cloud-connected antimalware services for the most current and accurate detection capabilities.

Protect data

Know where your sensitive data is stored and who has access. Implement information protection best practices such as applying sensitivity labels and data loss prevention policies. If a breach does occur, it's critical that security teams know where the most sensitive data is stored and accessed.

How Microsoft secures AI platforms



Building new principles for AI security

Ensure your data is *your* data

Microsoft will not use customers data to train the foundational AI models, without explicit consent. Data governance is a shared responsibility.

Customer:

Protect your data as a top priority. Ensure it remains private and controlled, end to end.

Be secure by design

The Microsoft AI stack is designed and built on decades of secure software practices, and a strong supply chain of partners, following mature SDL tools and processes.

Customer:

Ask for transparency in every AI system you connect to your data, for the whole AI supply chain.

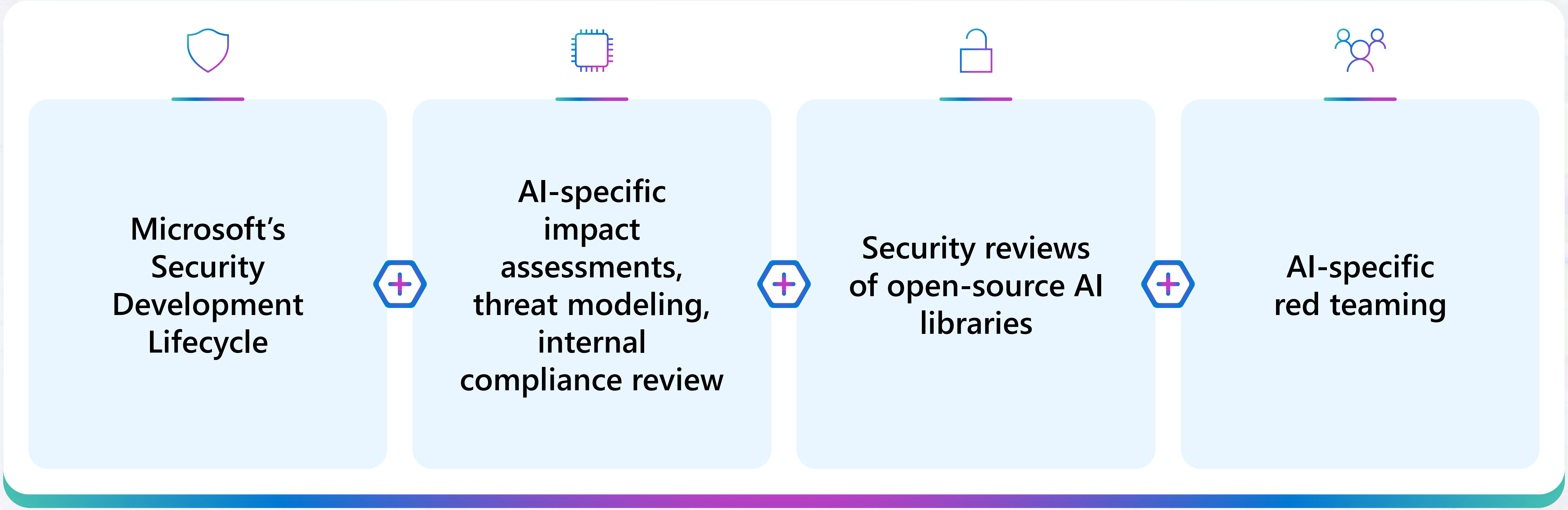
Secure by intention and in practice

Microsoft grounds its efforts to advance AI in strong principles that govern the technology's implementation and use: Positioning people at the center of the equation.

Customer:

Strong Zero Trust, and Data Governance programs will matter more than ever.

How does Microsoft address risks from attackers?



Microsoft's Security Development Lifecycle

+

AI-specific impact assessments, threat modeling, internal compliance review

+

Security reviews of open-source AI libraries

+

AI-specific red teaming

How does Microsoft address risks from the use or misuse of AI?

Example: Overreliance

Using AI to justify a viewpoint or action

Assuming the AI must fair or accurate

AI doing something that the user can't meaningfully check.

User is simply too busy to check it carefully

Microsoft Approach

Ground on authoritative data sources

Provide greater transparency and explainability

Design UX interfaces to mitigate overreliance

How does Microsoft address risks from the use or misuse of AI?

Example: Hostile Misuse

Hostile misuse involves using AI system to intentionally to cause harm including circumventing safeguards.

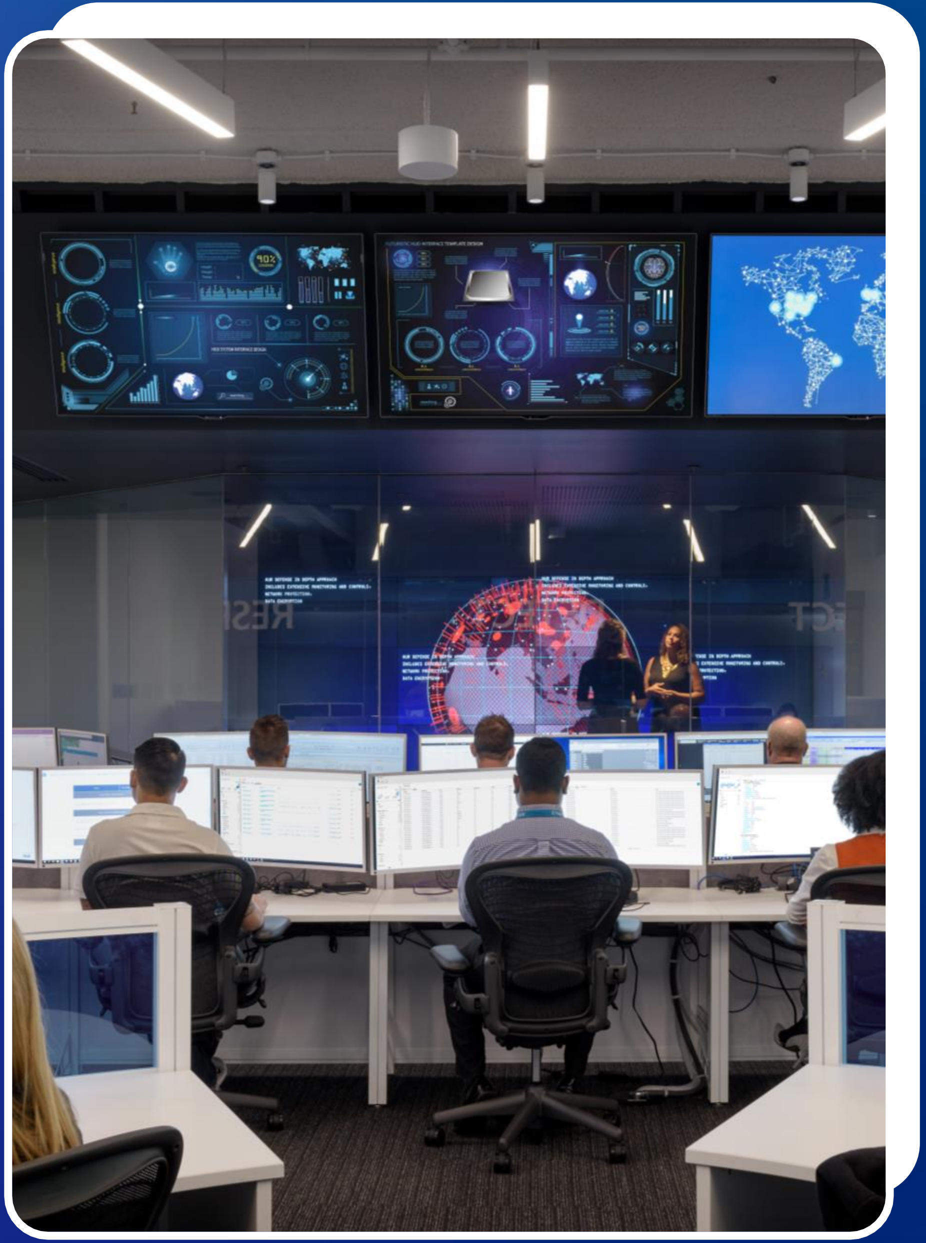
Generating malicious code	Asking instructions for harmful purposes

Microsoft Approach

Microsoft has invested heavily in a defense in depth approach including a deep safety layer that provides security by default to disallow the AI to perform tasks that are harmful or dangerous to the user, intentionally deceptive, or likely to adversely affect the public interest

Acceptable Use Policy governs AI usage

Microsoft's AI Red Teaming Approach



Security Community view of Red Teaming

Double Blind

Emulate real world adversaries

Mature toolkit and processes

RAI Community view of Red Teaming

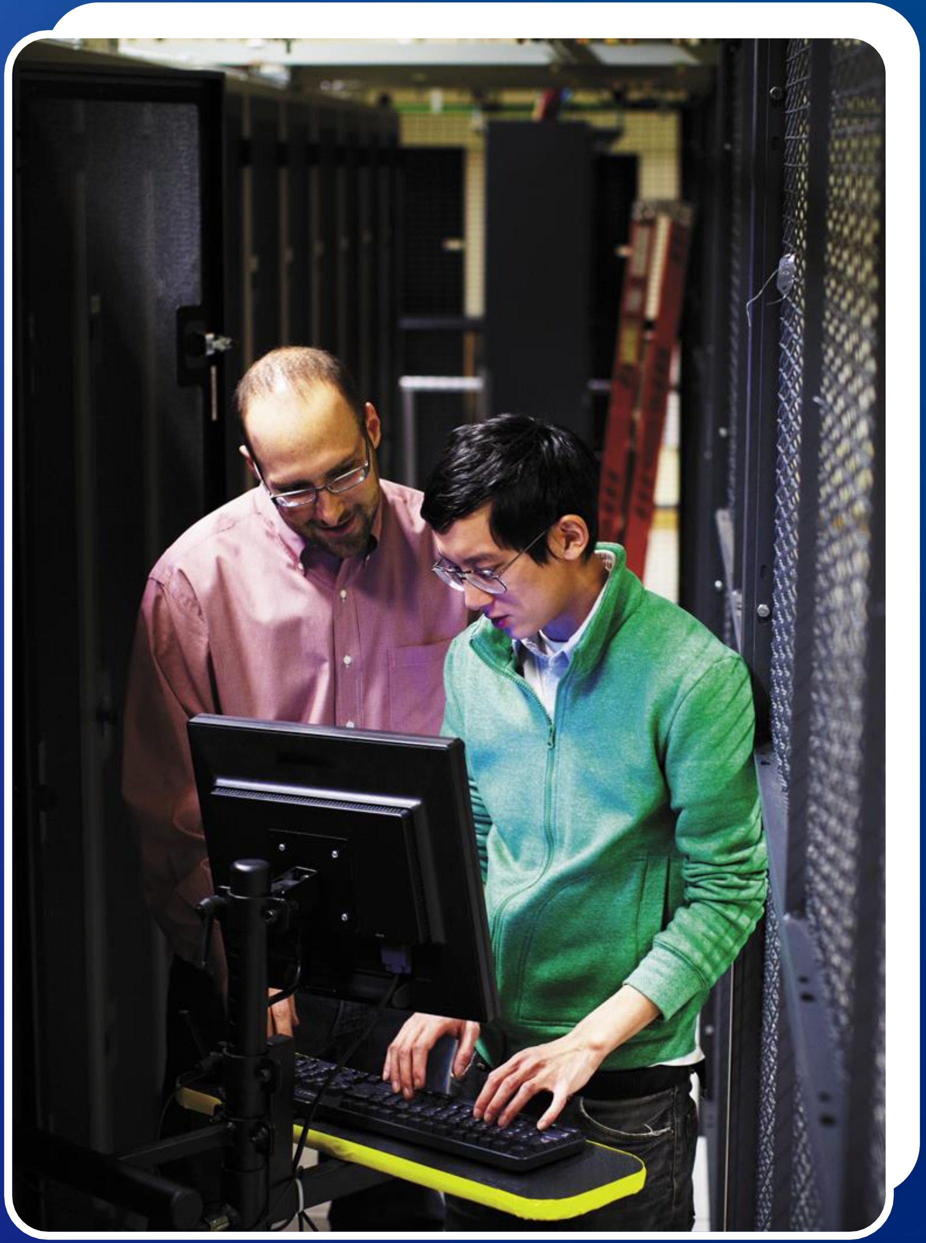
Generally single blind

Adversarial and Benign

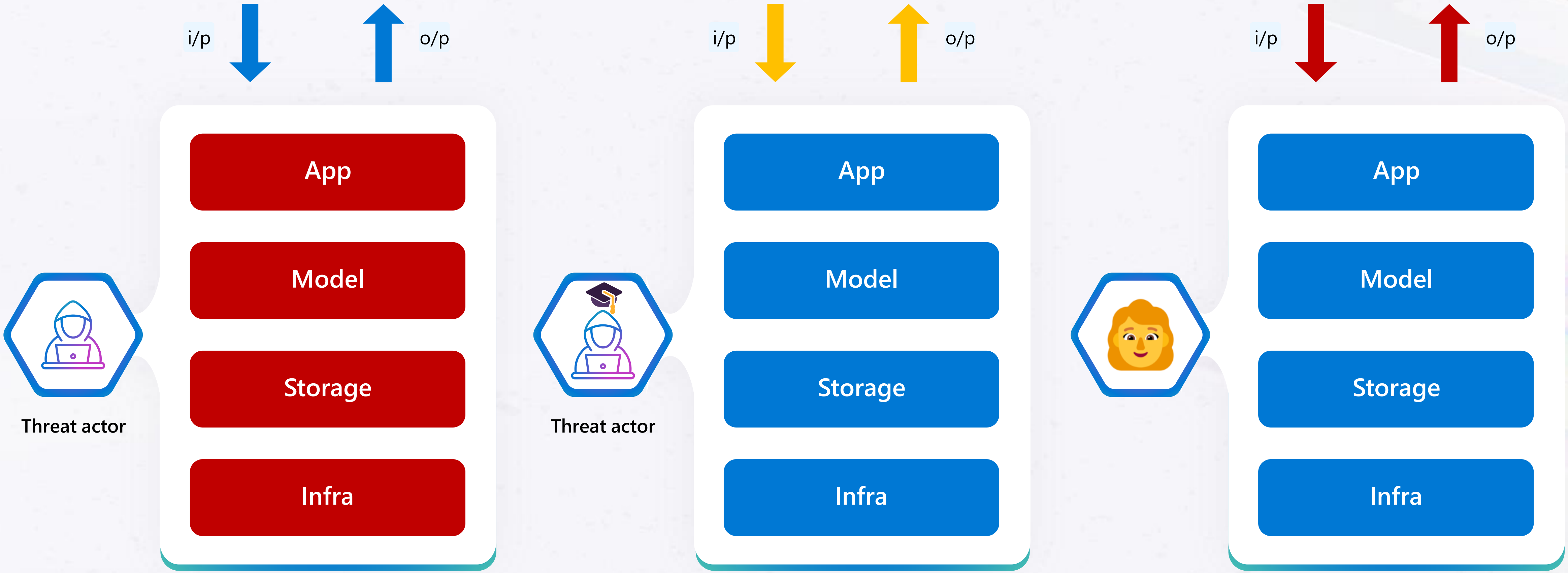
Rapidly Evolving Tools and processes

AI Red Teaming combines the best of both worlds

AI Red Team = Probing for Security + Responsible AI Harms



Three Flavors of AI Red Teaming



"Full Stack"

e.g., noisy neighbor DoS

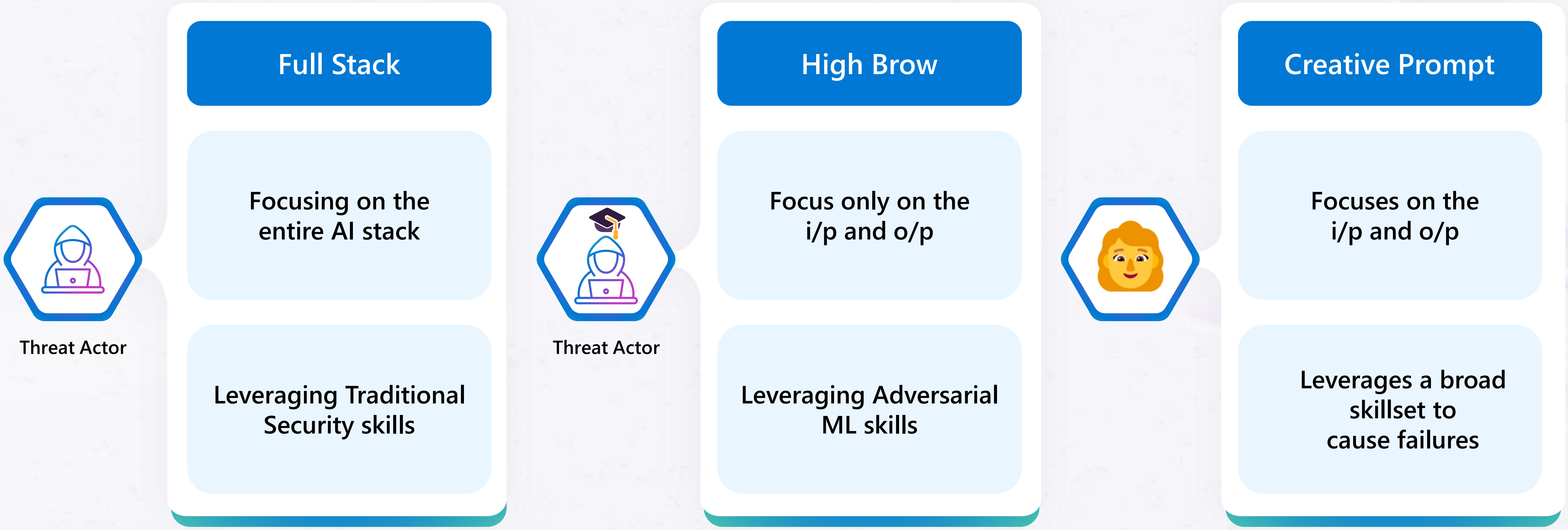
"High Brow"

e.g., model evasion

"Creative Prompts"

e.g., guilting, gaslighting

Three Flavors of AI Red Teaming



Threat Actor

Full Stack

Focusing on the entire AI stack

Leveraging Traditional Security skills

Threat Actor

High Brow

Focus only on the i/p and o/p

Leveraging Adversarial ML skills

Creative Prompt

Focuses on the i/p and o/p

Leverages a broad skillset to cause failures

AI-specific red teaming hardens the effectiveness of security protections

Expands the definition and scope for AI

Focuses on failures from both malicious and benign personas

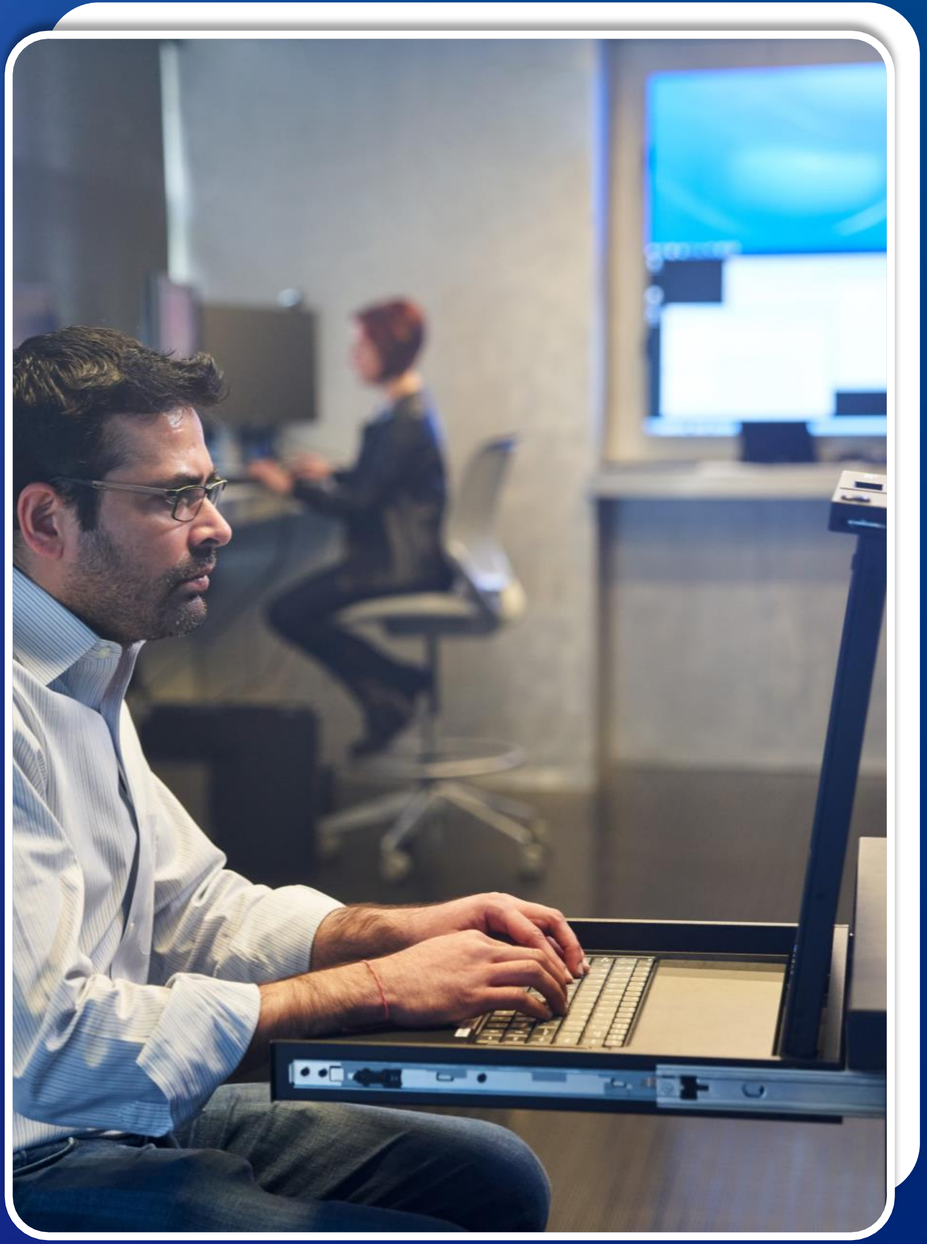
Recognizes that AI systems are constantly evolving

Learn More

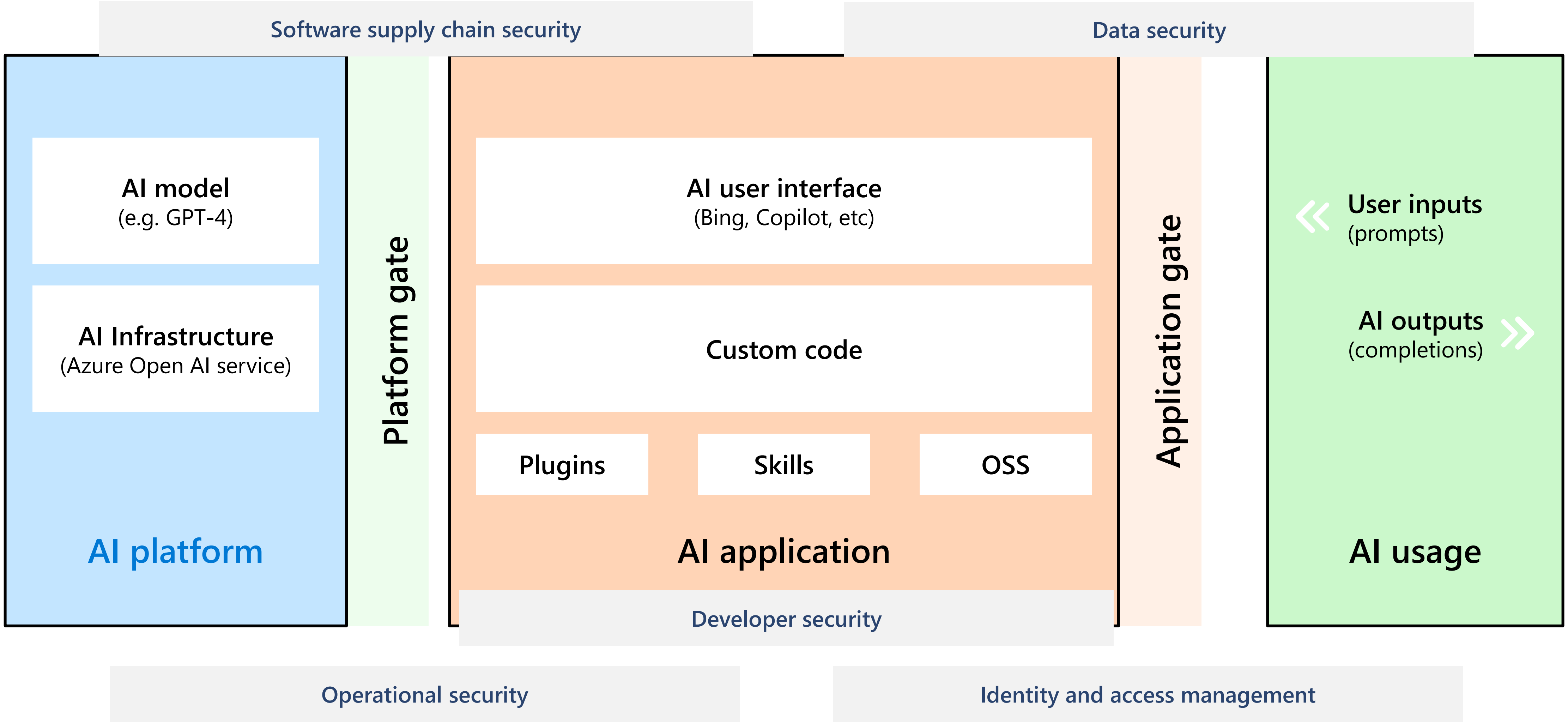
https://www.microsoft.com/en-us/security/blog/2023/08/07/microsoft-ai-red-team-building-future-of-safer-ai/

https://www.microsoft.com/en-us/security/blog/2024/02/22/announcing-microsofts-open-automation-framework-to-red-team-generative-ai-systems/

Security controls for developers building AI-enabled applications

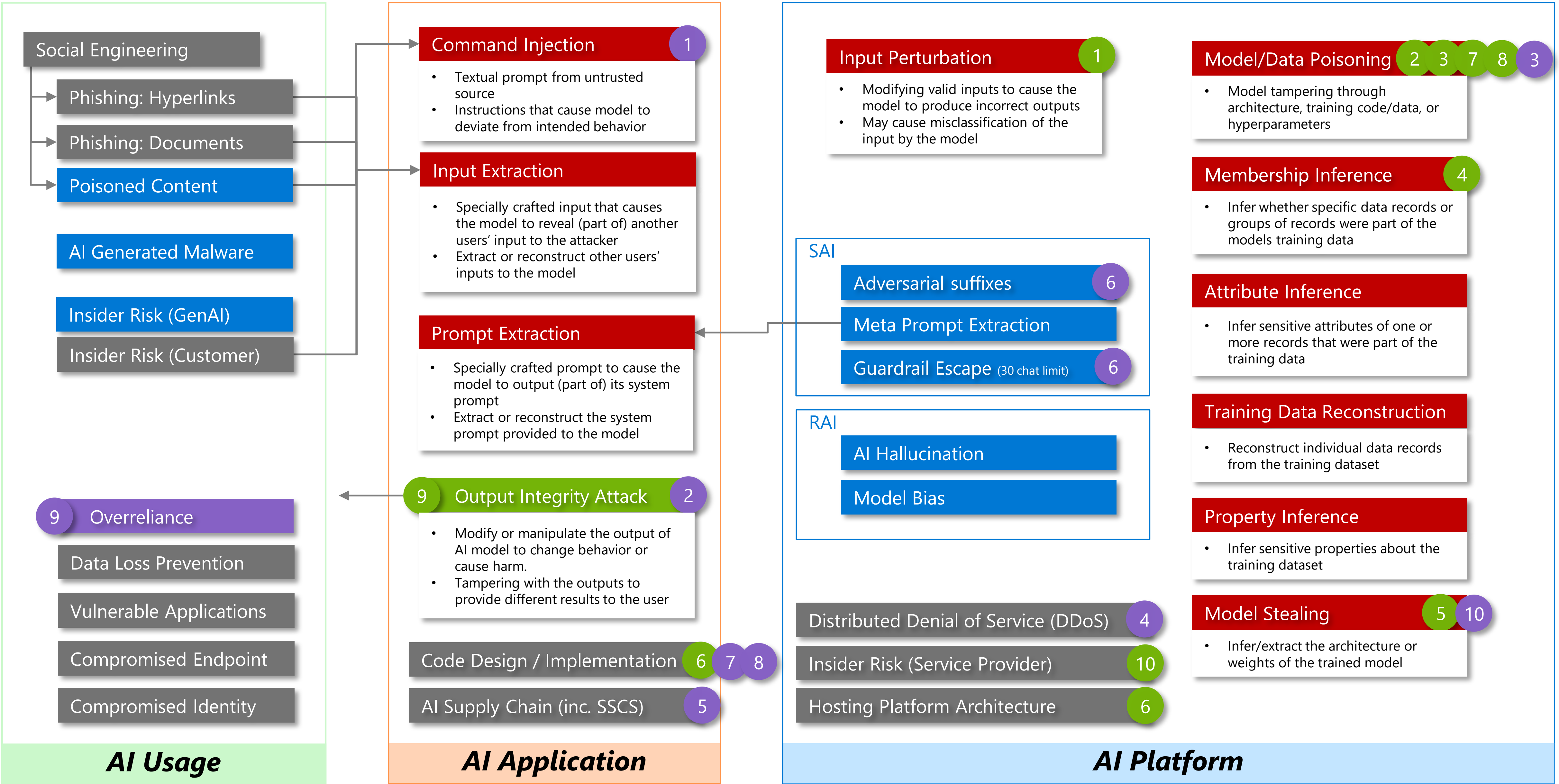


Security controls within AI systems



Threat Modelling Scenarios

- MSRC AI Bug Bar
- OWASP Top 10 for ML
- Generative AI Specific
- MITRE ATLAS
- OWASP Top 10 for LLM
- Common Cyber Threats



AI Usage

Social Engineering

- Phishing: Hyperlinks
- Phishing: Documents
- Poisoned Content

AI Generated Malware

Insider Risk (GenAI)

Insider Risk (Customer)

9 Overreliance

Data Loss Prevention

Vulnerable Applications

Compromised Endpoint

Compromised Identity

AI Application

Command Injection 1

- Textual prompt from untrusted source
- Instructions that cause model to deviate from intended behavior

Input Extraction

- Specially crafted input that causes the model to reveal (part of) another users' input to the attacker
- Extract or reconstruct other users' inputs to the model

Prompt Extraction

- Specially crafted prompt to cause the model to output (part of) its system prompt
- Extract or reconstruct the system prompt provided to the model

9 **Output Integrity Attack** 2

- Modify or manipulate the output of AI model to change behavior or cause harm.
- Tampering with the outputs to provide different results to the user

Code Design / Implementation 6 7 8

AI Supply Chain (inc. SSCS) 5

AI Platform

Input Perturbation 1

- Modifying valid inputs to cause the model to produce incorrect outputs
- May cause misclassification of the input by the model

SAI

- Adversarial suffixes 6
- Meta Prompt Extraction
- Guardrail Escape (30 chat limit) 6

RAI

- AI Hallucination
- Model Bias

Distributed Denial of Service (DDoS) 4

Insider Risk (Service Provider) 10

Hosting Platform Architecture 6

Model/Data Poisoning 2 3 7 8 3

- Model tampering through architecture, training code/data, or hyperparameters

Membership Inference 4

- Infer whether specific data records or groups of records were part of the models training data

Attribute Inference

- Infer sensitive attributes of one or more records that were part of the training data

Training Data Reconstruction

- Reconstruct individual data records from the training dataset

Property Inference

- Infer sensitive properties about the training dataset

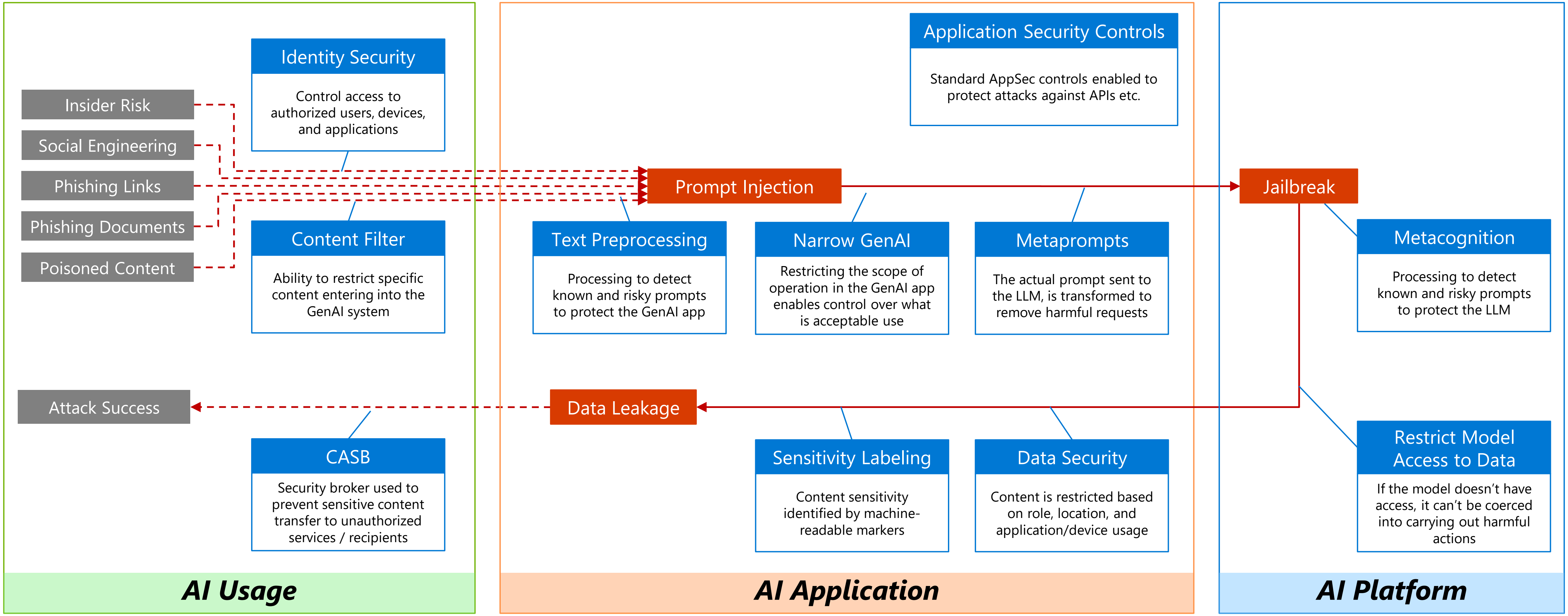
Model Stealing 5 10

- Infer/extract the architecture or weights of the trained model

Threat Mapping Template

This framework provides a repeatable method of articulating both the vulnerabilities (red) and the mitigations (blue)

Prompt Injection Attack (UPIA / XPIA)	Attacking Fusion and Metaprompt	Metacognition, text preprocessing, metaprompts, and filters
Jailbreaks	Convince the system to do something the designers didn't intend	XPIA defenses, Narrow GenAI, Identity & Data Security
Data Leakage	Exposure outside of data controls	Sensitivity labelling, data security, content filtering, app security, restrict model access to data



Insider Risk

Social Engineering

Phishing Links

Phishing Documents

Poisoned Content

Identity Security

Control access to authorized users, devices, and applications

Content Filter

Ability to restrict specific content entering into the GenAI system

Attack Success

CASB

Security broker used to prevent sensitive content transfer to unauthorized services / recipients

AI Usage

Application Security Controls

Standard AppSec controls enabled to protect attacks against APIs etc.

Prompt Injection

Text Preprocessing

Processing to detect known and risky prompts to protect the GenAI app

Narrow GenAI

Restricting the scope of operation in the GenAI app enables control over what is acceptable use

Metaprompts

The actual prompt sent to the LLM, is transformed to remove harmful requests

Data Leakage

Sensitivity Labeling

Content sensitivity identified by machine-readable markers

Data Security

Content is restricted based on role, location, and application/device usage

AI Application

Jailbreak

Metacognition

Processing to detect known and risky prompts to protect the LLM

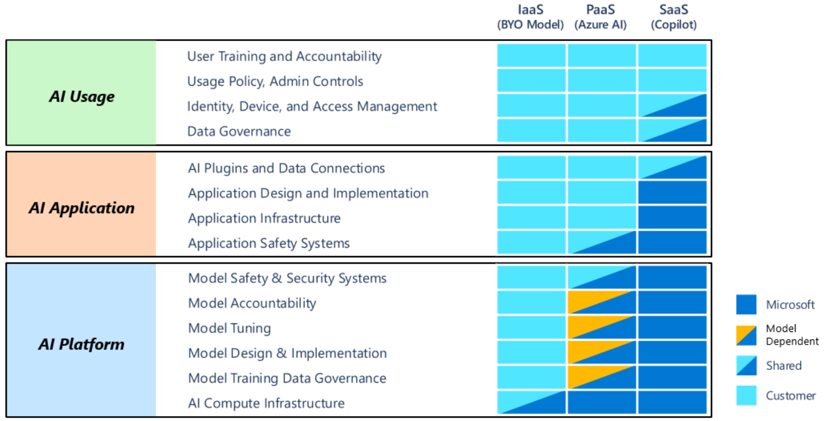
Restrict Model Access to Data

If the model doesn't have access, it can't be coerced into carrying out harmful actions

AI Platform

End-to-End Secure AI

SaaS (Copilot)



		IaaS (BYO Model)	PaaS (Azure AI)	SaaS (Copilot)
AI Usage	User Training and Accountability	□	□	□
	Usage Policy, Admin Controls	□	□	□
	Identity, Device, and Access Management	□	□	◪
	Data Governance	□	□	◪
AI Application	AI Plugins and Data Connections	□	□	◪
	Application Design and Implementation	□	□	■
	Application Infrastructure	□	□	■
	Application Safety Systems	□	◪	■
AI Platform	Model Safety & Security Systems	□	◪	■
	Model Accountability	□	◩	■
	Model Tuning	□	◩	■
	Model Design & Implementation	□	◩	■
	Model Training Data Governance	□	◩	■
	AI Compute Infrastructure	◪	■	■

■ Microsoft
◩ Model Dependent
◪ Shared
□ Customer

User Training	Customer needs to update their internal training to help users become productive with AI
Accountability	The user needs to remain accountable for the input and use of the output with AI
AI Acceptable Use Policy	Developing an AI Acceptable Use Policy is important for the identification of bad behavior
Administrative Controls	Configuration must be secure by default, with clear guidance to administrators for changes
Identity & Access Management	Built-in capabilities ensure customers can enable high-security controls
Data Governance	Copilot solutions honor the data governance of the existing solution they are created for

AI Usage

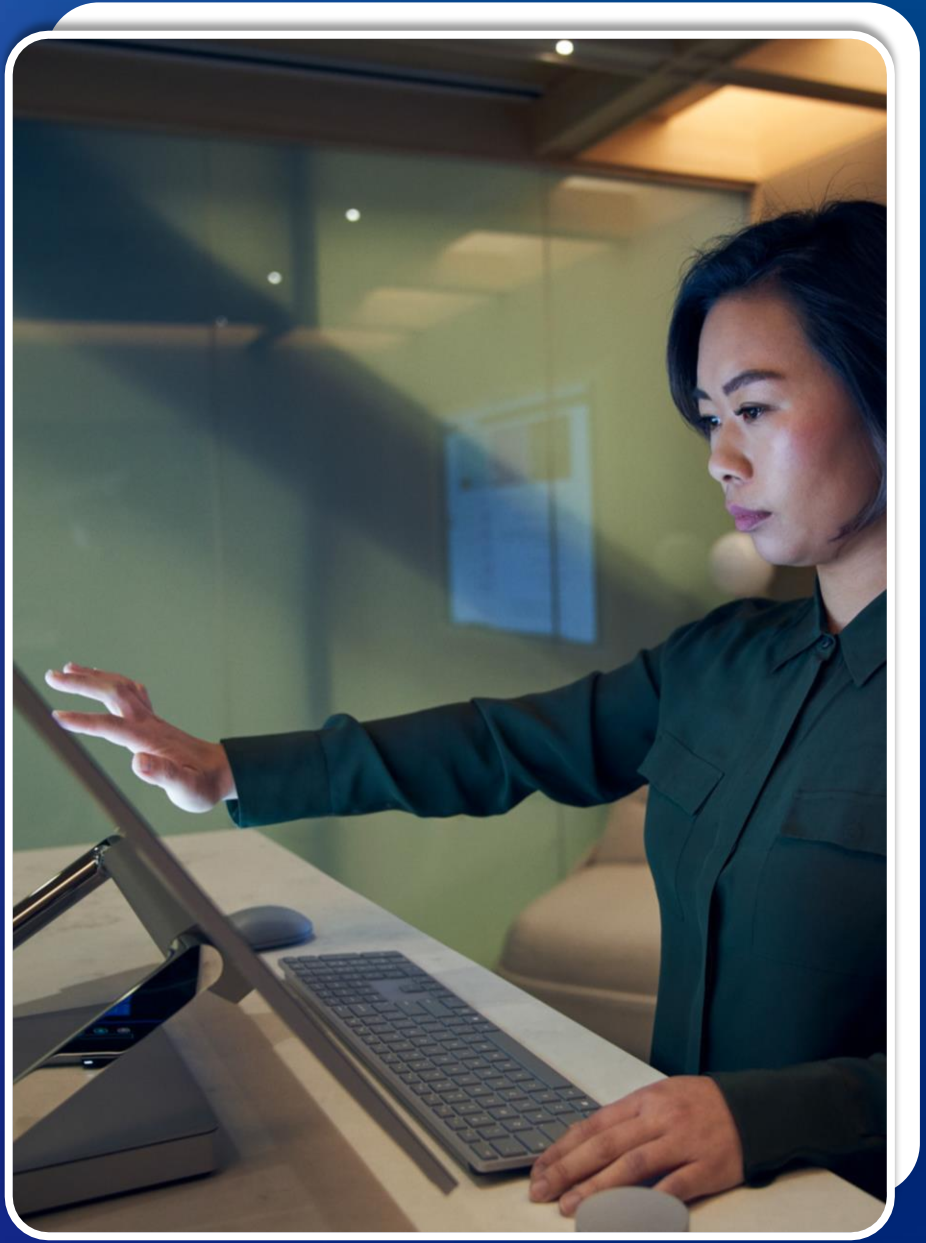
AI Plugins	Extending functionality via plugins must be carefully considered to protect integrity
Data Connectors	Internal and external data connectors must be carefully considered to protect data
Application Design & Implementation	Copilot solutions are developed following strict SDL governance with a deployment safety review board and AI Red Team
Application Infrastructure	Copilot solutions are made highly available, secure, and monitored from code to cloud
Application Safety Systems	Copilot specific safety systems are used to add additional layers of defense for AI

AI Application

Model Safety & Security Systems	The copilot inherits the safety and security systems built to protect the LLM
Model Accountability	Microsoft offers the pre-trained LLM capabilities as a private hosting
Model Tuning	For copilot solutions, models are not tuned, instead we use semantics and grounding
Model Design & Implementation	Microsoft builds, implements, and support the entire copilot stack end to end
Model Training Data Governance	Copilot runs on pre-trained LLM. Microsoft does not access the model or training data.
AI Compute Infrastructure	Azure has vast GPU resources to scale AI compute.

AI Platform

Wrap up



Security for AI is an ever-evolving process

Develop

Continually evolving secure by design and by default requirements

Test

Continual assessment and AI-specific red teaming

Monitor/Respond

Analyze 65T+ threat signals, respond to incidents

Evolve

Learn, share, collaborate

Further reading

- [Microsoft Security Copilot documentation | Microsoft Learn]
- [AI shared responsibility model – Microsoft Azure | Microsoft Learn]
- [Best practices for AI security risk management | Microsoft Security Blog]
- [aka.ms/copilotl33tsp34k]

Register for our AI security webinar series

Copilot L33T Sp34k is a new webinar series where we interview industry experts about how to use AI securely and how organizations should use AI, like Microsoft Copilot for Security, to enhance their security.

aka.ms/copilotl33tsp34k

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aka.ms/LearnAtAITour

Join the Azure AI Community on Discord

Connect with fellow enthusiasts, engage with Microsoft experts and MVPs, discuss your favorite sessions, and delve into AI discussions. Your space to ask, share, and explore!

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