The What, Why and How of Phishing-Resistant MFA

A Tale of FIDO, PIV, CBA, WHfB, and more

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Phishing attacks are on the rise around the globe, and they are becoming **more efficient and more costly to organizations that are unprepared**. Cybersecurity advisors and watchdogs, including the White House Office of Management and Budget, NIST, and CISA are well aware of the escalating threat. They advise security executives to prioritize a **technology-centric defense strategy**. But with so many options available – many of which have critical gaps that can be exploited by bad actors – how do you move forward in a pragmatic fashion? This eBook leverages insights from some top security insiders to help you prepare.

What: Key Elements of Phishing Attacks

The Fundamentals of Phishing

Phishing is a malicious activity that uses some form of social engineering to gain access to personal, sensitive, or proprietary information; or the goal may be to penetrate the victim's infrastructure and deploy malevolent software such as ransomware. It can target a specific person or group (called spear phishing) by leveraging details that aren't widely known to create a false sense of security, or it can apply to a wide population. Other variations include vishing, trap phishing, whaling phishing and email phishing scams.

These ill-natured attacks can come in many forms. The most common, according to **National Institute of Standards and Technology (NIST)**, are the following:

Impersonated Website

The use of fake authenticators at illegitimate websites.

Adversary-in-the Middle

When an adversary captures authentication data from the user and relays it to an illegitimate website.

User Entry

When authentication data is manually entered, which can be compromised.

Replay

The use of captured authentication data at a later point in time.

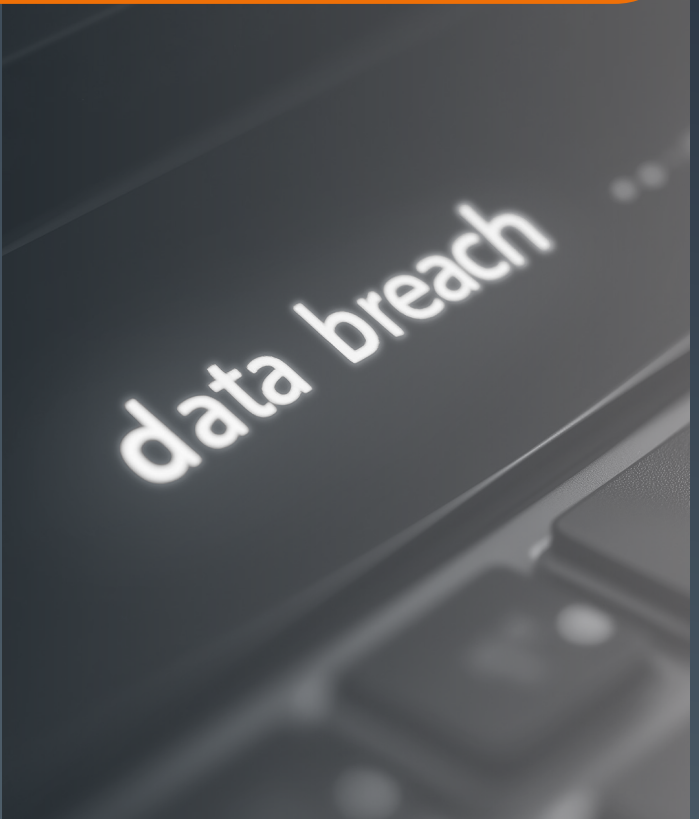
Another emerging threat vector to be aware of, which is a close cousin to phishing attacks, is called **prompt bombing**. This strategy is designed to circumnavigate multi-factor authentication (MFA) with sheer force. By methodically and continuously sending second-factor authentication requests to a user by email or phone (OTP) in a condensed time frame, the sender is counting on the user to become frustrated and approve the request. This can provide the **"keys to the kingdom"** with access to a variety of applications, systems and services, and it can also provide additional information that can be leveraged for a successful phishing attack.

At the root of each of these examples is a well-tuned strategy executed by cybercriminals to subvert the authentication process.

A Brief History of Successful Phishing Attacks

Phishing attacks aren't new. Some of the most-famous attacks are now almost a decade old and materially impacted the targeted organizations.

Here are a few:



Colonial Pipeline: 2021
Access to an employee's password, likely from a phishing email, led to a ransomware attack that crippled a major U.S. fuel supplier in 2021 and led to a $4.4M ransom – plus untold millions in operational and reputational damages.

Twilo: 2022
Cloud communications company Twilio said its customers' data was accessed by attackers who stole employee credentials in an SMS phishing attack. Twilio enables companies like Uber, Airbnb and Twitter to send SMS messages and phone calls over a telephone network.

Uber: 2022
An MFA push-bombing attack – a targeted type of spear-phishing attack, also called Prompt-bombing or MFA Fatigue – resulted in an Uber contract developer being compromised. This attack exposed sensitive data, disrupted internal operations, and opened the door to years of litigation.

Change Healthcare: 2024
This incident took down payment systems for several days and resulted in the CEO testifying before Congress that "roughly one-third" of all Americans had been affected. 100 million Americans were affected by the breach, making it the largest healthcare breach on record.

Twilo (again): 2024
Twilio suffered another data breach after hackers leaked 33 million phone numbers associated with Twilio's free mobile authentication app, Authy. Authy's mission? To provide "two-factor authentication to protect your accounts from fraud and identity theft.

Today, phishing remains a top concern for security professionals. A Verizon 2023 Data Breach Investigations Report lists phishing and stolen credentials as two of the four **"key pathways"** that organizations must be prepared to address in order to prevent breaches[1].

In many cases, employee training may have helped prevent the damage. But usually, training alone isn't enough to fend off sophisticated attackers who leverage an array of resources, information, and tactics that would rival a spy novel. To counter these attacks, technology must be leveraged as well.

1. Verizon: Data Breach Investigations Report: January 2023

Why: Reasons to Prioritize Phishing Resistance

Overwhelming Market Data

In a 2022 security report, phishing was cited as the second-most common cause of a breach (compromised credentials was number one), but it was also captured as the most expensive to an organization at an average cost of $4.91M[2].

This aligns with other market data that has been published recently. In a 2022 identity security report[3], for instance, it was reported that:

"An alarming 84% said their organization had experienced an identity-related breach in the past year. When asked what kind of breach, the most common answer was phishing attacks (59%), whether broad-based attacks or spear phishing."

2. IBM: Cost of a Data Breach Report, July 2022
3. Identity Defined Security Alliance: Trends in Securing Digital Identities, 2022

It's not just that the number of phishing related attacks is increasing, but the concern also stems from the fact that they can be highly effective. The U.S. Cybersecurity and Infrastructure Security Agency (CISA) noted that 80% of organizations had at least one individual who fell victim to a phishing attempt by CISA Assessment teams[4]. That's why there is a long list of successful breaches reported in the last few years, including Twilio, Acorn Financial Services, Mailchimp, and more.

$4.9M

Average cost of phishing attack[5].

59%

Experienced a phishing attack in last year[6].

4. CISA: Phishing Infographic, 2022
5. Identity Defined Security Alliance: Trends in Securing Digital Identities, 2022
6. CISA: Phishing Infographic, 2022

Cybersecurity-Related Watchdog/Regulator Guidance

As the risk on the ground has increased, organizations that are designed to help fight the battle against phishing-based attacks are responding in kind. In January 2022, the U.S. White House Office of Management and Budget (OMB) issued a memorandum[7] that addressed the concept of phishing resistance 23 times – in just 29 pages of total text. This guidance, formulated based on the research of many top minds in cybersecurity, is most applicable to the U.S. Federal Government, as related organizations must comply with the guidance by the end of the fiscal year 2024. But organizations doing business with the federal government, and in fact those organizations that simply want to adhere to emerging best practices, are also in line of sight.

CISA followed that guidance by stating in an October 2022 alert that it "strongly urges all organizations to implement phishing-resistant MFA to protect against phishing and other known cyber threats'"[8]

And in January 2023, NIST issued a blog[9] on the importance of implementing phishing-resistant authenticators. In this blog, NIST noted:

"Due to their effectiveness and simplicity, phishing attacks have rapidly become the tool of choice for baddies everywhere. As a tactic, it is used by everyone from low-level criminals looking to commit fraud, to the sophisticated nation state attackers seeking a foothold within an enterprise network."

Three different authorities on cybersecurity lining up behind a single topic within a short period of time – with strong caution and guidance – is meaningful. It tells you that phishing-based attacks aren't isolated and/or going away anytime soon.

7. Executive Office of the President Office of Management and Budget: Memorandum, 2022
8. CISA: CISA Releases Guidance on Phishing-Resistant and Numbers Matching Multifactor Authentication, October 2022
9. NIST: Phishing Resistance – Protecting the Keys to Your Kingdom, February 2023

A Countermeasure to Hidden Costs

Naturally, the primary and most visible costs of a phishing attack – for organizations that were unsuccessful in thwarting such an attack – are incurred shortly after a breach. Employee downtime, opportunity cost, and impact to brand is often significant. Fines and sanctions are also possible.

But a new and increasingly important cost to organizations is also starting to surface earlier on, even for those who are unscathed by such an attack: the increased cost for cyber insurance. As the volume and voracity of phishingbased attacks has increased, these entities have been subject to massive and repetitive financial payouts. As a result, cyber insurance providers have raised the bar on security for companies before they can be insured, and they have materially increased premiums as well – with many rates having gone up anywhere from 50-100 percent in the last several years.

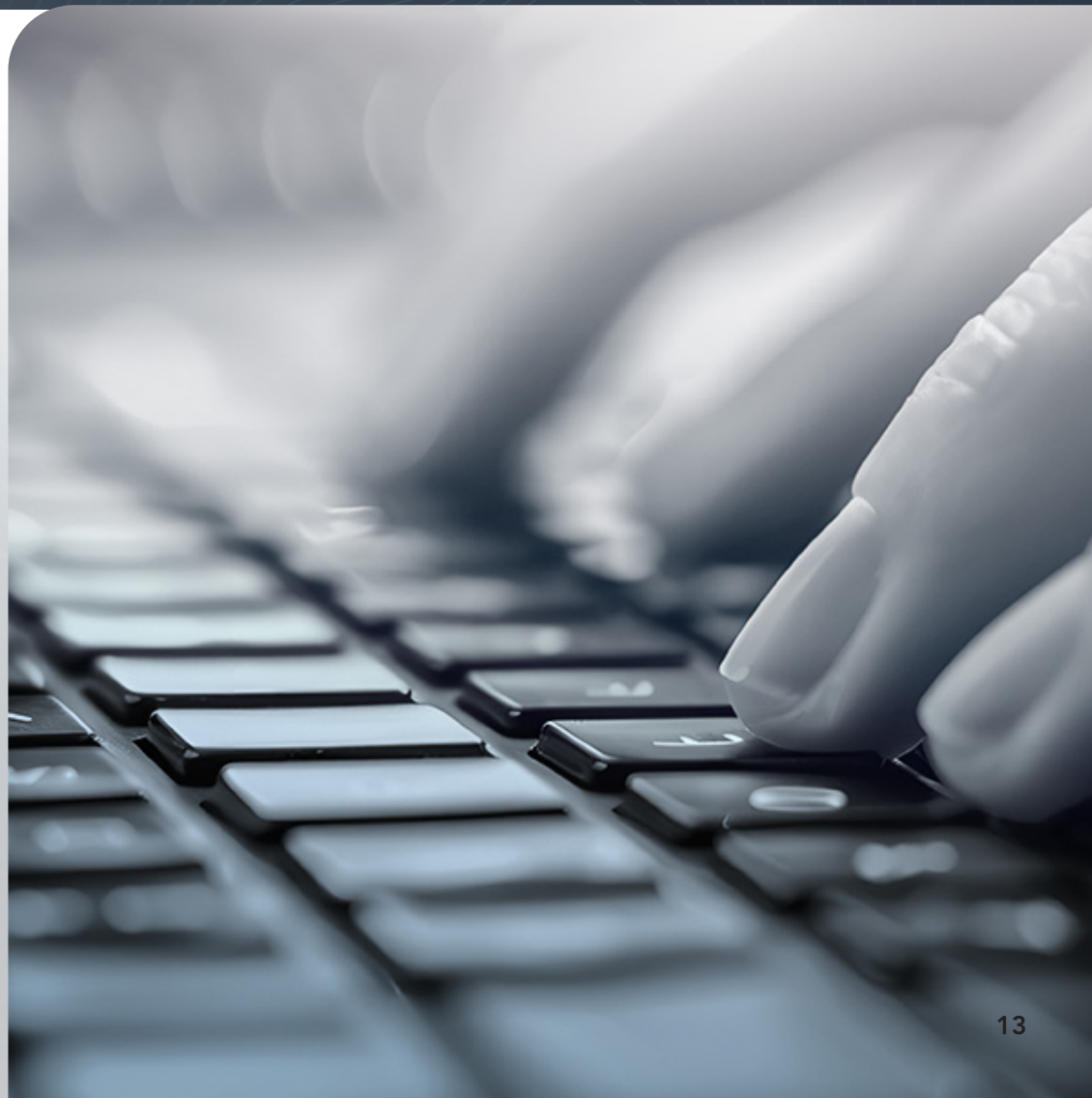
Dozens of cyber insurance providers, including Chubb, Travelers, AIG, CyberPolicy, and others have kicked off education campaigns to help their customers better prepare for phishing attacks. Many of these organizations have reported that a key to lower insurance rates is taking proactive measures to address the wide range of phishing tools and techniques that are currently in play.

How: Best Practices to Prepare for a Phishing Attack

With market data, industry watchdogs/regulators, and cyber insurance providers all underscoring the need to proactively prepare for a phishing-related attack, it's no surprise that one out of every two senior security and IT executives said that becoming more phishing resistant was their top cybersecurity priority in the next 12 months[10]. The big question for many is how to sift through the noise and accomplish this feat in a pragmatic fashion.

Here are some best practices gleaned from top cybersecurity experts:

10. Axiad: 2022 Authentication Survey Results, October 2022



1. Start with the Fundamentals

It's important to first do your homework and clearly define your requirements upfront. If you don't, you run the risk of getting lost in all of the products and features that are available. Some of the most common steps at this stage include:

Categorize End Users

Not all end users are the same, and applying the highest level of controls across the board may not be prudent. Place employees into groups by role (e.g., knowledge worker, compliance, IT, security, executives).

Map Authentication Levels

Armed with your categorization, map authentication levels to your groups. This might include different technology solutions for different categories of users.

Avoid Easily Compromised Credentials

Passwords are passe for a reason – they are too easy to corrupt. In fact, there are 24 billion username and password combinations available on the dark web[11]. Make sure you are planning to leverage advanced forms of authentication for all users.

Prioritize High-Risk Gaps

Look at the full risk landscape as you prioritize solutions for rollout. For instance, a finance executive with full access to financial systems is a higher risk for phishing than others. But perhaps entire groups – such as the Accounts Receivables team with access to both internal and partner teams – may cumulatively present a higher risk than an individual.

Enforce Day-One Enrollment

Take steps (perhaps through process initially and eventually through technology) to enforce critical policies for onboarding employees on their first day – so they aren't compromised before security controls are fully engaged.

11. Digital Shadows Analysis, June 2022

2. Be Realistic about What You Already Have

The most common myth about becoming phishing resistant is that what you have in place today will protect you from what will come in the – sometimes near – future. Standard MFA and broad-based Identity and Access Management (IAM) tools are two of the most common tools that organizations tend to view as a panacea. The problem is, often they are not.

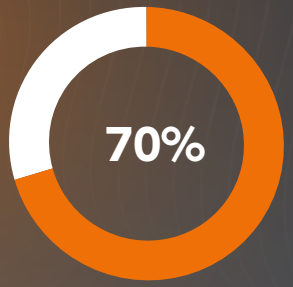
Not all MFA is the Same

Unfortunately, not all MFA is phishing resistant. Traditional MFA such as SMS authentication, OTP or even mobile push application notifications are all susceptible to phishing. In the Mobile Push scenario, the user accepts a push prompt sent to the mobile application to approve access. This approach is extremely vulnerable to prompt bombing attacks, as well as simple user error12. Also, this approach is vulnerable to everyday man-in-the-middle attacks in which hackers intercept web traffic and insert themselves in the middle with fraudulent, lookalike login pages that not only accept user credentials but also deploy MFA to capture access.

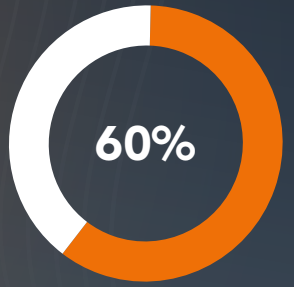
IAM Systems Can be Too Limited

With all the good that IAM solutions do, protection against a phishing attack often isn't one of the primary benefits provided. Many of these solutions – particularly legacy solutions – leverage older MFA capabilities that can be compromised.

The challenges typically don't stop there if you are relying on IAM for phishing resistance. In a recent survey, it was found that 70% of organizations use three or more IAM systems across their organization, and more than half use four or more[13]. When authentication is completed in a fragmented fashion – sometimes caused by dividing efforts across multiple tools in place – it leaves the side door open for a phishingrelated attack.



Have 3 or more IAM systems in place[14]



Leverage 5 or more authentication methods[15]

13. Axiad: 2022 Authentication Survey Results, October 2022
14. Axiad: 2022 Authentication Survey Results, October 2022
15. Axiad: 2022 Authentication Survey Results, October 2022

3. Leverage the Right Authentication Methodology

NIST concluded its recent guidance on the importance of being prepared for

"In the end, phishing-resistant authenticators are a critical tool in personal and enterprise security that should be embraced and adopted." 16"In the end, phishing-resistant authenticators are a critical tool in personal and enterprise security that should be embraced and adopted." [16]

16. NIST: Phishing Resistance – Protecting the Keys to Your Kingdom, February 2023

The challenge for many is to determine which ones, as there are several options to consider.

Here are the most common and effective forms of phishing-resistant technology to evaluate:

Personal Identity Verification (PIV) Cards

PIV Cards are an integrated solution for U.S. Federal Government identity, credentials and management. This PKI-based credential is typically used by agencies that have the infrastructure to implement and administer it. While the PIV card infrastructure is relatively expensive and implementation times long, it is highly reliable, trusted, and proven. Further, as the PIV card can also be used as a physical identity card (with name, photo, etc.), it has multiple uses.

Certificate-Based Authentication (CBA)

This newer, simpler, more flexible form of PIV uses a strong token such as a YubiKey, a virtual smart card, or hardware device storage for authentication. Since the certificate is validated using secure communications and without shared secrets, CBA delivers phishingresistant MFA. In addition, the process involves just the selection of the applicable certificate and the input of a PIN, so it is efficient for the end user. It's a great option for organizations in two major ways: 1) given the adoption of CBA by Microsoft, it works well with Azure AD; and 2) it can overlay an existing IAM ecosystem – or multiple IAMs – to effectively deliver an after-market kit for authentication and seamlessly upgrade them to phishing-resistant MFA.

FIDO

Fast ID Online (FIDO) represents an early and important advancement in authentication. To eliminate password storage on external servers, FIDO stores Personally Identifiable Information (PII), including biometric information, locally on the device. NIST says: "FIDO authenticators paired with W3C's Web Authentication API are the most common form of phishing-resistant authenticators widely available today."17 FIDO can take the form of separate hardware keys, or it can be embedded directly into platforms or hardware.

FIDO2

The latest iteration of FIDO enables users to leverage common devices to easily authenticate to online services in both mobile and desktop environments18. With support of some of the biggest names in the technology industry such as Apple, Google, and Microsoft – and adoption by browsers such as Google Chrome, Microsoft Edge, Safari, and Firefox plus hardware such as Windows, Android and MacOS devices – this standard is unquestionably the future of phishingresistant protection.

However, FIDO2 still must be integrated into the thousands of legacy on-premises applications that must be protected, many of which require special modifications. And securing internally developed and vendorsupplied applications further complicate matters and extend timelines.

It is important to know that the FIDO2 standard is evolving rapidly. A recent example is the introduction of the passkey (also called "multi-device passkeys"). As major vendors such as Microsoft have not yet finalized their implementation of passkey, FIDO2 still requires meaningful work before it can solidify its place as the gold standard of phishing resistance.

Windows Hello for Business (WHfB)

This approach provides strong two-factor authentication on devices. Passwords are replaced with the WHfB credential that is tied to the device. This credential uses a biometric or PIN, rather than a password – working well for Microsoft accounts, Active Directory, and Azure AD. It is a strong option for Microsoft-centric environments, particularly those that are hybrid across onpremises and Azure AD.

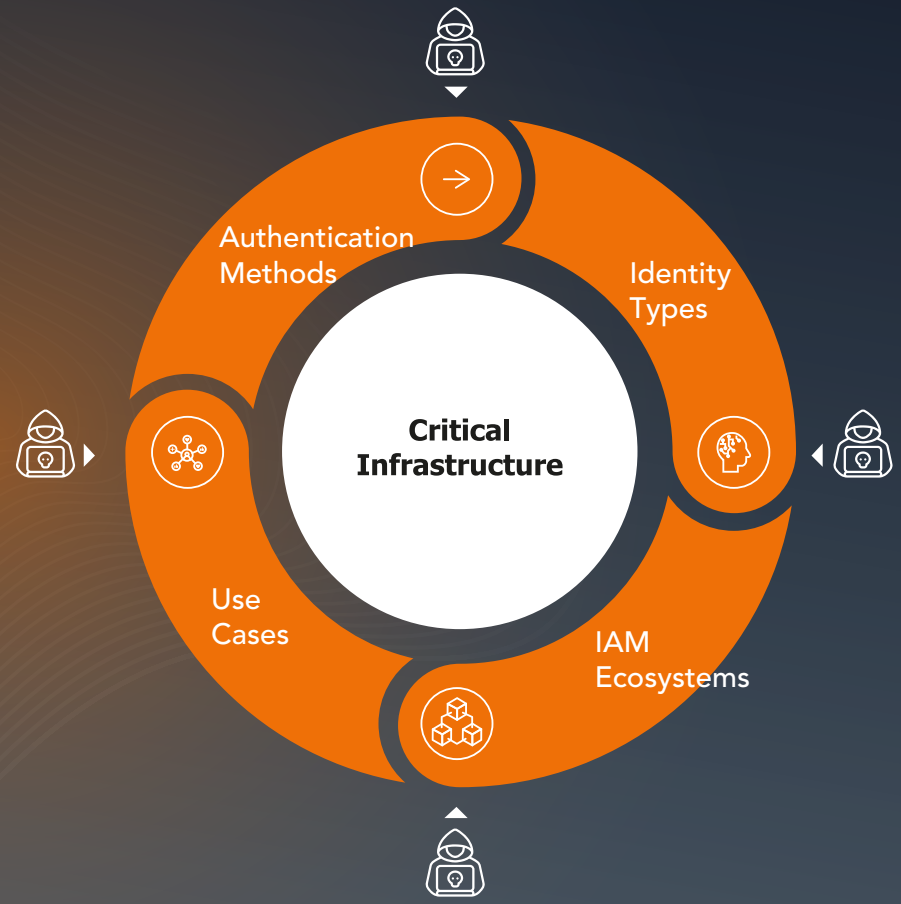
17. NIST: Phishing Resistance – Protecting the Keys to Your Kingdom, February 2023

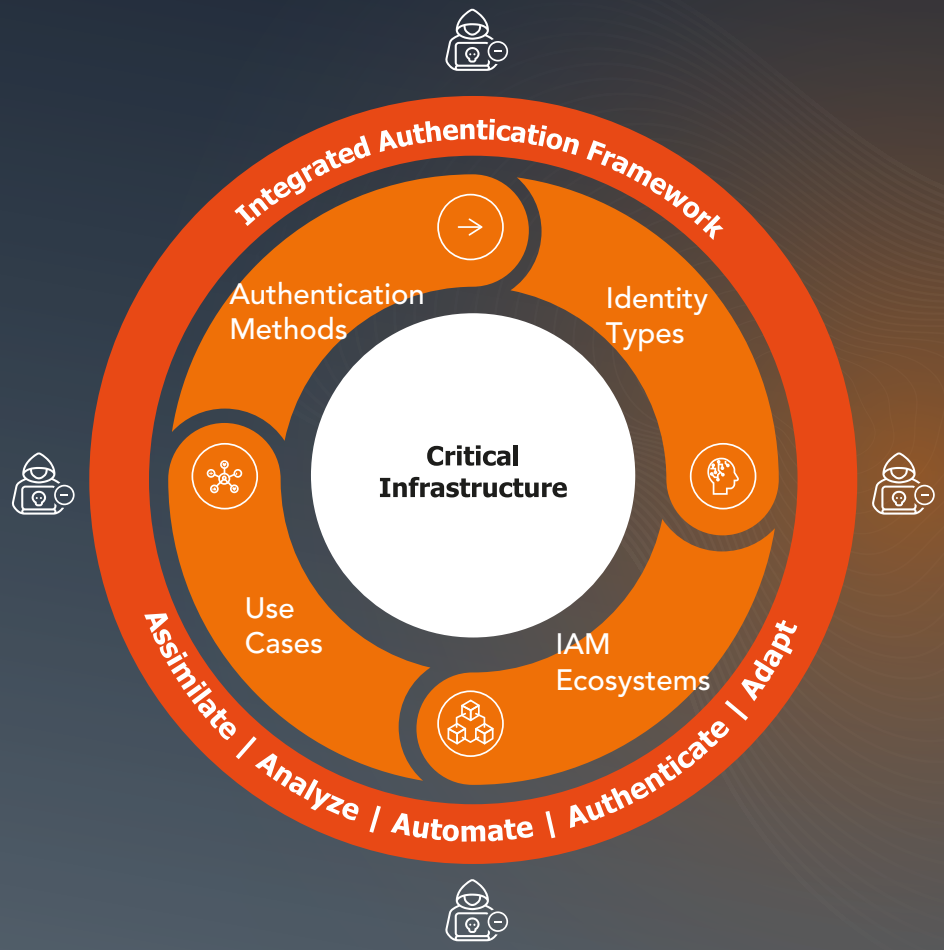
18. FIDO Alliance website: https://fidoalliance.org/fido2/

Organizations looking to achieve phishing resistance generally can't go wrong with any of those options, **but it is important to fit the right technology** (or set of technologies) **to the right problem**, at the right time to avoid unnecessary administrative costs, user challenges, and possible added risk if the wrong implementation decisions are made.

4. Pursue the Challenge Holistically

With multiple authentication alternatives to choose from, as well as so many authentication nuances to consider – including multiple operating systems perhaps in place, varying authentication methods in use, and user and machine identity types to secure – organizations run the risk of implementing phishing resistance in silos. The resulting gaps and inconsistences can be exploited by bad actors.

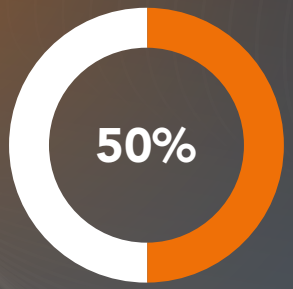




A smarter strategy is to shift from a fragmented approach to a single, **holistic strategy**: an integrated authentication framework. This strategy allows security executives to assimilate credentials, analyze in context, automate processes, authenticate uniformly, and adapt to emerging threats more efficiently. By systematically authenticating across all users, machines, and interactions – regardless of underlying IT complexity – organizations can not only improve their overall cybersecurity posture, but they can also can better **empower users and streamline processes for administrators.**

In the context of this analysis, an example of a holistic approach is that many organizations may require PIV/CBA and FIDO due to varying use cases, including authenticating to MacOS then O365. **And FIDO2 and CBA is the only way to deliver a truly passwordless experience for both user and machine authentication.**

Be sure you look at the big picture on what you're trying to accomplish, and then make the investments and develop the processes that will support that strategy over time. In a 2022 survey, 1 in 2 security IT executives said that are shifting from multiple, siloed tools for authentication to a holistic approach [19].



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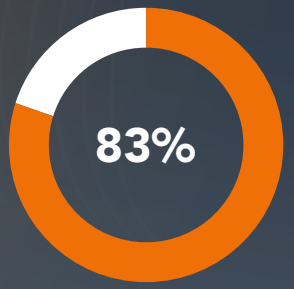

of organizations have at least 2 operating systems[21].

19. Axiad: 2022 Authentication Survey Results, October 2022
20. Axiad: 2022 Authentication Survey Results, October 2022
21. Axiad: 2022 Authentication Survey Results, October 2022

5. Balance Protection with Usability

Becoming phishing resistant with advanced authentication techniques is a noble (and necessary) objective, but organizations can't afford to do so at any cost. Tighten the controls too much or make the authentication process too complicated, and you can negatively impact organizational efficiency. In fact, three in five users say that authentication practices have stopped them from doing their jobs[22].

22. Axiad Passwords & Productivity Survey, Axiad Primary Research, 2021

Worse yet, putting in too many perceived roadblocks for users may have unintended consequences from a risk perspective. It has been reported that a majority of users have bypassed security controls if they find them too stringent or difficult to navigate [23].

To rectify these problems, enter passwordless authentication. This process, which uses factors like a user's device, biometrics, or behavioral analytics to verify identity instead of a password, can deliver on the promise of phishing resistance and reduce user friction at the same time.

But be careful as you consider your passwordless options, however. Not all passwordless solutions are the same. Most options (61 percent[24]) actually use a password or other shared secret. These solutions typically hide (or mask) the secret from the end user to deliver a passwordless experience. But behind the scenes, the shared secret is still there – and can be intercepted or read. Seek out a "no-password" passwordless solution to eliminate shared secrets that are open to compromise.

23. Axiad: 2022 Authentication Survey Results, October 2022
24. Cybersecurity Insiders: The State of Passwordless Security, 2021

6. Operationalize the Authentication Lifecycle

It's important to recognize that, in addition to the above, there is yet another weak link in authentication: the authentication lifecycle. This muti-step process spans authenticator enrollment, credential issuance, account recovery, credential (especially certificate-based) renewal, and revocation.

Once phishing-resistant MFA becomes the standard, bad actors focus on the vulnerabilities exposed during the lifecycle. An example of this kind of attack is hackers forcing the authentication to go to account recovery mode in order to exploit a weak link. For example, account recovery models that rely on personal information, such as your mother's maiden name, are a weak link since that information can be intercepted and then reused many times.

In addition to being secured at every stage, the lifecycle must be operationalized with the right tools and capabilities for IT to manage efficiently. And since IT cannot practically manage all stages of the lifecycle, user self-service – where secure emergency access is provided through face-to-face or remote authentication – must be enabled. Self-service also benefits the organization by reducing end user friction and driving down administrative costs.

Conclusion

Phishing resistance is not a 'nice to have.' With attacks becoming more common, and more effective, cybersecurity watchdogs/regulators, cyber insurance providers, and security professionals are all lining up to help address this emerging threat vector. The path forward is difficult to navigate, but not impossible to tame. Make sure you:

1. Use a pragmatic approach, and not one based on expensive rip-and-replace commitments
2. Leverage phishing-resistant technologies recommended by CISA
6. Think long term and future-proof your end-to-end MFA strategy
4. Seek out technology that helps you integrate your existing tools while lowering hurdles for end users

About Axiad

Axiad is an identity security company tackling the critical threats posed by compromised credentials, which account for over 70% of enterprise breaches. As human and non-human identities multiply across disparate systems, traditional IAM tools fall short, leaving organizations with fragmented visibility and significant security gaps.

Axiad bridges this divide by uncovering hidden identity risks and credential vulnerabilities, providing actionable insights to strengthen security—without requiring a complete system overhaul. Our solutions integrate seamlessly with existing IAM infrastructures, enabling organizations to shrink their attack surface and adopt phishing-resistant, strong authentication methods.

At Axiad, we make identity security simple, effective, and future-ready for a passwordless world. Discover more at **axiad.com** or follow us on **LinkedIn**.

Axiad Conductor is an advanced authentication toolset that combines multifactor authentication, cloud-based PKI and robust credential management that utilizes x.509 certificates and FIDO passkeys. Axiad Conductor helps organizations deploy and manage strong authentication processes and deliver the phishing-resistant authentication now being mandated for their people, machines and applications.

AXIAD