RAPID7

RESEARCH

Industry Cyber-Exposure Report (ICER): DB 314

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Executive Summary

As the world's knowledge workers were driven home amid a pandemic and cases of ransomware ran rampant across the internet, measuring the world's most critical businesses' internet exposure is more important than ever. In this round of Internet Cyber-Exposure Reports (ICERs), researchers at Rapid7 evaluate 5 areas of cybersecurity that are both critical to secure to continue doing business on and across the internet, and are squarely in the power of CISOs, their IT security staffs, and their internal business partners to address.

These five facets of internet-facing cyber-exposure and risk include:

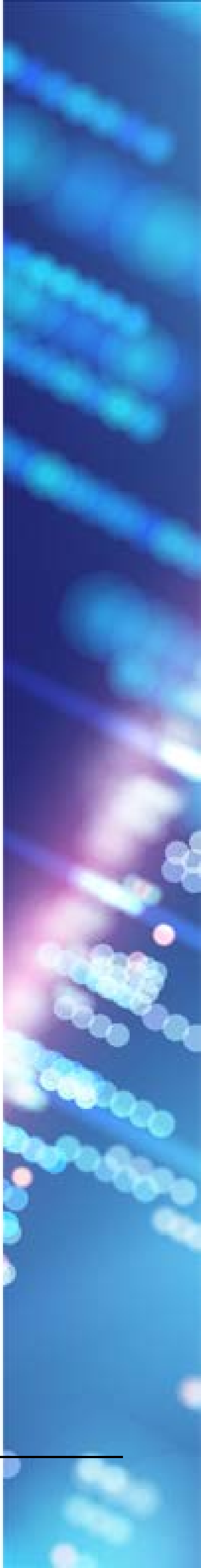
1. Authenticated email origination and handling (DMARC)
2. Encryption standards for public web applications (HTTPS & HSTS)
3. Version management for web servers and email servers (focusing on IIS, nginx, Apache, and Exchange)
4. Risky protocols unsuitable for the internet (RDP, SMB, and Telnet)
5. The proliferation of vulnerability disclosure programs (VDPs)

In this report, we examine the internet-facing cyber-exposure of the top companies listed on Germany's Deutsche Börse Prime Standard[1] (hereafter referred to as the DB 314). Each section is accompanied by real-world, practical advice that practitioners can start implementing today. Note that this advice is not only for those CISOs who are privileged to hold positions in Deutsche Börse Prime Standard companies, but also for those security experts who find themselves in business and regulatory relationships with members of this prestigious collection of corporations. with members of this august collection of corporations.

Through the first half of 2021, Rapid7 will be releasing reports measuring these 5 critical areas of cybersecurity fundamentals across 5 of the most advanced economies of the world:

1. The United States Fortune 500[2]
2. The United Kingdom's FTSE 350
3, Australia's ASX 200[4]
4. Germany's Deutsche Börse Prime Standard 314 (this report)
5. Japan's Nikkei 2255

[1] https://www.deutsche-boerse-cash-market.com/dbcm-en/instruments-statistics/statistics/listes-companies
[2] https://www.rapid7.com/research/report/2021-industry-cyber-exposure-report/
[3] https://www.rapid7.com/research/reports/2021-industry-cyber-exposure-report-uk
[4] https://www.rapid7.com/research/report/2021-industry-cyber-exposure-report-anz/



Key Takeaways

The paper is divided into 5 detailed sections covering the areas mentioned above, and the overall takeaways of this research are as follows:

- **DB 314 email security posture is lagging behind the US and UK.** At the beginning of 2021, email security among the DB 314 isn't keeping pace with its peers in the US and UK. While DMARC adoption in the US and UK hovers around 50%, only about 39% of all the surveyed companies operating in Germany have any DMARC records configured; of those, about two thirds are set with a p=none (or passthrough) policy. In other words, only about 13% of DB 314 listed companies are taking active measures to protect their brands, employees, and customers through DMARC p=quarantine or p=reject policies.

- **Exposed, dangerous services are less of a concern in Germany.** While dangerous protocol exposures of Windows Remote Desktop (RDP) file-sharing (SMB), and Telnet continue to be an issue across the surveyed companies, it does not appear to be nearly as much of a problem as we've seen among the U.S.-based Fortune 500: For any of the 3 protocols surveyed, almost 90% of the DB 314 had no exposure involving RDP, SMB, or Telnet. Additionally, when we looked at secure HTTP (HTTPS) deployment, we found that HTTPS is standard for 99.6% DB 314 companies (we'll be reaching out to that one lone HTTP holdout).

- **Version dispersion remains a problem.** Of the surveyed companies that are still running their own on-premises Microsoft Exchange servers for messaging, only about 20% are running the most current supported version, and another 20% are running versions from 2010 that are now end-of-life. Additionally, we found no less than 13 different versions of Microsoft IIS for web services, as well as a whopping 89 distinct versions of Nginx, the most popular web server on Earth. These distinct version counts are higher than any regional group of companies we've studied so far.

- **The German Automotive sector stands out when it comes to vulnerability disclosure.** While VDP adoption continues to have slow uptake in the DB 314 with only 34 companies advertising some mechanism to report vulnerabilities in products or infrastructure, the automotive industry has a higher-than-average commitment to VDP: 6 out of the 18 Automotive sector companies have a VDP.

With these key findings in mind, the remainder of this report explores each of the 5 areas of cybersecurity measurable in the DB 314

Before you dive in, we wanted to note that if your organisation was and/or still is impacted by those events, you may be feeling like you are spending most of your time and energy dealing with emergencies rather than being able to focus on some of the more chronic issues outlined in this report. Since our goal is to help organisations become (and remain) safe and resilient, we have a dedicated appendix you may want to jump to first before tackling the sections below.

Email Security Among the Deutsche Börse 314

We all know and love—or at least begrudgingly rely upon—email. It is a pillar of modern communications, but is unfortunately also highly susceptible to being leveraged as a mechanism for malicious actions, such as spoofing or phishing.

A core concern regarding email is the authenticity of the source, and in recent years DMARC has arisen as the preeminent email validation system. DMARC builds upon the foundations of 2 older email authentication systems: Sender Policy Framework (SPF) and DomainKeys Identified Mail (DKIM). Respectively, these check for mail server authorization ("Is the sender authorized?") and email integrity based on key signatures ("Was the content altered?"). The various components of DMARC can serve to mitigate direct threats as well as potential reputational damage, such as spoofed emails intended to mislead partners, suppliers, or customers.

A properly implemented DMARC system can identify illegitimate emails and define how those emails should be handled. DMARC can be configured to handle emails of suspect provenance with different degrees of severity, depending on the aggressiveness of IT administrators. The DMARC policy options include:

- `None`, where suspect emails are reported to a designated email address that serves to monitor DMARC notifications.
- `Quarantine`, where suspect emails are punted to the spam folder and a report of its receipt is delivered to the monitoring email address.
- `Reject`, where in addition to notifying the monitoring email address, suspect emails are not delivered at all.

By virtue of its efficacy in mitigating malicious messaging via email, we consider DMARC a significant risk mitigator and highly recommend its implementation.

Unfortunately, while the benefits of DMARC are profound, its implementation is not global.

DMARC's implementations are tracked in public Domain Name System (DNS) records. To determine whether an organisation utilizes DMARC only requires the examination of the organisation's published DMARC record. We are able to discern the scale and types of DMARC implementations by comparing the primary, well-known domains of the DB 314 organisations against their corresponding DMARC records that appear alongside DNS.

Note that for the scope of this study, we focus primarily on the apex domains of organisations, and do not explore additional domains owned by particular organisations. We elected this approach because there can be significant variation in domain set ownership by organisations. By focusing on apex domains, we are, in effect, treating it as a bellwether indicator of an organisation's overall email security posture. After all, if an organisation fails to implement DMARC on a primary domain, how confident should we be that the organisation practices healthy email hygiene across far less-prominent domains?

These published DMARC records are intended to be highly accessible. They are the means through which email recipients determine how to validate emails using DMARC, what email address to notify when receiving emails that fail DMARC validation, and what DMARC policy to apply in handling invalid emails.

Results

While the coverage is not complete, we found that 124 (or approximately 39%) of the DB 314 set of organisations had implementations of DMARC for their primary domains, all of which were validly formatted. Of the set of national indexes we have examined so far in the ICER series, this is a remarkably low level of DMARC coverage in comparison.

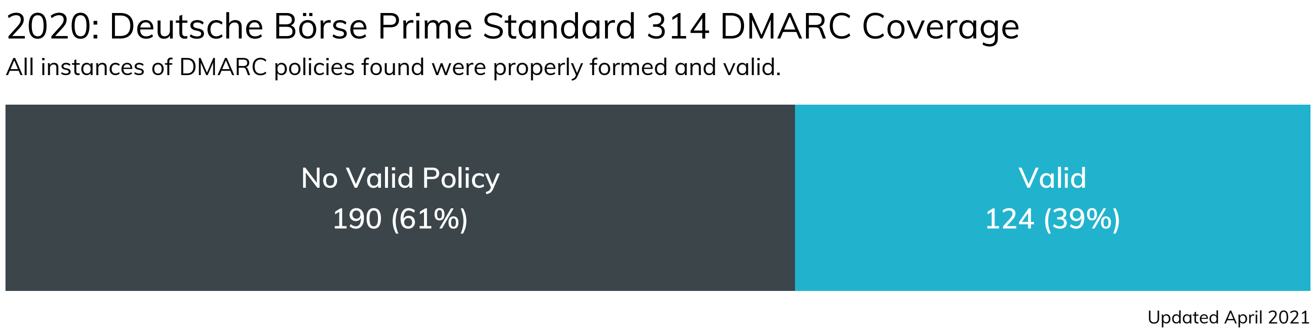


Figure 1: 2020 Deutsche Börse Prime Standard 314 DMARC Coverage

When we examine the DMARC policies in a bit more detail, we find that most valid DMARC policies are set to "`none`", or simply to monitor and inform, followed by "`quarantine`", a policy to isolate suspect emails. The least prominent policy implementation is "`reject`" which is the most aggressive approach.

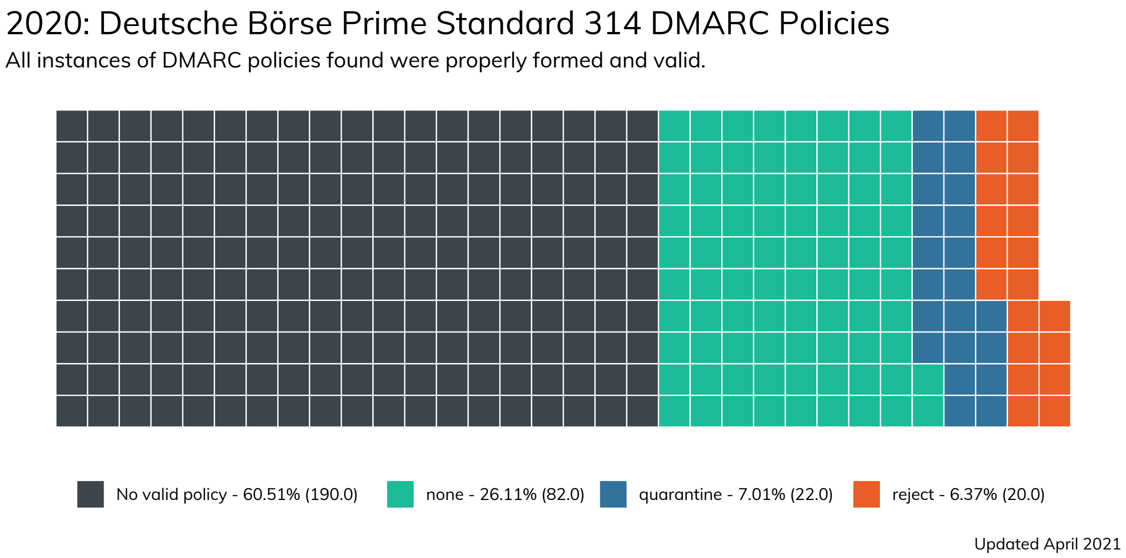


Figure 2: 2020 Deutsche Börse Prime Standard 314 DMARC Polcies

By Industry

We can also separate the organisations by industry to get a better sense of DMARC variations across the sectors. The most prominently featured industries in the DB 314 include industrial, financial services, and software.

Alarmingly, we find that across most industry segments, the majority of organisations within each industry simply have no valid DMARC policy implementation. Poor or absent email security practices are rampant across industries.

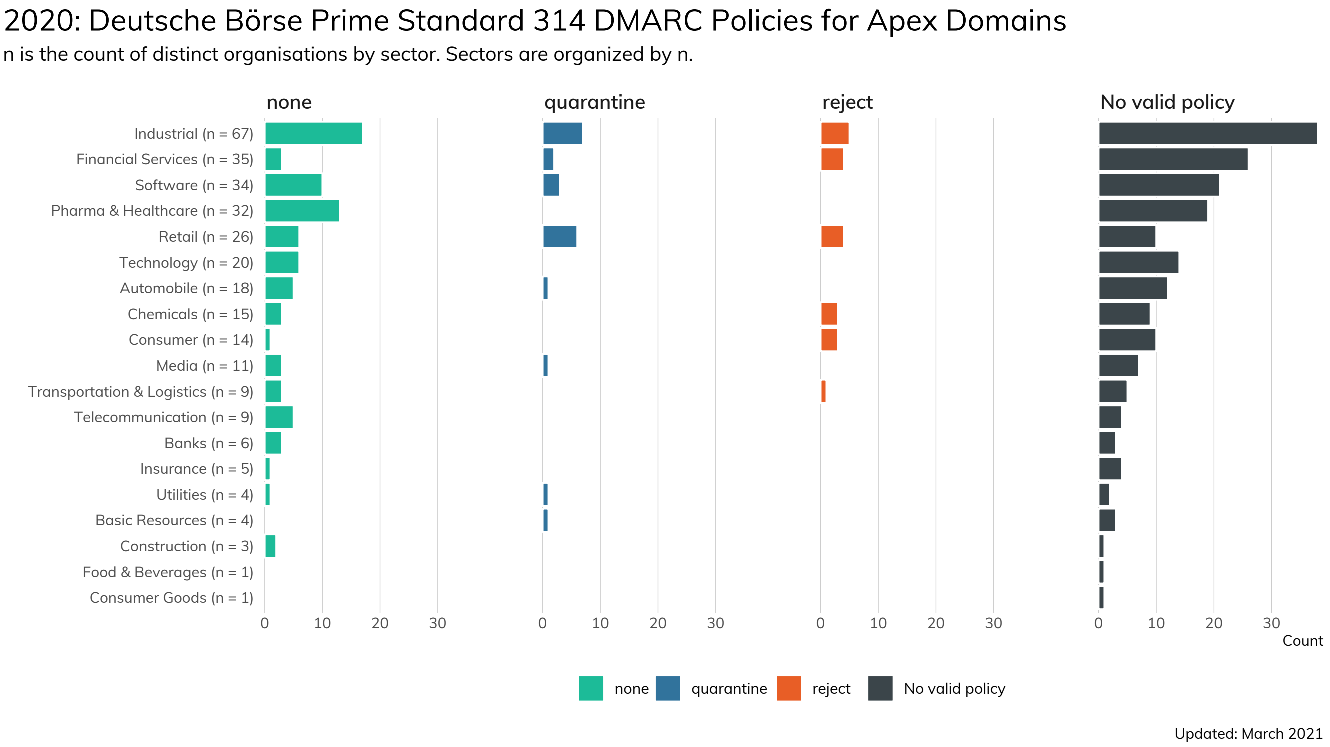


Figure 3: 2020 Deutsche Börse Prime Standard 314 DMARC Policies for Apex Domains

CISO Takeaways

If DMARC has not already been implemented in your organisation, take proactive measures to get it set up.

Nowadays, DMARC can be thought of as a foundational fixture of email hygiene, and it broadly signals an organisation's commitment to modern information security norms. Furthermore, lacking a DMARC implementation leaves an organisation potentially blind to malicious email campaigns that are not captured through some form of DMARC monitoring that can be informative in terms of scale, source, and severity.

Once the decision has been made to implement DMARC, it's time to consider the policy implementation in a more nuanced manner. An aggressive reject policy is highly secure, but might result in legitimate emails being blocked. A more forgiving quarantine policy could strike a balance between preventing aggravation and allowing for some form of recourse. At the very minimum, a DMARC implementation of some form should be in place to monitor for illegitimate or poorly configured email traffic.

Web Service Security Among the Deutsche Börse 314

The vast majority of the interactions an average person has with technology is through some form of web application, but what constitutes a "web app" can be considered quite nebulous, and the security controls for hardening these applications are equally broad. APIs, distributed authentication schemes, single-page applications, and static websites all might fall under the general category of "web application." There are very few security measures that should be applied to all web applications across the board without further subdividing what specific type of application we are referring to. However, there are a couple that we will examine here.

All web applications should require strong encryption, with a vanishingly small number of exceptions. While this is most critical for applications that are serving up sensitive information, such as personally identifiable information (PII), it is important even if you serve only static informational content. There is a common misconception that the only risk of using an insecure connection is a loss of confidentiality—that the information a user is browsing could be observed by a malicious third party. While this certainly is a risk, it is often overlooked that a lack of encryption makes the connection vulnerable to modification (a loss of integrity). This means malicious third parties could not only observe potentially confidential information, but that they could alter that information or inject their own content that could potentially compromise your users.

The risk of malicious content injection exists regardless of whether your web application serves sensitive information or just cute pictures of cats. Due to this universal risk to a site's users and to the overarching brand reputation of the site owner, we will consider the support of strong encryption (in our case, TLS) and the enforcement of its usage via HTTP Strict Transport Security (HSTS). For the purposes of this section, we will look at the primary domain for each company, as it is the domain that is most responsible for a company's brand reputation.

HTTPS Support

HTTPS is the protocol that ensures web traffic is encrypted and secure. There are a few ways that HTTPS could be configured in an environment.

- Not available (HTTP only)
- Available and optional
- Required (HTTP "Strict Transport Security", or HSTS, configured)
- Required with HSTS preloading

Supporting HTTPS for your site is table stakes for having a web presence at all, with requiring encryption following very closely behind. HSTS preloading does carry some technological challenges, but they are challenges that a web-security program should be working to proactively address. The DB314 comes just shy of a perfect score for HTTPS adoption, with a single domain not supporting the secure protocol. Again, in 2021, HTTPS is table stakes for having a web presence, and failing to adopt it will even reduce your Search Engine Optimisation (SEO) score, so we would hope for this to be at 100%.

HSTS Adoption

The outlook for HSTS adoption was also unfortunately grim.

As you can see, only about 30% of the sites examined supported HSTS at all. This is substantially less than what we have observed in other reports. If the site already fully supports HTTPS (and these sites all do), it should be relatively trivial to implement HSTS to guarantee your users visit the secure version of your site. Most of these sites do provide a redirect from the insecure version of their homepage—however, that will not mitigate a man-in-the-middle (MiTM) attack.

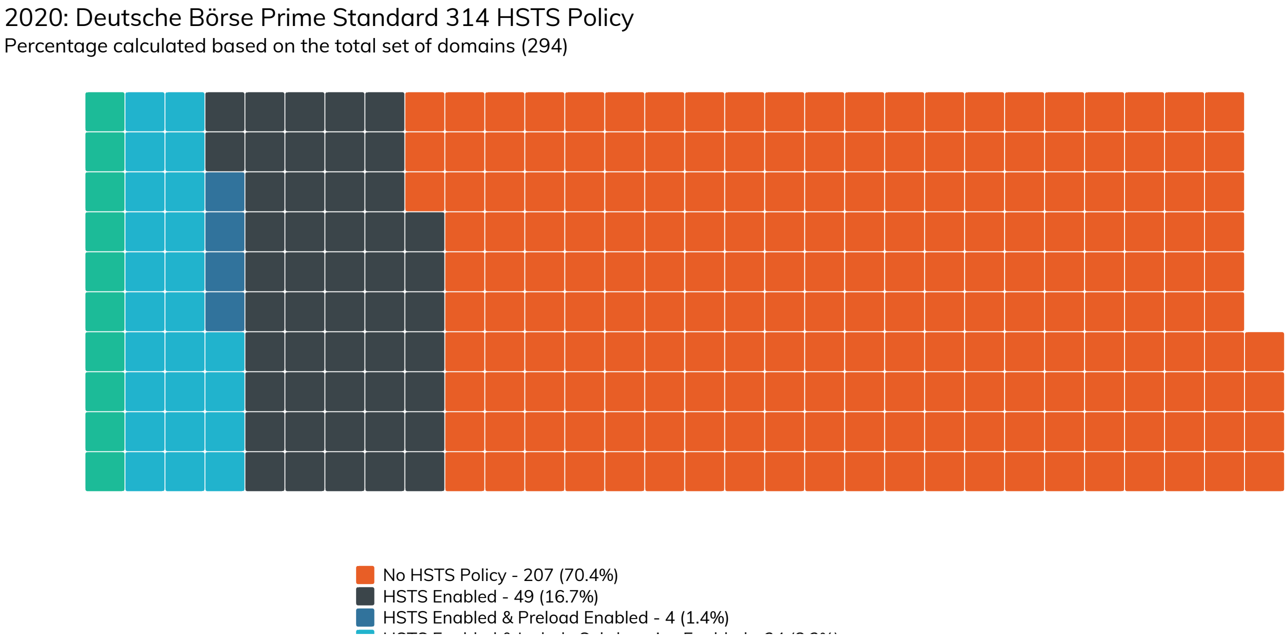


Figure 4: 2020 Deutsche Börse Prime Standard 314 HSTS Policy

None of the observed domains have HSTS manually disabled. The percentage of domains with this configuration tends to be low, so this observation is likely due to the low total number of HSTS supporting domains in this list. 39% of sites that support HSTS also support the "`includeSubDomains`" directive, protecting the entire domain and all subdomains. This is a fantastic security feature, but it can be difficult to implement in certain situations. 16% of sites with HSTS also support the "preload" directive. This directive will cause crawlers to automatically add your site to a global list of known sites that support HSTS. If a supporting browser is directed to a site with HSTS preload enabled, it will guarantee that the first connection is always conducted over HTTPS, meaning it eliminates the one, single place where your site's users are vulnerable to MiTM attacks—the first connection to your site before an HSTS header has ever been encountered. This configuration option is a simple way to add an extra layer of protection for your users, and if you bother to enable HSTS, you should certainly add this option. While it's a somewhat newer directive with less browser support, there is no downside to including it (browsers that do not support HSTS will simply ignore it). The percentage of sites in the DB314 DB312 that support the preload directive is significantly lower than what has been observed in other industry reports.

Summary

Securing and encrypting traffic to your user-facing domains is not only good practice, but it also protects your corporate brand. Securing HTTP with TLS has been a major point of focus for the web security community for the past several years, and for good reason. Nearly all of the DB314 companies provided a secure version of their primary website, but they have a long way to go before they come up to snuff in terms of best practices.

The especially poor adoption of HSTS across the DB314 could be an indicator that their application security programs are falling behind, especially since other, more sophisticated, mitigations can be significantly more complicated to implement. While the standards certainly move quickly, it's important to keep up to speed, especially when your brand reputation is on the line.

CISO Takeaways

If you haven't thought about your site's encryption for a while, now might be the time to revisit it. A company's brand reputation is at stake when consumer-facing web applications suffer from security failures, and it's important to consider this fact when making investment decisions in various security programs.

If your company's website is not supporting HSTS, it might be worthwhile to find out why. Is it a technical, organisational, or budgetary constraint? Finding the cause could be a great springboard for re-evaluating your entire application security program.

Version Complexity Among the Deutsche Börse 314

Complexity is the enemy when it comes to successful security outcomes in an organisation. Diversity in systems, technologies, and business processes present real, daily challenges for even the most mature security teams, especially when it comes to patch and vulnerability management.

Patching even 1 major vulnerability can be a Herculean task in many places. Diversity compounds complexity within each technology component. That is to say, an organisation may have multiple web-server technologies in use. Each technology, in turn, may have its own hodgepodge of versions, which directly (negatively) impacts configuration management and patch management.

To get a feel for how well these well-resourced organisations are performing in this area, we looked at 3 factors:

1. The diversity of the portfolio of a selected technology—web servers—in use by each organization.
2. How well maintained this portfolio is.
3. How well organizations maintain critical services, such as email gateways.

Our findings show that:

- Within a single technology stack (web servers), organizations in a staggering number of industries—Business Services, Financials, Healthcare, Leisure, Industrials, Media, and Technology—**expose 10 or more different versions of Apache and/or Nginx**. 12 industries have 1 or more members exposing 3 or more different versions of IIS. **This increases their respective attack surfaces** and makes it difficult to deploy patches (when they bother to apply patches) due to testing and quality-assurance complexity.

- Organizations have **serious difficulty keeping critical IT infrastructure**—such as Microsoft Exchange—**current**. Only around 22% (13 out of 57) of Deutsche Börse 314 that still run self-hosted Microsoft Exchange are running current/supported versions. Further, 20% are running end-of-life versions of Exchange 2010, putting them at **risk of future vulnerability exploitation**.

We used Project Sonar[5] and Recog[6] to identify internet-facing technologies—e.g., web servers, file servers, DNS, SSH, etc.—that were in use for each organization in the Fortune 500. We then mapped them to available Common Platform Enumeration[7] (CPE) strings.

[5] https://www.rapid7.com/research/project-sonar
[6] https://github.com/rapid7/recog
[7] Common Platform Enumeration definition and database: https://nvd.nist.gov/products/cpe

This methodology has some limitations in that the results are constrained by:

- The fingerprints available to Recog
- How promiscuous each fingerprint service is (i.e., whether Recog can extract version information)
- The ports and protocols Project Sonar studies
- Our measurement of only IPv4-space
- Sonar honoring IPv4 opt-out requests

These constraints, if anything, generally result in underreporting of the magnitude of the findings.

Version Dispersion Among Web Servers

Back in 2018, when we began our first foray into analyzing the cyber-exposure of the Deutsche Börse 314, we created the term “version dispersion” to refer to the diversity of versions within a service component an individual organisation was exposing to the internet. With the dramatic rise[8] in enterprise use of tooling such as Kubernetes[9], we expected to see a reduction in version dispersion of the 3 web servers—IIS, Apache, and Nginx—that we previously measured.

There are at least more than 69 distinct versions of Nginx[10], 51 distinct versions of Apache, and 13—yes, 13—versions of IIS[11] running across Deutsche Börse 314 members. Let’s see how that stacks up per industry.

Web Server Version Dispersion in 2020 Deutsche Börse 314 Members

Each dot is one organisation. Placement on the X-axis denotes how many different versions are in-use by a single organisation

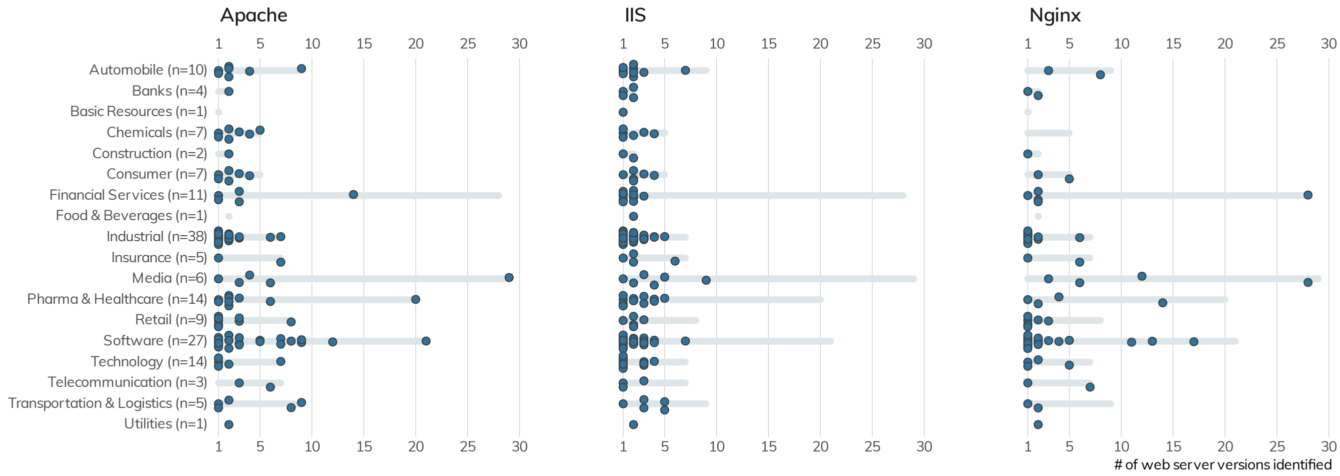


Figure 5: Web Server Version Dispersion in 2020 Deutsche Börse 314 Members

[8] A Cloud Native Computing Foundation 2019 survey notes 78% of respondents are using Kubernetes in production, a huge jump from 58% in 2018

[9] Kubernetes main site: https://kubernetes.io

[10] Some organizations announce they use a particular server type but redact the discrete version number.

[11] We frequently see leaking of IIS build strings in announced Server header banners in IIS deployments.

A higher density of points toward "1" on the X-axis means that each of the organizations those points represent are running with a low version dispersion. This means they have better control over server/service deployments and configurations, have fewer versions to test patches against, and can make changes faster and with more confidence than others. It also likely means they have a more rigorous "you must be this tall to deploy a server on the internet" rules than organizations that are further to the right on the X-axis. Attackers and cyber-insurance assessors alike notice such things and may be more likely to target organizations that exhibit a more "wild, wild west" stature.

There is a striking difference between web-server version dispersion in the Deutsche Börse 314 vs what we've reported in the FTSE 350 and Fortune 500 ICERs. One reason for this is that companies listed in the Deutsche Börse seem to have a preference for "the cloud", possibly to ensure faster global connectivity to the information or services provided by the web services they expose. We do not measure "cloud" assets in the ICERs, so these positive results come with said additional caveat.

Version Dispersion: Focus on Microsoft Exchange

Some internet-facing services are more important than others. It's one thing to have a crusty old Apache HTTPD server attached to the internet, which may only have a denial-of-service weakness. It is quite another thing to run old versions of what most organisations would (or, should) deem critical infrastructure, such as Microsoft Exchange servers or VPN/gateway/remote access services.

To get a feel for how well these organisations maintain critical services, we'll take a peek at Microsoft Exchange hygiene. Unlike their Fortune 500 counterparts, only 18% of Deutsche Börse 314 organisations still[12] have at least 1 internet-facing Exchange server handling business-critical email, and Exchange has had a fair number of weaknesses—of varying criticality—uncovered over the years:

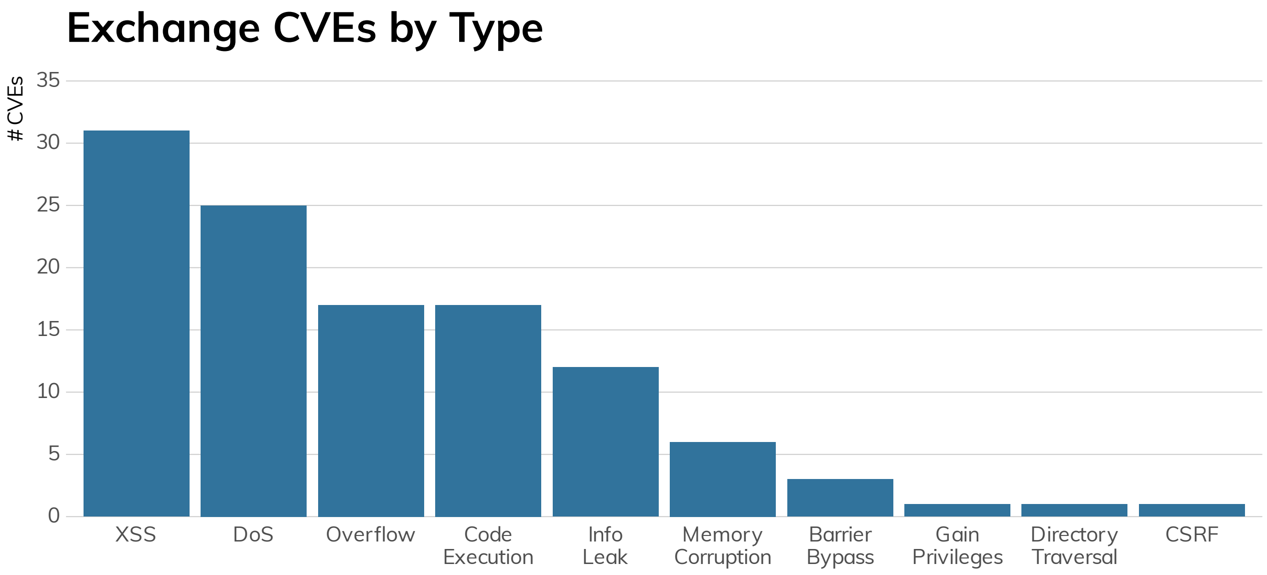


Figure 6: Exchange CVEs by Type

[12] Microsoft 365/Office 365 adoption continues to grow at a significant clip, with 70% of the Fortune 500 using one or more services, including hosted Exchange. Source: https://www.thexyz.com/blog/microsoft-office-365-usage-statistics/

One caveat for the lower percentage (compared to the Fortune 500) is that more of the companies that regularly make the Deutsche Börse 314 list are holding companies or meta-entities that have little infrastructure and are perfect candidates for cloud-hosted mail services.

However, 57 organisations (excluding 3 ISPs that allow general-service hosting) have chosen to go it on their own, so surely they know the dangers facing self-hosted Exchange and take care to ensure this vital service is at peak resiliency, at least when it comes to security patches. Right?

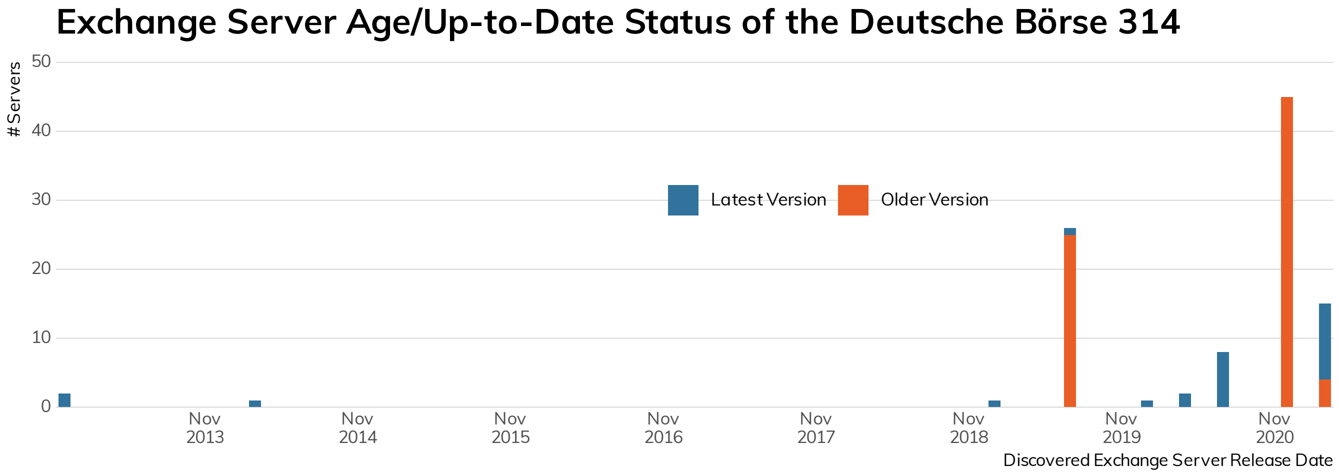


Figure 7: Exchange Server Age/Up-to-date Status of the Deutsche Börse 314

The above figure paints a fairly disturbing picture of the state of Microsoft Exchange in the Deutsche Börse 314 in both currency (i.e., age of some server versions) and whether the deployed version is supported[13] by standard Microsoft support contracts.[14] On the plus side, 69% of discovered, precise-version fingerprinted instances are 2020/2021 releases.

Fortunately, none are running Exchange 2007 (which has been at end-of-life status for a while). Unfortunately, a handful of the Deutsche Börse 314 did not seem to get the memo[15] about Exchange 2010 reaching end-of-life status in October 2020.

[13] https://docs.microsoft.com/en-us/exchange/new-features/build-numbers-and-release-dates

[14] We use the term "unsupported" as a catch-all for "not on the latest version" as well as a version that is out of support. Note that this does not take into account the fact that an organisation may have a custom or extended-support agreement with Microsoft, though that matters little when it comes to vulnerability exploitation.

[15] https://docs.microsoft.com/en-us/microsoft-365/enterprise/exchange-2010-end-of-support?view=o365-worldwide

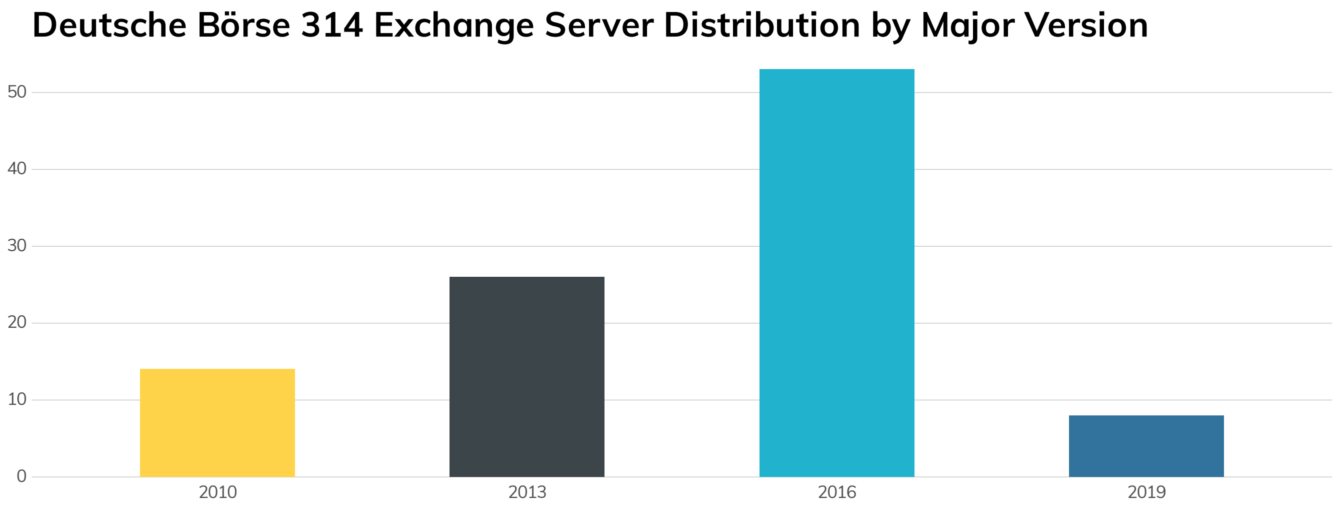


Figure 9: Deutsche Börse Exchange Server Distribution by Major Version

If your organisation is struggling to keep up with Exchange patching, you may have a bit of wiggle room when it comes to excuses since Microsoft does keep you busy, as seen in the volume of in-year updates for at least modern versions of Exchange:

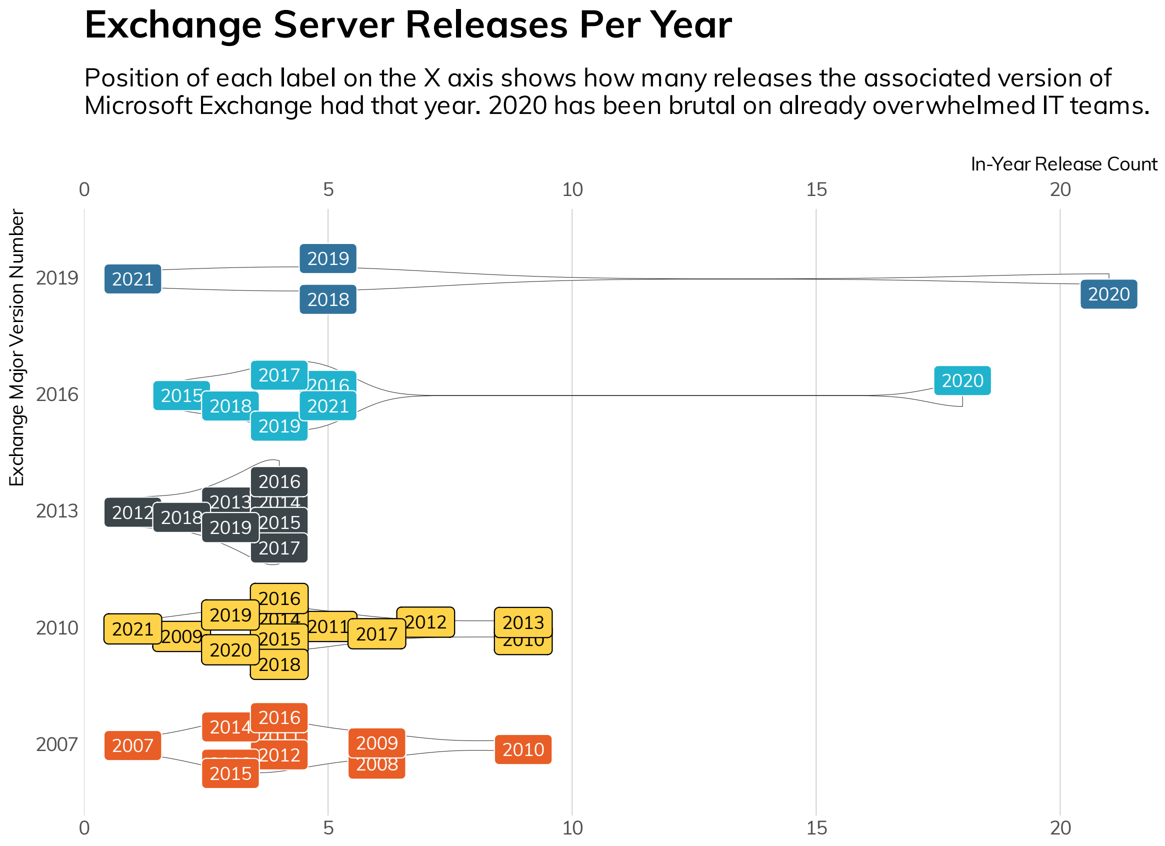


Figure 9: Exchange Server Releases Per Year

And, the outlook is still pretty grim across industries.[16] Figure 11 shows release and support status of Exchange deployments in each industry, and virtually all of them are having trouble keeping current.

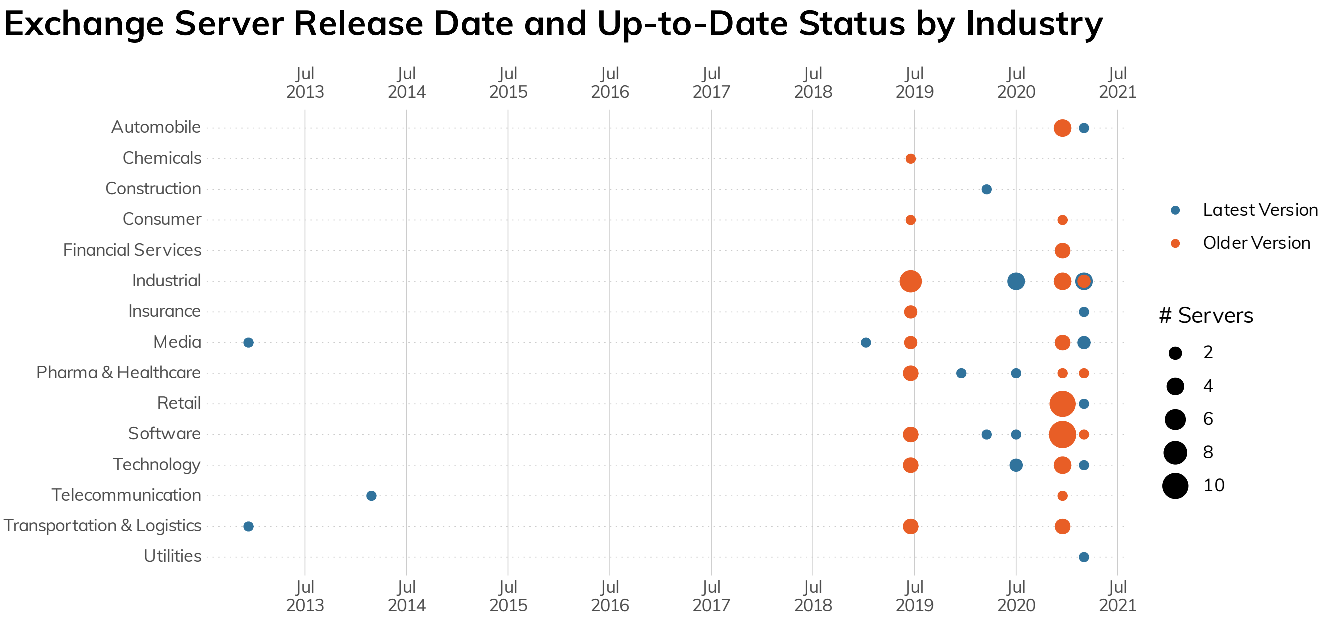


Figure 10: Exchange Server Release Date and Up-to-Date Status by Industry

If keeping Exchange deployments updated, secure, and resilient is a challenge for you, take some comfort in the fact that even Microsoft has issues normalising hosted Exchange (Microsoft 365) build levels, though this chart is far less shameful than the December 2020 snapshot used in the Fortune 500 ICER, where their most current deployments were firmly “stuck in the middle” of the chart, with an almost equal number of dispersed versions lingering on the internet’s edges

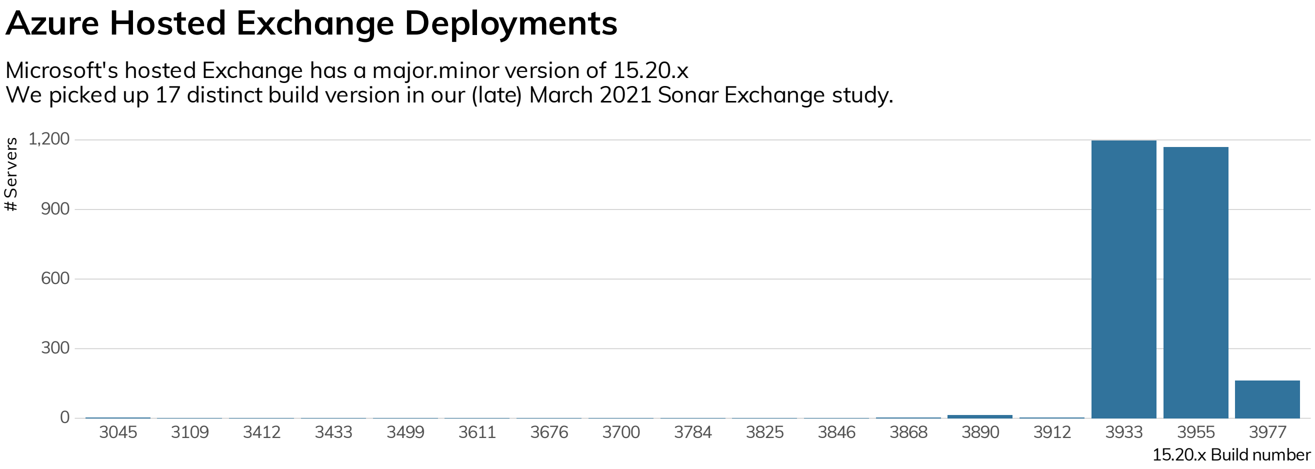


Figure 10: Azure Hosted Exchange Deployments

[16] Yes, we took the obvious pun.

CISO Takeaways

For this chapter, we'll be talking to 2 different sets of CISOs: those who see their image reflected in the mirrors in each of the sections, and those who have organisations like this as business partners or suppliers.

If you're a security leader who is working to build resilience and safety into the DNA of your organisation, issues such as technology sprawl, version management, and critical service maintenance are non-negotiable must-haves. The good news is these aren't just "security" issues. organisations deploy services to meet a business need, and it is far easier to sustain service uptime and stability if there are fewer moving parts to maintain. To achieve buy-in with your peers, collect historical and current data regarding service degradation (and/or outages). Add to that data how long it takes IT, application, and operations teams to support each component of each business process. If you pair that up with information on the volume and severity of identified weaknesses (CVE-based or otherwise), you will find areas that have a solid business case to warrant partnering for improvement. As each area ameliorates, you'll have far more agency to affect change in other, lagging areas.

For those who shuddered at what this section revealed, make sure these are areas you look for when evaluating third parties on behalf of business-process stakeholders in your organisation. It's fairly straightforward to both ensure you're asking about these potential areas of weakness and verifying that the answers you receive are accurate. There's no guarantee that the internal exposure of organisations reflects what is seen externally. However, it is generally more likely that the internal picture is even worse than what is presented to the outside world. Holding your partners and suppliers to a higher level of safety and resilience will not only lessen the risk to your organisation, but can also have a cascading positive effect as other organisations follow the standards you're setting.

[17] For free, even! https://opendata.rapid7.com/

High-Risk Services Among the Deutsche Börse 314

There are certain services that are generally considered to be high-risk when found available on the public internet. For example, with very few exceptions[18], placing SMB file shares on the internet is considered a Bad Thing. Doing so may expose data, leak environmental information such as domain names, enable brute force attacks against credentials, and provide a vector for exploiting vulnerabilities in the Windows Server Message Block (SMB) implementation, as was seen in the Conficker[19] and WannaCry[20] worms.

In our research across the public internet, we know that we're only seeing a surface level of information, and we often try to find ways to understand what it is telling us about the organisations that operate these services. We can look at configuration and protocol details and use them as proxy markers for the internal environment and security maturity of an organisation.

For example, if we discover an SMB service and can detect that it doesn't support SMBv2[21], which was introduced in Windows Vista[22] and Server 2008, we can make certain assumptions about the age of the operating system and/or requirements for legacy compatibility.

If an organisation permits Telnet[23] connections to routers from a different country, we can make assumptions about the age of the equipment as well as the security policies for secure protocols and network access control lists (ACLs).

In order to get a sense of how well the FTSE 350 organisations were performing in this area, we surveyed SMB, Windows Remote Desktop Protocol (RDP)[24], and Telnet on the default ports in their public IPv4 address space and reviewed service data where present.

Our findings show that:

- Most of the exposure was in the Pharma and Healthcare industry and clustered around one company.
- Of those hosts exposing SMB, all leaked the SMB hostname, DNS name, and fully qualified domain name (FQDN) configured on the host.
- 101 RDP services were found across 19 companies. These were heavily skewed toward the Pharma and Healthcare industry vertical due to the outsized impact of one company.

We used Project Sonar and Recog to identify internet-facing SMB, Windows Remote Desktop Protocol (RDP) [24], and Telnet services on the default ports that were in use for each organisation in the FTSE 350. In each case, we fully negotiated the protocol to verify that we were indeed communicating with the expected ser-

[18] https://docs.microsoft.com/en-us/sysinternals/
[19] https://en.wikipedia.org/wiki/Conficker
[20] https://en.wikipedia.org/wiki/WannaCry_ransomware_attack
[21] https://wiki.wireshark.org/SMB2
[22] Which now old enough to drive in most states (it was born in November 2006)
[23] https://en.wikipedia.org/wiki/Telnet
[24] https://en.wikipedia.org/wiki/Remote_Desktop_Protocol

communicating with the expected service. This methodology has some limitations in that the results are constrained by the fact that:

- Services are only observed on the default ports. Telnet and, less commonly, RDP can be moved to non-default ports.
- Measurements are made only in IPv4-space.
- Certain IP ranges are not examined by Sonar by request.
- Certain cloud and ISP related ranges were excluded. The impact of this will vary greatly from company to company.
- Certain networks were excluded if they were believed to be assigned to customers or otherwise allocated to third parties.

All things being equal, these constraints generally result in underreporting of the findings.

Findings: RDP, SMB, and Telnet

We should start this section by stating that any **non-zero number of these services made available to the general internet is considered to be unacceptable** in organisations with mature security programmes. Followers of the Rapid7 blog and past Rapid7 research reports will be quite familiar with this advice, but looking at the calendar here in 2021, we have to note that it's been a while since the last major worm outbreak on the internet. NotPetya (SMB) was 2018, WannaCry (also SMB) was 2017, and Mirai (Telnet) was way back in 2016. Despite all the vulnerability and exploit churn we saw in 2019 and 2020, we appear to be overdue for another self-replicating issue across open ports to insecure services. Closing off your exposure to these services will certainly save you weeks of cleanup later.

Windows Remote Desktop Protocol (RDP)

While some may think that RDP should be considered an exception to this rule, we'd argue that there are commonly available techniques and technologies such as virtual private networks (VPNs), RDP Gateway servers, and firewall access control lists (ACLs) that remove the risk related to this technology and so, as a general rule, **RDP shouldn't be exposed to source addresses outside of the organisation.**

Since we're on the topic of RDP, let's discuss the findings there. On the default RDP port of 3389/tcp, we observed 101 services across 19 companies. One organisation in the Pharma and Healthcare industry accounted for 45% of the observed RDP services.

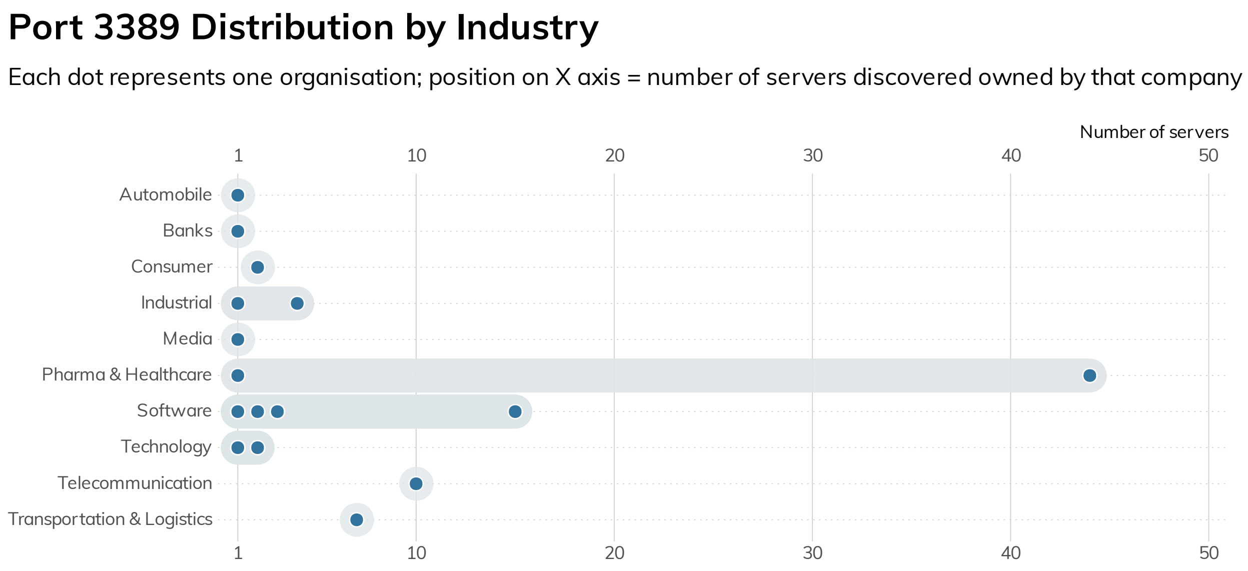


Figure 12: Port 3389 Distribution by Industry

The graphic above shows that while the overall numbers are mostly attributable to just a few companies, we do see quite a few industries represented.

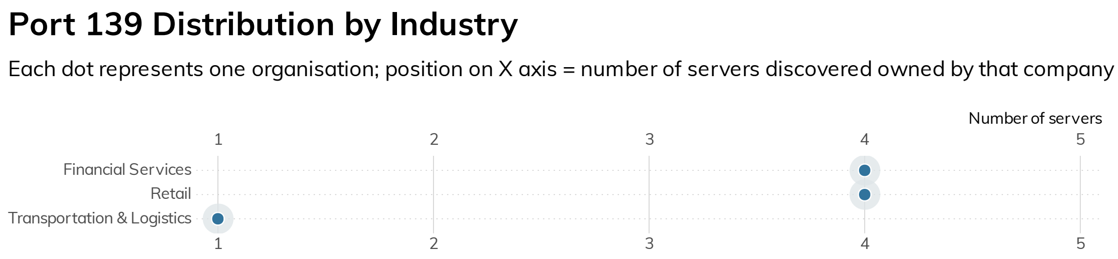
On a positive note, when we looked at the security requirements for RDP authentication, we found that 91% required Network-Level Authentication (NLA)[25]. NLA, introduced in Windows Server 2008, enforces Transport Layer Security (TLS) protection of traffic in-flight, strengthens authentication options, and significantly reduces the risk and impacts related to brute force and certain denial-of-service attacks. NLA has been enabled by default since Windows 2012. The lack of NLA serves as a proxy indicator for older infrastructure either on the server itself or a requirement for compatibility with older clients. The only other reason for not having NLA enabled is that it doesn't allow authentication with expired passwords. That is another reason to deploy RDP Gateway servers, VPNs, or other infrastructure to provide facilities for changing the password as well as enable security access to remote desktop services.

Windows Server Message Block (SMB)

The SMB protocol is for file- and print-sharing as well as interprocess communication on Windows and compatible networks. **We say this in every report[26], but SMB should never be exposed to the internet.** The risks include data leakage from file shares, credential compromise via brute force attacks, and malware infection (think of the previously noted Conficker and WannaCry) via vulnerabilities in the host operating system or service. Given the plethora of options for securely sharing files, SMB shares aren't worth the risk.

[25] https://en.wikipedia.org/wiki/Network_Level_Authentication
[26] https://www.rapid7.com/research/report/nicer-2020/#smb-tcp-445

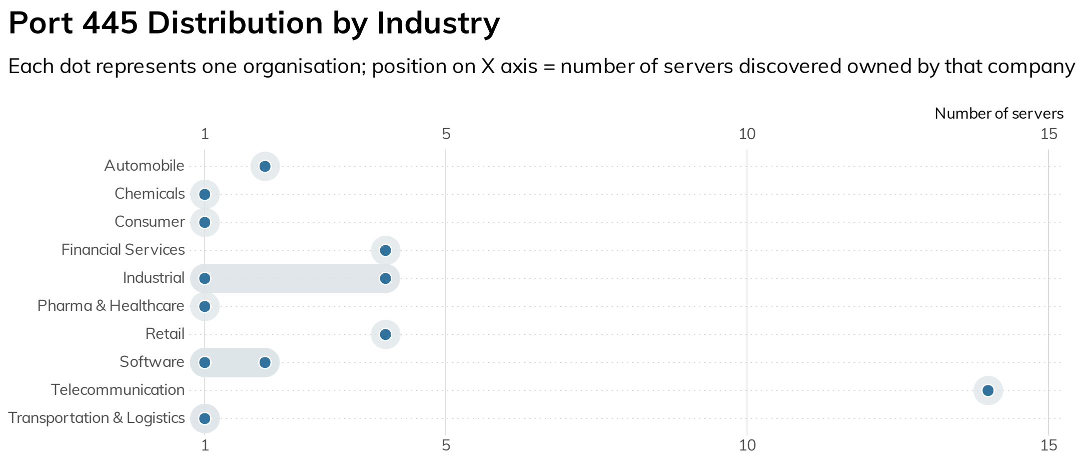
When we surveyed the DB 314, we decided to look at 2 different SMB ports: 139/tcp and 445/tcp. Port 139/tcp is used for older variants of SMB, and its presence is generally a sign of very old software and legacy requirements. In our surveys, we found 9 servers across 3 companies. They were all running an open source SMB server called Samba[27] The oldest version of Samba we observed, 3.0.36, was released in late 2009 and contains quite a few critical vulnerabilities.


Port 139 Distribution by Industry

Each dot represents one organisation; position on X axis = number of servers discovered owned by that company

Figure 13: Port 139 Distribution by Industry

We also surveyed SMB on port 445/tcp. Introduced in Windows 2000, this transport for SMB removed some of the legacy protocol overhead. In our research, we observed 40 servers across 15 organisations.


Port 445 Distribution by Industry

Each dot represents one organisation; position on X axis = number of servers discovered owned by that company

Figure 14: Port 3389 Distribution by Industry

[27] https://www.samba.org/

The mere presence of these SMB servers on the internet is cause for concern, but when we dug into the protocol configurations, the concern increased. All servers supported SMBv1, which means they are missing several critical security controls, and attackers can force clients to downgrade to SMBv1 from more secure versions of the protocol. All 40 servers we observed supported a newer version of SMB and so, absent a dependency by legacy systems, shouldn't need to have SMBv1 enabled. We strongly recommend Microsoft's guidance to disable SMBv1.[28]

SMBv3 was released with Windows Server 2012 and included many security and performance improvements [29], such as encryption of data on the wire-and-protocol downgrade protections. SMBv3 was supported on 68% of the observed servers.

These SMB services also leaked information about the organisation. All of the services provided a hostname, DNS name, and fully qualified domain name (FQDN) configured on the host. This information may indicate role (VCENTER01) or indicate internal organisational structure `(db1.prod.us.corp.local)`.

Telnet

Telnet is a plaintext-based protocol used for providing remote-console access to devices. It nearly always transmits credentials and data in cleartext and has no protections against man-in-the-middle (MiTM) injection of commands or data.

Originally specified in 1969, Telnet is well past its "Use By" date and has been superseded by other, more-secure technologies such as SSH. Our survey found 70 hosts across 19 companies. The majority of these hosts were in the Pharma and Healthcare sector.

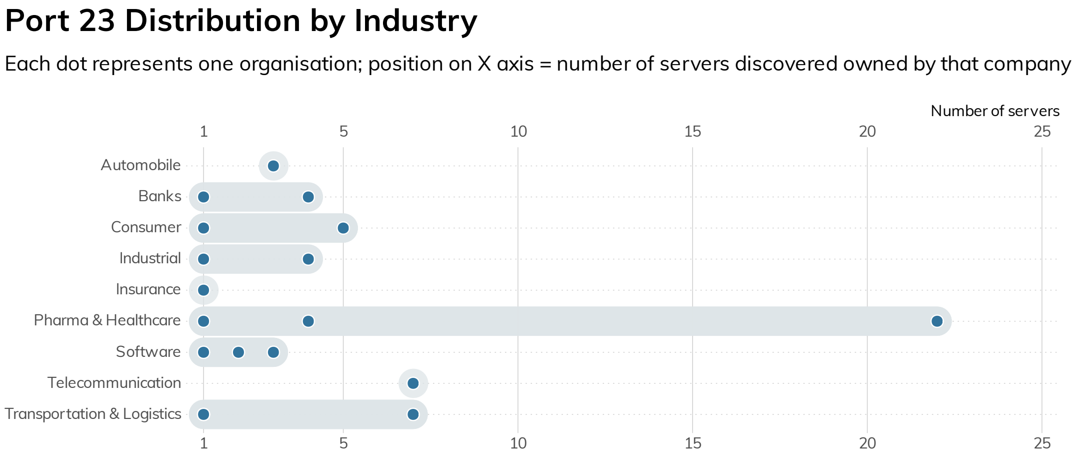
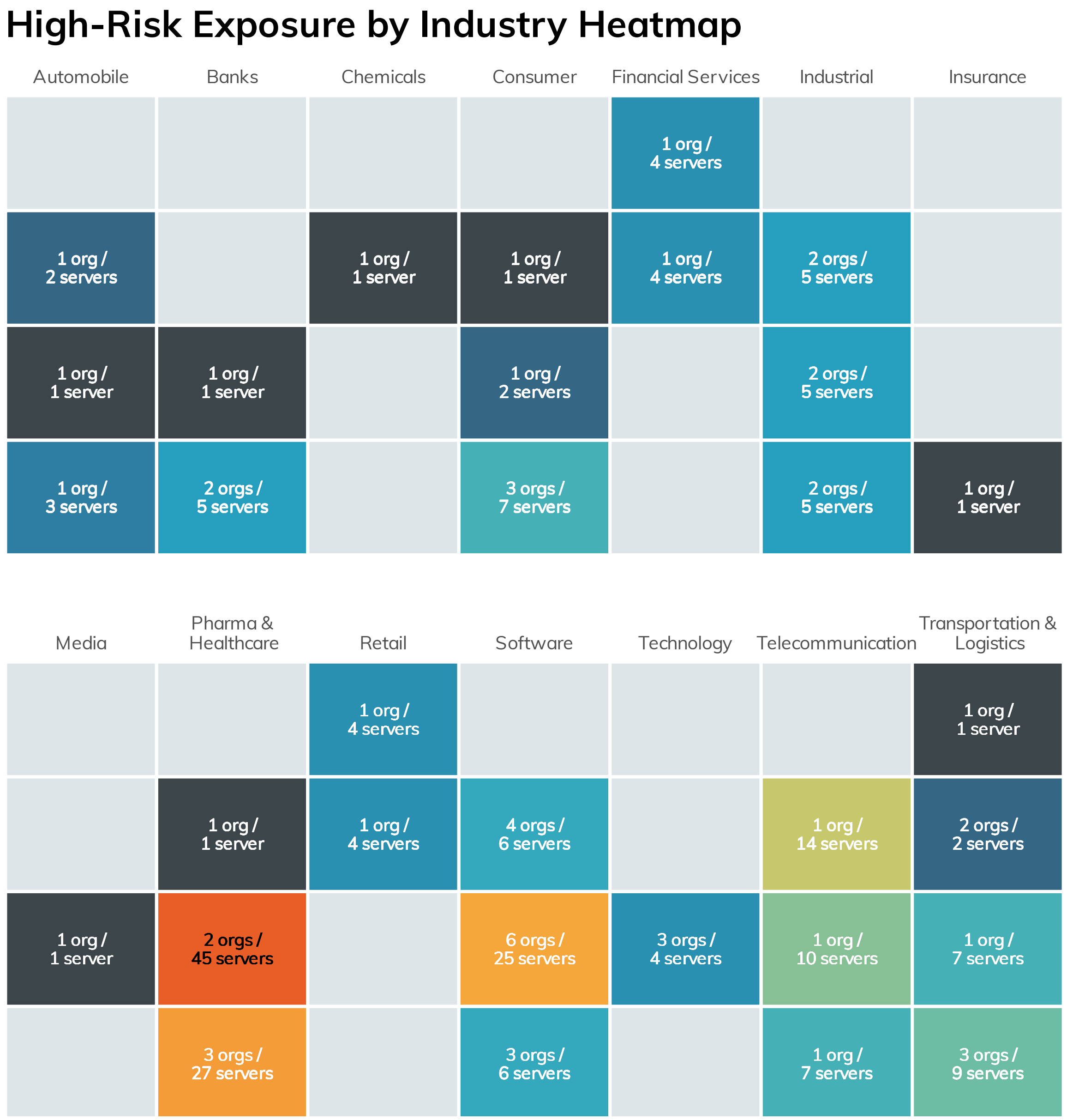


Figure 15: Port 23 Distribution by Industry

[28] https://techcommunity.microsoft.com/t5/storage-at-microsoft/stop-using-smb1/ba-p/425858
[29] https://docs.microsoft.com/en-us/windows-server/storage/file-server/file-server-smb-overview

Most of the equipment was found to be a router or switch, though there were a handful of industrial control systems (ICS) gateways, cameras, firewalls, and servers. As a general rule, it's considered insecure to use Telnet as opposed to more secure protocols such as SSH. Also, if Telnet is unavoidable, firewall access control lists (ACLs) and other controls should be used to limit which internet IPs can access the devices. Since our survey process had to make connections from multiple IPs—in some cases in different countries—to validate a service, we can say that this was likely not in place or overly broad.

When we look across the surveyed protocols and industries, we can see that there are certain hotspots.



High-Risk Exposure by Industry Heatmap

	Automobile	Banks	Chemicals	Consumer	Financial Services	Industrial	Insurance
139					1 org / 4 servers		
445	1 org / 2 servers		1 org / 1 server	1 org / 1 server	1 org / 4 servers	2 orgs / 5 servers	
3389	1 org / 1 server	1 org / 1 server		1 org / 2 servers		2 orgs / 5 servers	
23	1 org / 3 servers	2 orgs / 5 servers		3 orgs / 7 servers		2 orgs / 5 servers	1 org / 1 server

	Media	Pharma & Healthcare	Retail	Software	Technology	Telecommunication	Transportation & Logistics
139			1 org / 4 servers				1 org / 1 server
445		1 org / 1 server	1 org / 4 servers	4 orgs / 6 servers		1 org / 14 servers	2 orgs / 2 servers
3389	1 org / 1 server	2 orgs / 45 servers		6 orgs / 25 servers	3 orgs / 4 servers	1 org / 10 servers	1 org / 7 servers
23		3 orgs / 27 servers		3 orgs / 6 servers		1 org / 7 servers	3 orgs / 9 servers

Figure 16: High-Risk Exposure by Industry Heatmap

While it is surprising most of the RDP exposure is in the Pharma and Healthcare industry (as opposed to Information Technology) it is important to keep in mind that most of this is due to the outsized impact of just 1 company which we will not name for obvious reasons.

On a more positive note, when excluding cloud and ISP network ranges, we did not observe these services on the default ports for 280 of the DB 314 companies.

CISO Takeaways

The findings here indicate that even some of the most resourced companies are exposing services that have an outsized risk.

Our guidance for addressing the risks above isn't to implement some advanced security controls or software, but instead to return to the basics. You can find all of them in the early parts of the CIS Top 20[30] controls.

- Develop and maintain an inventory of internet-facing hosts that includes software versions, roles, and services that are expected to be exposed, as well as the reason why. Make sure that this inventory is validated by outside-in scans of all of your public-facing IP ranges.
- Implement security policies and supporting configuration standards that enforce the use of secure protocols and configuration settings. Using the example of Telnet, every device currently using Telnet should be able to support SSH—and if it doesn't, it is too old or insecure to be directly connected to the internet.
- Ensure that software and hardware are kept current. In many cases, such as with Microsoft Windows, newer software brings better security features and controls. Older software's lack of these features can force security trade-offs and require the implementation of compensating controls, which add complexity.

[30] https://www.cisecurity.org/controls/cis-controls-list/

Vulnerability Disclosure Programs Among the Deutsche Börse 314

Special thanks to Andreas Galauner who made sure our regional searches for VDPs in Germany were appropriately German.

Every major corporation on Earth is a technology company[31]. It is unthinkable that a business that generates billions of pounds in revenue and employs thousands of workers worldwide would not have a significant technological investment in their products, processes, and logistics. We rely on fantastically advanced technology in every aspect of our modern lives. Of course, anyone who has spent any time analysing these technologies will notice that we are routinely bedevilled with vulnerabilities, especially when it comes to internet-based technologies. As it happens, we have a powerful and proven method to stem the tide of vulnerabilities in major technologies: coordinated vulnerability disclosure[32] (CVD), and a now-standard mechanism to participate in CVD, vulnerability disclosure programmes[33] (VDPs).

The presence of a publicly accessible VDP is conspicuously lacking across most of the companies listed in The presence of a publicly accessible VDP is conspicuously lacking across most of the companies listed in the DB 314, which, in turn, makes it difficult for those companies to ever learn about vulnerabilities in their products and technical infrastructure in a constructive way. While VDPs are more common today among the U.S.-based Fortune 500 (about 20%), these programs are largely absent in the DB 314: Only 34 of the exchange-listed companies (or about 11%) have a discoverable VDP. Without vulnerability disclosure programs, these industries are telegraphing that they do not want to know about their own vulnerabilities, intentionally or not, to their shareholders' and customers' peril. For this study, we searched for VDPs associated with the DB 314 listed companies and the flagship brands of those companies, much in the same way we would if we were about to disclose a vulnerability about those companies' products or services. Specifically, we looked for the following, in this order:

- The presence of a VDP associated with all FTSE 350 listed companies (or flagship brands of those companies) listed on either Bugcrowd's[34] or HackerOne's[35] crowdsourced bug bounty lists, or in the Disclose.io[36] programme database.
- The presence of a standardised security.txt file on each company or flagship brand website to facilitate the sharing of discovered vulnerabilities with website maintainers.
- An obvious pointer to, or indication of, a VDP offered by the candidate companies by Googling the terms "vulnerability," "disclosure," and "security" along with the company name and flagship brand.

The initial survey was conducted in December 2020 and reviewed again in January 2021. It is possible some of the surveyed companies that appear to not offer a VDP do, in fact, have a process for receiving vulnerability intelligence, but the lack of an easily discoverable VDP drastically undercuts the effectiveness of the VDP for both researchers and the companies.

[31] https://www.wsj.com/articles/every-company-is-now-a-tech-company-1543901207

[32] https://blog.rapid7.com/2018/10/31/prioritizing-the-fundamentals-of-coordinated-vulnerability-disclosure/

[33] https://blog.rapid7.com/2016/11/28/never-fear-vulnerability-disclosure-is-here/

[34] https://www.bugcrowd.com/bug-bounty-list/

[35] https://hackerone.com/directory/programs

[36] https://github.com/disclose/diodb/

Assessing the relative merits of individual VDPs is beyond the scope of this paper, but it should be noted that not all VDPs are created equal—some offer robust "safe harbor" protections for researchers and accidental discoverers when reporting and publishing vulnerabilities, while others seek to bind researchers in restrictive agreements about what can be assessed and how results are to be handled and communicated. For this paper, the mere existence of a VDP, no matter how liberal or restrictive, counts as a positive.

Results: Prevalence of VDP Adoption

In January 2019, Bugcrowd founder and noted Australian Casey Ellis remarked in a blog post that "only 9% of the Fortune 500 run vulnerability disclosure programs.[37] " This is right about what we found in Germany in the first half of 2021. We were able to discover a total of 34 vulnerability disclosure programs across the 314 ticker symbols investigated in April 2021, which accounts for about 11% of the DB 314 listings.

With such a low showing, it's difficult to say that any particular industry or valuation quintile has normalised the practice of advertising a VDP—the industries represented in this set are Automobile (6), Banks (1), Chemicals (2), Industrial (5), Media (1), Pharma & Healthcare (3), Retail (4), Software (5), Technology (3), and Telecommunications (3), which is a pretty representative cross-section of the DB 314 overall.

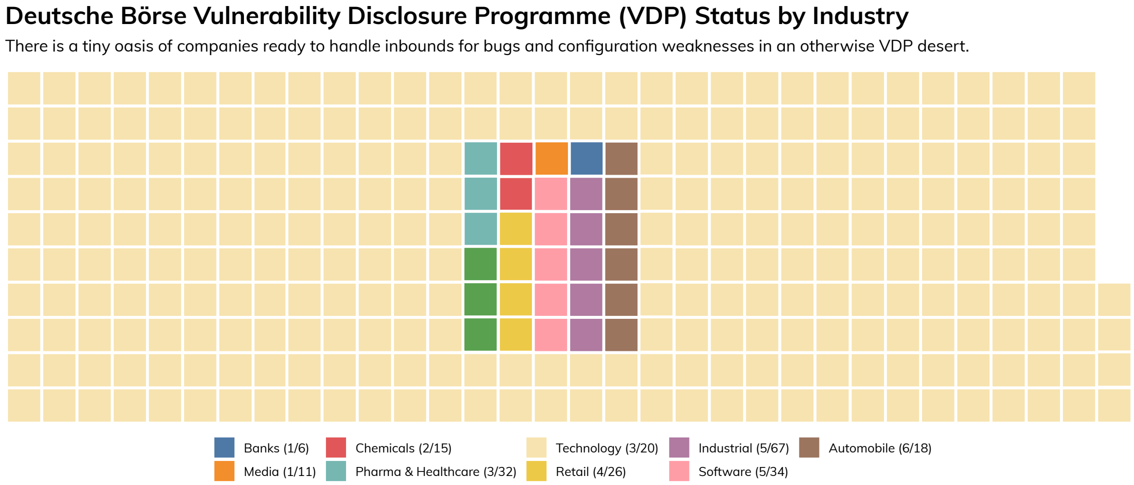


Figure 17: Deutsche Börse Vulnerability Disclosure Programme (VDP) Status by Inudstry

The key takeaway from this view of the DB 314 is that, while all major companies have some technical component (and therefore have technical vulnerabilities), nearly 90% of these top companies in Germany lack a formal vulnerability disclosure program. While this might be understandable in prior decades, this state of affairs is simply unacceptable in today's hyper-technical business environment.

The lack of VDPs across the upper echelons of the German economy discourages the reasonable and responsible disclosure of newly discovered vulnerabilities in their products, services, and infrastructure—after all, VDPs aren't just for reporting software bugs in software applications, but are also useful for reporting the discovery of sensitive data found about customers or company internals left open on insecure cloud storage.

[37] https://www.bugcrowd.com/blog/3-reasons-why-every-company-should-have-a-vdp/

It is, of course, possible to disclose vulnerabilities to companies in industries without a formal VDP, but the lack of VDPs introduces inefficiencies for the companies and legal risk to researchers.

Finally, a functioning VDP signals that a given company has made some investment in their overall information security program, so it stands to reason that the lack of a VDP is signaling the opposite. Every company on this list has a website privacy policy, so every company should have some formal method for receiving and handling vulnerability reports.

CISO Takeaways

Hopefully, it is obvious by now that the authors of this paper are strong proponents of clearly defined, easily discoverable vulnerability-disclosure programs. We believe that every company in the DB 314 (and beyond) should adopt one.

Launching and running a successful VDP may be tricky—after all, the presence of a VDP implies a level of security maturity that may not yet exist at a given company, so CISOs at organisations without a VDP are strongly encouraged to familiarise themselves with the basics of vulnerability disclosure.

We believe there is a critical mass of CISO expertise in building and maintaining VDPs, and that there is plenty of opportunity to learn from the experiences of others in the field. In our experience, not only do CISOs personally enjoy discussing their VDP experiences, but it can be hard to stop them when they get going.

ISO 29147[39] (Information technology—Security techniques—Vulnerability disclosure) and ISO 30111[40] (Information technology—Security techniques—Vulnerability handling processes) are excellent starting points for building, maintaining, and improving a vulnerability-disclosure programme. These ISOs were developed in partnership with internationally recognised experts in the field of vulnerability disclosure, and can help any CISO get a leg up.

Another first-step approach to establishing a minimal VDP is a contact and policy document placed at `<hxxps://your-company.com/.well-known/security.txt>`. This is a relatively new standard for VDP communication that provides for basic contact-information signalling, readable by both humans and machines.[41]

[38] https://www.iso.org/standard/72311.html
[39] https://www.iso.org/standard/69725.html
[40] Interested CISOs can read up on it at https://securitytxt.org/

Conclusion

The global COVID-19 pandemic forced many of these companies to abruptly shift to a large work-from-home workforce in short order, and each company is its own miracle of corporate survival in the face of such drastic and unprecedented changes to the workplace. In addition, German companies are doing extremely well in stamping out dangerously exposed services.

However, these companies are lagging their international counterparts in the 4 other areas we measured for this report. More progress must be made, and faster. Because of their outsized position in the German business community, they also tend to have access to the best and brightest cybersecurity experts from around the world, and so it is incumbent upon them to behave more like model internet citizens. The researchers at Rapid7 who contributed to this report sincerely hope that these companies—and the organisations that have business relationships with these companies—find this information and advice useful in our shared responsibility of advancing security for everyone.

CISO at a Glance

Throughout this report, we've kept our focus on what CISOs in the DB 314 can do, today, to reduce their exposure to the most common issues we've discussed here. For the reader's convenience, those recommendations are summarised here

Email Security: If you're on the Domain-based Message Authentication, Reporting & Conformance (DMARC) path, like 39% of the DB 314, that's great! Now is the time to plan out how you'll move from a `p=none` to a `p=quarantine` policy, and ultimately a `p=reject` policy. This is not an easy journey, since you will certainly uncover pockets of shadow IT running their own email infrastructure, but the confidence of being able to authenticate mail from your major brand domains is a pretty great feeling, and a nice item to report to your board of directors.

Web Security: HTTP Strict Transport Security (HSTS) is rapidly becoming table stakes for running a reasonably secure website, and this is the kind of security feature that browser manufacturers like Google, Apple, Microsoft, and Mozilla are likely to enforce in future versions of Chrome, Safari, Edge, and Firefox. It's a relatively easy switch that CISOs can flick (compared to the universe of nice-to-haves in cybersecurity, anyway), so take some time to investigate whether your organisation is using HSTS; and if not, why not?

Version Dispersion: For the mega-corporations that roam the fields of capitalism, mergers and acquisitions are a fairly common activity throughout the year. That means the DB 314 CISO is never truly “done” with ensuring version consistency across the enterprise, even after investing in an excellent asset and vulnerability-management toolchain. New networks and network services will join your ranks, and that means undertaking a fairly continuous modernisation and normalisation effort for those new assets. Taking on this continuous effort will pay off in easier, more straightforward planning for the next patch cycle, scheduled or surprise.

High-Risk Services: Telnet, SMB, and RDP have no business being exposed directly to the world at large, and are just waiting for the next self-replicating cyberattack to sweep across the internet. An up-to-date inventory of exposed services, sourced from internal and external scanning, is worth its virtual weight in Bitcoin, and will help you enforce a no-nonsense policy of network-service exposure to the internet. As stated above, though, there are very few of these exposed services left in the DB 314 as of 2021.

Vulnerability Disclosure Programs: As a CISO, you might have hired on the best of the best software, QA, and platform engineers. But, without a good way to harness the smarts of the tens of thousands of talented hackers around the world, you may never learn about the most critical vulnerabilities in your products and services. A VDP is a bridge to that enormous community of well-meaning investigators who have goals aligned with your own: a safer and more secure internet. Getting that program spun up now will give you plenty of time to practice safer software production. As a bonus, most of the pioneering work is already done for you, in the form of ISO 29147 and ISO 30111.

Appendix: Prioritisation in Times of Crisis

The disclosure of both the SolarWinds-related multiple-technology vulnerabilities (and associated campaigns), the release of the out-of-band Microsoft Exchange patches responding to active exploitation campaigns, and the Codecov compromise that will undoubtedly impact many, many software development CI/CD processes, have all strained virtually every single information security team in every industry. We wanted to take a moment to help ensure you're on safer ground now, and also put each section into context relative to some of the crises we have already had to deal with this year.

The SolarWinds and Codecov situation brought third-party risk squarely into focus like it has never been before. If you had a solid list of partners/vendors and a well-oiled contact plan (which many organisations did), you may have weathered that portion of these extended incidents fairly well. If not, we hope you had the support required to put such things in place and have been able to use it in some subsequent serious vulnerability disclosures and exploit campaigns since.

When it comes to being able to get a feel for how well a partner/vendor values safety and resilience, you may want to heed the advice in the "CISO Takeaway" section. It's much easier to sleep at night knowing that the bulk of your third-party contacts prioritise email safety, avoid exposing dangerous services to the internet, and stay current with both patching and advanced encryption standards. You will also know how to contact them in the event you do discover a security issue with any of their products and services, since they'll have a vulnerability-disclosure program in place.

Similarly, the massive Exchange vulnerability and associated malicious campaigns further demonstrated how quickly 1 weakness in a component used by hundreds of thousands of organisations can come out of the blue to disrupt execution on even the most well-crafted enterprise information-security roadmap. Having current, accurate telemetry of what is deployed internally and externally, along with highly agile quality assurance and change management processes (as noted in the section on version complexity), can be the difference in having an unexpected patch (like Exchange) be a quick exercise with a slight bit of triage (to ensure attackers did not have time to target you) versus an "all hands on deck" massive incident.

We hope our quantification, context, and advice prove useful to you as you emerge from these 2 major incidents to take on the remaining challenges that await us all in 2021 and beyond.