

2009 Data Breach Investigations Supplemental Report

A study conducted by the Verizon Business RISK team.

For additional updates and commentary, please visit <http://securityblog.verizonbusiness.com>.

AUTHORS:

Wade H. Baker
C. David Hylender
J. Andrew Valentine

CONTRIBUTORS:

Thijs Bosschert
Eric Brohm
Calvin Chang
Ron Dormido
K. Eric Gentry
Mark Goudie
Ricky Ho
Alex Hutton
Stan S. Kang
Wayne Lee
Jelle Niemantsverdriet
Christopher Novak
David Ostertag
Raphael Perelstein
Christopher Porter
Michael Rosen
Bryan Sartin
Enrico Telemaque
Peter Tippet, M.D., Ph.D.
Matthijs Van Der Wel
Ben Van Erck
RISK Intelligence Team
ICSA Labs

TABLE OF CONTENTS

Introduction	2
Threat Action Catalogue	3
Threat Action Type	6
1. Keyloggers and Spyware	7
2. Backdoor or Command/Control	8
3. SQL injection	9
4. Abuse of system access/privileges	10
5. Unauthorized access via default credentials	11
6. Violation of Acceptable Use and other policies	12
7. Unauthorized access via weak or misconfigured ACLs	13
8. Packet Sniffer	14
9. Unauthorized access via stolen credentials	15
10. Pretexting (Social Engineering)	16
11. Authentication bypass	17
12. Physical theft of asset	18
13. Brute-force attack	19
14. RAM scraper	20
15. Phishing (and endless *ishing variations)	21
Conclusion	22
Appendix A: Comparison of Verizon IR dataset to DataLossDB	23
Methodology	24
Dataset Comparison	25
Conclusions	30

2009 Data Breach Investigations Supplemental Report

A study conducted by the Verizon Business RISK team

Introduction

The Data Breach Investigations Report (DBIR) is an annual publication based on cybercrime cases worked by Verizon's Investigative Response team. Following the release of the original DBIR in June of 2008, many readers requested industry-specific results. In response, we published a supplemental report comparing statistics along four industries in October of that same year. After releasing the 2009 DBIR (April 2009), it was unclear as to whether a supplemental would be forthcoming. The decision was deferred to see which topics (if any) might arise to warrant an additional publication.

In the months that followed, five themes kept coming up during DBIR-related presentations and conversations:

1. A desire for data on impact or losses
2. An interest in case studies and "war stories"
3. A need for more detailed explanations of attacks
4. Requests for additional recommendations for deterring, preventing, and detecting breaches
5. Questions regarding the amount of bias in our dataset and how it differs from other breach listings and reports

This is quite a diverse collection of topics to cover in a single report, but we're not ones for giving up easily.

As described [here](#)¹, evidence gathered during a breach investigation is not sufficient to quantify losses. We put our heads together on the remaining topics and felt that putting the data in the format provided would go far toward achieving these goals. Items 2-4 are addressed in the Threat Action Catalogue section of this document. To address the final request (at least partially), we have also included Appendix A, which compares all five years of our caseload to incidents reported to the well-known DataLossDB community research project.

Overall, this supplemental report is a break from the norm for the DBIR series. Rather than heavily centered around statistics, it is much more descriptive and narrative. This change in direction represents what we felt to be the most suitable form for the intended function. We hope the detour proves worth your time and that it leads to a better understanding of what possible problems your organization might face, and how to be better prepared to meet them.

As always, we would like to reiterate that we make no claim that the findings of this report are representative of all data breaches in all organizations at all times. The narratives and statistics are based solely upon our caseload and any conclusions or recommendations we make are drawn from this sample. Although we believe this information to be appropriate for generalization, bias undoubtedly exists. Even so, there is a wealth of information here and no shortage of valid and clear takeaways. As with any study, the reader will ultimately decide which findings are applicable within their organization.

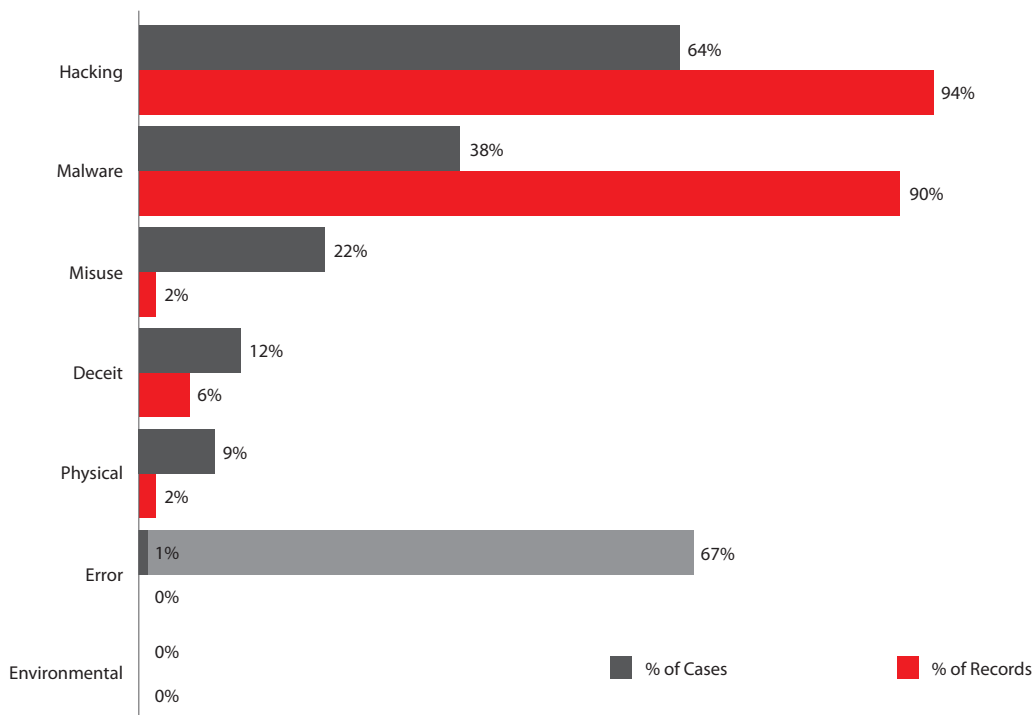
Finally, it is important to note that Verizon is committed to maintaining the privacy and anonymity of Investigative Response clients. This supplement report includes a number of Case Examples to illustrate our point. While these examples are based on our real world experiences, we altered certain non-essential case details to maintain client anonymity.

¹ <http://securityblog.verizonbusiness.com/2009/04/16/to-dbir-show-me-the-money/>

Threat Action Catalogue

As stated in the introduction, we often receive requests for additional information and explanation surrounding incidents presented in the DBIR. Sometimes this involves clarifying our terminology, but often includes details like indicators that an attack is underway or has already occurred, circumstances in which various attacks take place, how they unfold, what commonalities exist, which controls are effective, and where we find evidence during an investigation. To help answer such questions, we offer the catalogue contained in this section which covers the top 15 threat action types as presented in the 2009 DBIR.

Figure 1. Threat categories by percent of breaches (black) and records (red)



Before we begin, though, some clarification is prudent. Figure 1 is taken from the 2009 DBIR and depicts the seven *categories* of threat actions used by Verizon. Each category contains multiple sub-categories or *types* that are also presented in the report (for example, see Figure 15 on page 17 in the 2009 DBIR for a breakdown of types within the Hacking category). The DBIR discusses common types of threat actions within the context of each category but does not include an inter-category “top to bottom” ranking. Such a view is given in Table 1, in which the 15 most prevalent threat actions are listed, along with their frequency and impact (measured in amount of data records compromised), across our caseload.

Table 1. Top 15 threat action types from 2009 DBIR

Threat Category	Threat Action Type	Legend	% of Breaches	% of Records
Malware	Keyloggers and Spyware	KEYLOG	19%	82%
Malware	Backdoor or Command/Control	BACKDR	18%	79%
Hacking	SQL injection	SQLINJ	18%	79%
Misuse	Abuse of system access/privileges	ABUSE	17%	1%
Hacking	Unauthorized access via default credentials ²	DFCRED	16%	53%
Misuse	Violation of Acceptable Use and other policies ³	POLICY	12%	<1%
Hacking	Unauthorized access via weak or misconfigured ACLs	WKACL	10%	66%
Malware	Packet sniffer ⁴	SNIFFER	9%	89%
Hacking	Unauthorized access via stolen credentials	STLCRED	8%	<1%
Deceit	Pretexting (Social Engineering)	SOCIAL	8%	2%
Hacking	Authentication bypass	BYPASS	6%	<1%
Physical	Physical theft of asset	THEFT	6%	2%
Hacking	Brute-force attack	BRUTE	4%	7%
Malware	RAM scraper ⁴	RAMSCR	4%	<1%
Deceit	Phishing (and *ishing variations)	PHISH	4%	4%

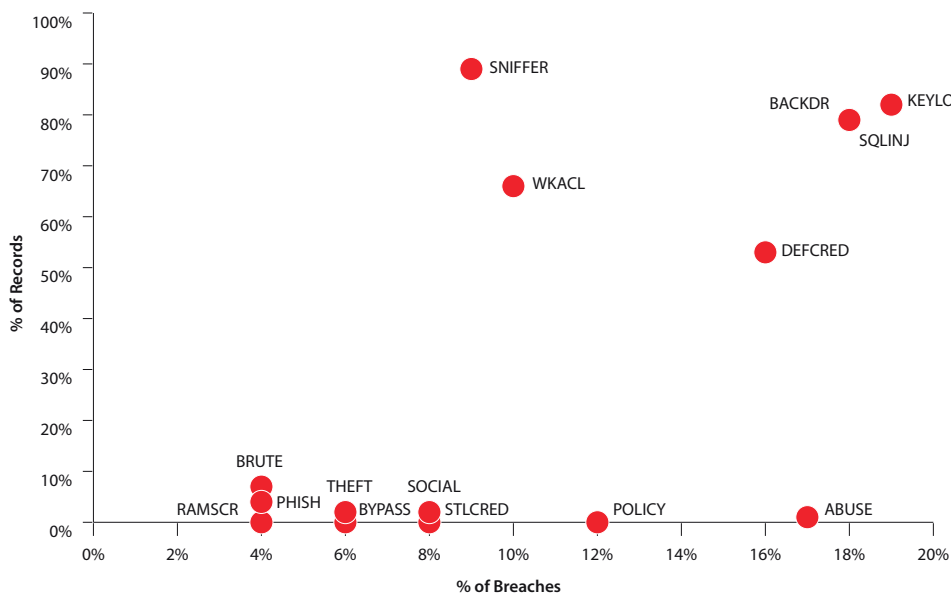
It is important to note that the figures given in Table 1 represent the percent of records compromised by breaches in which the threat action occurred, not necessarily records attributed exclusively to that threat action. For instance, Keyloggers and Spyware compromised only a few hundred records (mostly authentication credentials) but played a crucial role in larger breach scenarios in which hundreds of millions of records were compromised. While most action types listed in Table 1 appear exactly as they did in the 2009 DBIR (and can thus be cross-referenced), some have changed. These are denoted by a footnote explaining the change.

² Listed as "Unauthorized access via *default* or *shared* credentials." Oftentimes the breach involved both but, for this catalogue, we narrow the focus to default credentials (which generally played more of key role in the breach).

³ Combines "Violation of other security policies" and "Violation of PC/Email/Web use policies."

⁴ Separates malware types/functions listed as "Captures and stores data" to allow individual treatment of these two methods of capturing data.

Figure 2. Top 15 threat action types plotted by percent of breaches (x) and percent of records (y).



The information recorded in Table 1 is represented in Figure 2 with the percentage of breaches (frequency) along the x-axis and percentage of compromised records (impact) along the y-axis. It is immediately apparent that even among the top 15, a relatively small subset dominates the field. In the catalogue that follows, each of these 15 threat actions are given individual treatment. The catalogue follows a standard template that contains the information shown in Table 2 for each entry. Table 2 is immediately followed by the first entry in the catalogue, Keyloggers and Spyware.

It is immediately apparent that even among the top 15, a relatively small subset dominates the field. In the catalogue that follows, each of these 15 threat actions are given individual treatment.

Table 2. Explanation of information contained in the threat action catalogue.

Threat Action Type

Description	A brief explanation of the threat action.
Types / Variations	Identifies common types, variations, alternate forms and functions, etc.
Frequency	Frequency of occurrence by percent of breaches across caseload.
Impact (data loss)	Percent of total data (records) compromised across caseload.
Associated Industry	If the threat action is particularly common to certain industries, they are identified here.
Associated Threat Sources	Identifies the most common sources (External, Internal, Partner) of the threat action.
Associated Threat Actions and Vectors	Most incidents involve multiple threat actions or events. Some action types are often seen in tandem. Such associations are identified here along with common vectors or pathways.
Associated Assets and Data	Identifies assets commonly targeted or affected by the threat action.
Indicators	A listing of warning signs and controls that can detect or indicate that a threat action is underway or has occurred.
Mitigators	A listing of controls that can deter or prevent threat actions or aid recovery/response (contain damage) in the wake of their occurrence.
Case Example	An example of how the threat action was used within a breach scenario in our caseload.

1. Keyloggers and Spyware

Description	Malware that is specifically designed to collect, monitor, and log the actions of a system user. Typically used to collect usernames and passwords as part of a larger attack scenario. Most run covertly to avoid alerting the user that their actions are being monitored.
Types / Variations	There are numerous keylogging varieties, ranging from hardware and software to electromagnetic and acoustic analysis. They can capture data from the system or keyboard along with other connected devices such as a payment card reader. Spyware is almost always software-based but can make use of system hardware (i.e., webcam) as well. Varieties that capture and send information are more common than those that capture and store for later retrieval.
Frequency	Factor in 19% of breaches in caseload
Impact (data loss)	Factor in 82% of records compromised in caseload
Associated Industry	Ubiquitous but particularly common to breaches in the Retail and Financial Services industries.
Associated Threat Sources	Predominately external sources but also used to harvest partner credentials and gain trusted access. Insiders also cause infection (i.e., web browsing).
Associated Threat Actions and Vectors	Infection usually occurs through web browsing (sometimes legitimate but mostly <i>Violations of Acceptable Use policies</i>), after a remote attacker gains access to the system, or downloaded via <i>SQL Injection</i> . Contributes to <i>Unauthorized access via stolen credentials</i> and is often paired with <i>Backdoor or Command/Control</i> . The hardware-based versions require physical access to the device, which is more difficult and less common.
Associated Assets and Data	Typically installed on end-user systems and servers. Authentication credentials for applications and remote access services are commonly stolen but personal information and other data types are targeted as well.
Indicators	<p>Unusual system behavior or performance; unusual network activity; IDS/IPS (for non-customized versions); registry monitoring; system process monitoring; routine log monitoring; presence of other malware on system; signs of physical tampering (i.e., attachment of foreign device). For indicators that harvested credentials are in use, see <i>Unauthorized access via stolen credentials</i>.</p> <p>During investigations involving suspected malware we commonly examine active system processes and create a list of all system contents sorted by creation/modification date. These efforts often reveal malicious files in the Windows\system32 and user temporary directories.</p>
Mitigators	Restrict user administrative rights; code signing; use of live boot CDs; onetime passwords; anti-virus and anti-spyware; personal firewalls; web content filtering and blacklisting; egress filtering (these tools often send data out via odd ports; protocols, and services); host IDS (HIDS) or integrity monitoring; web browsing policies; security awareness training.
Case Example	<p>A mid-size medical instrument manufacturer was alerted by law enforcement that systems belonging to them were communicating with IP addresses known to have a criminal connection. During the early stages of Verizon's investigation, the suspicious activity was traced to a laptop belonging to a member of the company's IT staff. After imaging the disk, investigators were able to verify that malware was present on the system. It was configured to run automatically as a service in the background while logging keystrokes and recording browsing activity.</p> <p>The keylogger stored the captured data in a ".key" file saved in the C:\windows\system32 directory. The infected host frequently attempted to connect to the same website over an uncommon port. These connection attempts executed a POST command of a randomly named file with the .jsp extension. Time stamps associated with the keystroke log revealed that it was created on the same date that the malware was introduced onto the system. Keystroke log entries indicated that it had been continuously capturing data since being activated months prior. A review of contents in file revealed the user's domain account credentials, home address, telephone number, and bank account information.</p>

2. Backdoor or Command/Control

Description	Tools that provide remote access to and/or control of infected systems. Backdoor and command/control programs bypass normal authentication mechanisms and other security controls enabled on a system and are designed to run covertly.
Types / Variations	The most common variety is foreign malicious software, but hijacked or modified versions of legitimate administrative tools are used for this purpose as well.
Frequency	Factor in 18% of breaches in caseload
Impact (data loss)	Factor in 79% of records compromised in caseload
Associated Industry	Common to all types of organizations
Associated Threat Sources	Predominately malicious external sources
Associated Threat Actions and Vectors	Usually installed by a remote attacker after gaining access to the system or downloaded via <i>SQL injection</i> . Web browsing (sometimes legitimate but mostly <i>Violations of Acceptable Use policies</i>) is also an infection vector. Very often seen in conjunction with other types of malware, particularly <i>Packet Sniffers</i> because attackers utilize backdoors to retrieve captured data.
Associated Assets and Data	Usually installed on servers, the ultimate target being those that process, store, or transmit sensitive data or provide some advantage to the attacker (i.e., opportunity to escalate or prolong the attack). Sometimes found on end-user systems.
Indicators	<p>Unusual system behavior or performance (several victims noted watching the cursor navigating files without anyone touching the mouse); unusual network activity; IDS/IPS (for non-customized versions); registry monitoring; system process monitoring; routine log monitoring; presence of other malware on system; previous SQL injection attacks; AV disabled.</p> <p>During investigations involving suspected malware we commonly examine active system processes and create a list of all system contents sorted by creation/modification date. These efforts often reveal malicious files in the Windows\system32 and user temporary directories.</p>
Mitigators	Egress filtering (these tools often operate via odd ports, protocols, and services); IP blacklisting (consider blocking large address blocks/regions if they have no legitimate business purpose); host IDS (HIDS) or integrity monitoring; restrict user administrative rights; personal firewalls; data loss prevention (DLP) tools; anti-virus and anti-spyware (although increased customization rendering AV less effective—we discovered one backdoor recognized by only one of forty AV vendors we tried); web browsing policies.
Case Example	<p>When a researcher in a pharmaceutical firm noticed unusual content and activity on an R&D system, Verizon was called to investigate the possibility of a breach. Investigators were quickly able to verify that a breach had occurred and began working to determine the likelihood and scope of data compromise.</p> <p>Because it contained highly sensitive assets and data, the R&D lab was not Internet facing and was segregated from the rest of the corporate network. It was clear, however, that the environment was exposed. The investigation revealed over 20 unique varieties of backdoor programs. The perpetrators had command line access to numerous systems and could pass traffic at will between the lab and external systems located in Asia. Analysis of system contents confirmed files had been created, accessed, modified, duplicated, and moved around the environment. Though there was no concrete evidence to show that data had been removed, there was nothing that would have prevented the attackers from doing so, and many indicators that they had, in fact, done so. Naturally, the victim was concerned about the exposure of several ongoing research projects involving high value intellectual property (IP) as well as other extremely sensitive information.</p> <p>As to how the assailants first gained access, investigators found a non-sanctioned commercial remote desktop program on one of the R&D workstations. Apparently, one of the researchers installed it in order to access the system from home. Eventually, attackers exploited security settings in the software, which allowed them to implant the first instances of malware into the lab.</p>

3. SQL injection

Description	SQL Injection is an attack technique that is used to exploit how web pages communicate with back-end databases. An attacker can issue commands (in the form of specially crafted SQL statements) to a database using input fields on a website.
Types / Variations	SQL Injection has three main uses: 1) query data from the database, 2) modify data within the database, and 3) cause the server to download malware from remote sites. The versatility and effectiveness of SQL Injection make it a multi-tool of choice among cybercriminals.
Frequency	Factor in 18% of breaches in caseload
Impact (data loss)	Factor in 79% of records compromised in caseload
Associated Industry	Common to all types of organizations with web applications that communicate with back-end databases.
Associated Threat Sources	Predominately malicious external sources.
Associated Threat Actions and Vectors	Can be a stand-alone attack method but is often used in combination with other techniques and/or to introduce malware (especially <i>Packet Sniffers</i> , <i>Backdoor or Command/Control</i> , and <i>Keyloggers and Spyware</i>) into the victim environment. These attacks occur via web applications, many of which are custom-developed.
Associated Assets and Data	The target of SQL injection attacks is database servers, especially those that store sensitive data or are in a networked environment that contains sensitive data. SQL injection is used to compromise all types of data but is most commonly associated with payment card data across our caseload.
Indicators	Routine log monitoring (especially web server and database); IDS/IPS.
Mitigators	Secure development practices; input validation (escaping and whitelisting techniques); use of parameterized and/or stored procedures; adhere to principles of least privilege for database accounts; removal of unnecessary services; system hardening; disable output of database error messages to the client; application vulnerability scanning; penetration testing; web application firewall.
Case Example	<p>During a Monday morning balancing of their transactions, personnel at a European issuer of pre-paid debit cards found major discrepancies exceeding 5 million Euro in their ledger. For numerous cards used over the weekend, the available balance had been increased without a corresponding load increase from an authorized merchant. Verizon IR personnel arrived on-site the next day to acquire digital evidence.</p> <p>Through forensic analysis of web server logs, it was apparent that intruders originating from Russian IP addresses had used SQL injection strings to increase the value of multiple pre-paid credit card accounts. Furthermore, intruders also used SQL Injection to harvest credentials to the issuing web services page that allowed employees and merchants to manage card accounts sold at their store locations. Attackers logged in and altered properties (i.e., card value cap and transaction withdrawal limit) of pre-paid cards they purchased from merchants across Europe.</p> <p>With these loaded cards in hand, one group of criminals spent the weekend visiting ATMs all around the world. Another group spent it using SQL injection to reload cards as their values were depleted. Through these efforts, criminals successfully withdrew roughly 3 million Euro. As bad as that is, the heist would have been much worse if the card issuer had been lax about balancing transactions. Perhaps there's a lesson there for those of us responsible for reviewing ledgers of a different sort—those log entries that so often contain evidence of discrepancies in the normal functioning of our information systems.</p>

4. Abuse of system access/privileges

Description	Deliberate and usually malicious abuse of resources, access, or privileges granted to an individual by the organization.
Types / Variations	Varies by degree of access/privileges granted and the type of resources (spans physical, logical, network access).
Frequency	Factor in 17% of breaches in caseload
Impact (data loss)	Factor in 1% of records compromised in caseload
Associated Industry	Relevant to all types of organizations but more common to the Financial Services and Technology Services industries within our caseload.
Associated Threat Sources	Insiders and partners (because access/privileges are a prerequisite). Sometimes found to be colluding with external parties or even other internal parties.
Associated Threat Actions and Vectors	The nature of this threat is such that it is sufficient to accomplish the goal in and of itself. If one has privileged access already, one does not need methods of elevating privileges or circumventing controls. We observe a correlation between <i>Violations of Acceptable Use policies</i> and a propensity to engage in more malicious forms of misuse.
Associated Assets and Data	Any and all assets. Can be used to compromise all forms of data but more often targets IP and other corporate information rather than, for instance, bulk payment card data.
Additional Notes	Breaches involving insider abuse often occur after the employee is terminated or notified of termination.
Indicators	Monitor all administrative/privileged activity; user behavioral analysis (i.e., abnormal logon time); unusual employee behavior (i.e., odd hours or locations in the office); Acceptable Use policy violations.
Mitigators	Trust but verify. Pre-employment screening; do not hire known felons or those shown to be untrustworthy during screening process; adhere to principles of least privilege; separation of duties; rotation of duties; employee termination procedures (i.e., deprovision access and reclaim assets); minimize opportunities for collusion; time-of-use rules; periodic review of user access; network segregation; egress filtering; data loss prevention (DLP) tools; Acceptable Use policies that reflect risk tolerance (i.e., if high security requirements, restrict use of personal email from corporate assets, etc); use unique user accounts.
Case Example	<p>Verizon received a case in which an aerospace manufacturing company was concerned that they had experienced a breach leading to the compromise of intellectual property. The company grew suspicious when rumors surfaced about a competitor spinning up a new technology initiative eerily similar to one of their own secret projects. The research was unique enough that it was unlikely that the competitor would have independently made the knowledge advancements necessary to begin development.</p> <p>Verizon investigators met with corporate executives to identify where relevant information existed within the organization and ascertain who might have access to it. As it happened, the authorized list of individuals was relatively short and all but one was quickly exonerated. The remaining individual was a recently fired project lead (an obvious red flag) but those familiar with the project were certain that the IP in question did not exist until after his termination.</p> <p>Nevertheless, investigators examined all available evidence and discovered that the suspect's VPN account was still active. Although his company laptop had been confiscated, the IT department had not received his SecurID token or deactivated the VPN account. Closer inspection revealed that the account had been used on numerous occasions since the individual had left the company.</p> <p>The pieces all fit together when it was learned that the individual in question was currently working for the competitor. He had been mining his old company's IP at will and placing it in the hands of their competitor. His access was immediately shut down and he was arrested within hours of the discovery.</p>

5. Unauthorized access via default credentials

Description	Refers to instances in which an attacker gains access to a system or device protected by standard preset (and therefore widely known) usernames and passwords.
Types / Variations	Default credentials vary by vendor but the mode of attack to exploit them is essentially the same.
Frequency	Factor in 16% of breaches in caseload
Impact (data loss)	Factor in 53% of records compromised in caseload
Associated Industry	Relevant to all types of organizations but more common to the Retail and Food & Beverage industries within our caseload.
Associated Threat Sources	Predominately malicious external sources, but commonly involves a trusted partner connection.
Associated Threat Actions and Vectors	Enabled by omissions and misconfigurations. Can be a stand-alone attack method but is often used in combination with other techniques and/or to introduce malware (especially <i>RAM Scrapers</i> , <i>Packet Sniffers</i> , <i>Backdoor or Command/Control</i>) into the victim environment. Commonly followed by <i>Unauthorized Access via Weak or Misconfigured ACLs</i> to compromise additional systems. Often conducted via third party remote administrative services.
Associated Assets and Data	Almost always targets applications, servers, and network devices. Contributed to the compromise of much payment card data and personal information within our caseload.
Indicators	User behavioral analysis (i.e., abnormal logon time or source location); monitor all administrative/privileged activity (including third parties); use of "last logon" banner (can indicate unauthorized access).
Mitigators	<p>Change default credentials (prior to deployment); delete or disable default account; scan for known default passwords (following deployment); password rotation (because it helps enforce change from default); inventory of remote administrative services (especially those used by third parties). For third parties: contracts (stipulating password requirements); consider sharing administrative duties; scan for known default passwords (for assets supported by third parties).</p> <p>We very often see this used to gain an initial point of entry. Attackers then exploit weak access control to move around the internal network and find sensitive systems and data. Therefore, refer to mitigators listed under <i>Unauthorized Access via Weak or Misconfigured ACLs</i> to help contain this activity.</p>
Case Example	<p>After learning that they had been identified as a likely common point of purchase for fraudulent payment card activity, a U.S. restaurant chain brought Verizon in to investigate. Initial review of forensic images from the POS controller found large stores of unmasked, unencrypted magnetic stripe card data. These files contained 30,000+ entire Track I and Track II data strings, including Primary Account Numbers (PANs), expiration dates, and CVV/CVC (Card Verification Value Code) numbers. Thousands more were discovered in unallocated portions of the disks, indicating that they had been deleted from the live directory structure.</p> <p>After additional evidence confirmed that much of this data had been compromised, investigators turned attention to discovering the source of the breach. The typical signs left by an intruder trying to break into systems were not found. What was found was that all of the POS systems in the restaurant chain were configured with the vendor-supplied default password. A third party firm hired to set up their payment process and provide ongoing administration had neglected to make the change. Restaurant personnel naturally assumed they had done so.</p> <p>From that point, it was rather obvious what had occurred. Going back years, criminals had been logging in using these credentials and removing full Track I and II data from the network. With this data, the criminals had all the information necessary to create counterfeit cards. Evidence from separate sources revealed that this was done and the cards were sold over the web.</p>

6. Violation of Acceptable Use and other policies

Description	Acceptable Use policies govern how employees utilize the corporate information assets. Violations occur when an employee accidentally, purposely, or maliciously disregard these policies.
Types / Variations	Varies greatly by intent, assets misused, degree of misuse, and result. Across our caseload, most often occurs in the form of accessing pornographic material on the web, using personal email accounts to send corporate information, storing personal (sometimes illegal) content on corporate systems, and downloading/installing non-sanctioned software.
Frequency	Factor in 12% of breaches in caseload
Impact (data loss)	Factor in <1% of records compromised in caseload
Associated Industry	Common to all types of organizations.
Associated Threat Sources	Predominately insiders but also partners, depending on the extent to which they use corporate assets.
Associated Threat Actions and Vectors	Not usually the primary cause or vector of data compromise but rather a contributing factor in breaches of all types of data. Can lead to the introduction malware (especially <i>Keyloggers and Spyware</i>) into the corporate environment. We observe a correlation between policy violations and a propensity to engage in more malicious forms of misuse like <i>Abuse of system access/privileges</i> .
Associated Assets and Data	Typically directly involves end-user systems but affects a wide variety of assets and data.
Indicators	Scan for misuse (i.e., browsing history, pornographic content, illegal content, non-sanctioned software, etc); routine log monitoring; follow up on anti-virus and anti-spyware alerts; presence of other malware on system.
Mitigators	Pre-employment screening; do not hire known felons or those shown to be untrustworthy during screening process; Acceptable Use policies are understandable and accessible to all employees; the consequences of non-compliance are fitting and communicated; consistent enforcement of policies; restrict user administrative rights; web content filtering and blacklisting; data loss prevention (DLP) tools.
Case Example	<p>An investment firm contacted Verizon regarding a potential breach involving employee credentials used to gain illicit access to an online financial management portal. Two corporate laptops were identified as the likely point of compromise for the credentials. Disk images of these systems revealed two malicious files, <i>ibm00001.dll</i> and <i>ibm00002.dll</i>, capable of logging keystrokes. The software captured user credentials as they were furnished to the web portal and wrote them to a text file named <i>\$_2341233.TMP</i> stored in the <i>\System32</i> directory. Examination of the file's contents showed eight months of usernames and passwords entered for numerous financial management sites.</p> <p>However, those weren't the only credentials stored in the keylogger's file. Also contained were the usernames and passwords to several adult web sites. It was not difficult to deduce that if the laptop was used to access such content <i>after</i> malware was installed, it was likely used in similar fashion <i>before</i> infection. Further analysis confirmed this to be the case. This activity was in clear violation of the investment firm's Acceptable Use policy, but nothing was done to check for violations or otherwise enforce the policy. The individual responsible was questioned and later admitted that he had regularly used corporate assets to browse and store adult content for well over a year.</p>

7. Unauthorized access via weak or misconfigured ACLs

Description	Access control lists (ACLs) are mechanisms that specify which entities can access an object and what operations they can perform. If ACLs are missing, weak (referring to loose permissions), incorrectly scoped, or misconfigured, entities (attackers) can access resources and perform actions not intended by the victim.
Types / Variations	They can apply to network devices, systems, processes within a system, users, groups of users, and all manner of operations.
Frequency	Factor in 10% of breaches in caseload
Impact (data loss)	Factor in 66% of records compromised in caseload
Associated Industry	Common to all types of organizations.
Associated Threat Sources	Predominately malicious external sources.
Associated Threat Actions and Vectors	Enabled by omissions and misconfigurations. Can be a stand-alone attack method but is often used in combination with other techniques and/or to introduce malware (especially <i>Packet Sniffers</i> and <i>Backdoor or Command/Control</i>) into the victim environment.
Associated Assets and Data	Relevant to all types of assets and data except offline forms but most commonly affects network devices, applications, and servers within our caseload. Contributed to the compromise of much payment card data and personal information within our caseload.
Indicators	Routine log monitoring; user behavioral analysis (i.e., abnormal source location or logon time); IDS/IPS.
Mitigators	Default deny policy on routers and firewalls; adhere to principles of least privilege for user accounts; network segregation; configuration management tools; periodic configuration audits; restrict administrative connections (i.e., only from specific internal sources); IP blacklisting (consider blocking large address blocks/regions if they have no legitimate business purpose); inventory of remote access services; change control process requires review and validation.
Case Example	<p>Verizon was recently retained by a consumer banking institution in order to investigate a compromise within their ATM environment. The IR team confirmed that PANs and PINs were actively being resolved and exported from the bank's systems. Intruders initially breached the perimeter through a SQL injection attack on their website. However, it was determined that this was not the root cause of the compromise of card data.</p> <p>The fundamental issue was that, once inside, the assailants had unfettered access to the entirety of the network. The attackers explored the environment, installed malware, and managed to locate the organization's ATM Hardware Security Modules (HSM). The HSM had no access control mechanism and could be accessed from hundreds of systems on the network. For several months, the attackers moved data out of the network via FTP connections to IP addresses originating from South America.</p>

8. Packet Sniffer

Description	A packet sniffer (aka network sniffer or packet analyzer) monitors and captures data traversing a network.
Types / Variations	Packet sniffers employed in data compromise scenarios are usually software-based but hardware varieties exist. Furthermore, they range from native services on a platform or device to legitimate administrative tools to foreign malicious software. Varieties that capture and store information for later retrieval are more common than those that capture and send.
Frequency	Factor in 9% of breaches in caseload
Impact (data loss)	Factor in 89% of records compromised in caseload
Associated Industry	Common to all types of organizations
Associated Threat Sources	Predominately malicious external sources although a few cases have involved insiders utilizing packet capture tools.
Associated Threat Actions and Vectors	Almost always installed by a remote attacker after gaining access to the system or downloaded via <i>SQL injection</i> . Very often seen in conjunction with other types of malware, particularly <i>Backdoor</i> or <i>Command/Control</i> which attackers utilize to retrieve captured data. Packet sniffers have also been employed as reconnaissance tools to map out a network and locate target systems.
Associated Assets and Data	Almost always installed on servers, the ultimate target being those that process, store, or transmit large amounts of sensitive data or are in a networked environment that contains sensitive data. Packet Sniffers can, of course, capture any kind of data but are responsible for the bulk of payment card data compromised across our caseload.
Additional Notes	Heightened awareness around security issues and increased regulatory requirements are pushing many organizations to minimize data retention or encrypt data that must be retained. Attackers are utilizing packet sniffers to circumvent such controls and capture data in transit where it is less likely to be encrypted.
Indicators	<p>Tools that identify network interfaces operating in promiscuous mode; presence of large or unusual files; sudden changes in free disk space; unusual system behavior or performance; registry monitoring; system process monitoring; routine log monitoring (i.e., "PROMISC" entries in *nix systems); presence of other malware on system; AV disabled.</p> <p>During investigations involving suspected malware we commonly examine active system processes and create a list of all system contents sorted by creation/modification date. These efforts often reveal malicious files sitting in the Windows\system32 and user temp directories.</p>
Mitigators	Network segmentation; switched networks; encryption of data in transit; restrict administrative utilities; egress filtering (to prevent exfiltration of data); host IDS (HIDS) or integrity monitoring; data loss prevention (DLP) tools; anti-virus (although increased customization rendering AV less effective).
Case Example	<p>In one case, fraud reports alerted a data processor of a possible breach. Internal IT personnel found evidence of SQL injection residing in the web server logs. Because these entries were months old and low in number, staff concluded that the attacks had subsided. Verizon was called in to verify these findings and help determine the extent of data compromised.</p> <p>Arriving on the scene, investigators suspected there might be more to the case than early evidence suggested, because fraud patterns indicated a large-scale breach. Investigators verified SQL injection was used to pull various customer records but it soon became clear that these attacks also pulled an extensive array of packet sniffers into the environment. The queries discovered by IT personnel disappeared from web server logs simply because the attacker had no further need of SQL injection.</p> <p>Attackers used sniffers to map out the internal network and locate target systems that processed payment card data. Keyloggers were then pushed onto various systems and used to obtain administrative credentials. Using those credentials, attackers were able to install a packet sniffer on the core payment switch. This strategically-placed sniffer captured millions of transactions and stored this data locally on the system. The attacker used the stolen domain credentials to reenter periodically and FTP data out of the environment.</p>

9. Unauthorized access via stolen credentials

Description	Refers to instances in which an attacker gains access to a protected system or device using valid but stolen credentials.
Types / Variations	Usually involves usernames and passwords but other types of credentials such as tokens and “secret questions” are included as well.
Frequency	Factor in 8% of breaches in caseload
Impact (data loss)	Factor in <1% of records compromised in caseload
Associated Industry	Common to all types of organizations
Associated Threat Sources	Predominately malicious external sources, but often involves a trusted partner connection. We have had cases in which insiders steal the credentials of other employees.
Associated Threat Actions and Vectors	Credentials are obtained through any number of methods including <i>Keyloggers and Spyware</i> , <i>Pretexting</i> , and <i>Phishing</i> . They are also stolen through various forms of reconnaissance or by compromising a third party knowledgeable of your (the victim’s) credentials. Attacks involving the latter are often conducted via third party remote administrative services. Commonly followed by <i>Unauthorized Access via Weak or Misconfigured ACLs</i> to compromise additional systems. Once successful, often used to introduce malware (especially <i>Packet Sniffers</i> , <i>Backdoor or Command/Control</i>) into the victim environment.
Associated Assets and Data	Almost always targets applications, servers, and network devices.
Additional Notes	Unauthorized access via stolen credentials is particularly problematic because it looks and acts like <i>authorized</i> access.
Indicators	Presence of malware on system; user behavioral analysis (i.e., abnormal source location or logon time); use of “last logon” banner (can indicate unauthorized access); monitor all administrative/privileged activity.
Mitigators	Two-factor authentication; change passwords upon suspicion of theft; time-of-use rules; IP blacklisting (consider blocking large address blocks/regions if they have no legitimate business purpose); restrict administrative connections (i.e., only from specific internal sources); password rotation (although most stolen creds are used within a shorter timeframe than typical change requirements). For prevention of stolen credentials, see <i>Keyloggers and Spyware</i> , <i>Pretexting</i> , and <i>Phishing</i> entries. We very often see this used to gain an initial point of entry. Attackers then exploit weak access control to move around the internal network and find sensitive systems and data. Therefore, refer to mitigators listed under <i>Unauthorized Access via Weak or Misconfigured ACLs</i> to help contain this activity.
Case Example	Over the period of several months, Verizon worked a series of cases involving supermarkets across the U.S. The cases were similar in nature (they all involved POS servers running the same application software) but the supermarkets themselves were completely unrelated, being different chains and geographically disparate. One after another, however, they were notified of potential compromise through CPP analysis. The investigation centered on analyzing the POS infrastructure to determine the source and cause of the breach. Each server had a broadband connection to the outside world via a DSL connection or cable modem. As several of these cases were underway concurrently, investigators made the interesting discovery that a single South Asian IP address was accessing each of the supermarket’s POS servers. What’s more, the method of access was authenticated connections via legitimate remote administrative software. Having worked similar cases in which default credentials were not changed, investigators immediately examined active accounts. Access via default credentials was ruled out, as were other typical means of entry. Verizon investigators working the seemingly separate but obviously related cases compared evidence and realized that each victim used the same vendor to manage the affected systems. The investigation refocused on that vendor. At the culmination of this investigation, Verizon discovered that the vendor had suffered a data breach about three weeks prior to the onset of the string of supermarket cases. Investigators were able to determine that intruders stole a document listing the names of all the vendor’s clients as well as the credentials necessary to access those clients. Not surprisingly, every one of the supermarkets was among the names on the list. Investigators were able to contact additional merchants listed and assist them in appropriately locking down their systems before they too fell victim to the crime spree.

10. Pretexting (Social Engineering)

Description	A social engineering technique in which the attacker invents a scenario to persuade, manipulate, or trick the target into performing an action or divulging information. These attacks exploit “bugs in human hardware” and, unfortunately, there is no patch for this.
Types / Variations	Scenarios vary greatly and are limited only by the creativity of those individuals inventing them. Pretexting is often used interchangeably with Social Engineering but is actually a type of that broader category.
Frequency	Factor in 8% of breaches in caseload
Impact (data loss)	Factor in 2% of records compromised in caseload
Associated Industry	Relevant to all types of organizations but more common to the Financial Services and Technology Services industries within our caseload (likely related to better defenses requiring criminals to resort to higher-cost attacks).
Associated Threat Sources	Typically employed by external entities although insiders sometimes use pretexting to elevate privileges or circumvent internal controls.
Associated Threat Actions and Vectors	Related to and often intermingled with <i>Phishing</i> , another method that borrows from the social engineering toolbox. Sometimes used to “open the door” for <i>Physical theft of assets</i> or <i>Unauthorized access via stolen credentials</i> . Vectors of pretexting are myriad: email, phone, in-person, snail-mail—basically any medium that can support the scenario.
Associated Assets and Data	Humans are the target of pretexting but the goal is gaining access to other information assets. Therefore, employees with higher levels of access or responsibilities within the organization are targeted (i.e., Human Resources staff, IT administrators, etc.). Pretexting is used to compromise all forms of data but more often targets IP and other corporate information rather than, for instance, bulk payment card data.
Indicators	Very difficult to detect as it is designed to exploit human weaknesses and bypasses technological alerting mechanisms. Unusual communication, requests outside of normal workflow, and instructions to provide information or take actions contrary to policies should be viewed as suspect. Call logs; visitor logs; email logs.
Mitigators	General security awareness training; clearly defined policies and procedures; do not “train” staff to ignore policies through official actions that violate them; train staff to recognize and report suspected pretexting attempts; verify suspect requests through trusted methods and channels; restrict corporate directories (and similar sources of information) from public access.
Case Example	<p>If a criminal doesn’t have the time, inclination, or resources to conduct a highly sophisticated attack campaign involving midnight reconnaissance, rappelling down elevator shafts, customized malware, and 133t hacking skills, he or she can always fall back on simply asking for the data.</p> <p>In one such case, Verizon investigators discovered that criminals were calling the help desk of a Canadian annuities firm to gain access to confidential accounts.</p> <p>All the attacker needed was a voice that sounded authoritative, an earnest tone, and an ability to think on his feet. In spite of a thick foreign accent (and a rather unimaginative pretext), the attacker was able, within minutes of each of seven separate phone calls, to convince the help desk that he was the owner of these separate and distinct annuity accounts. The help desk member in all seven cases granted the attacker the appropriate credentials to access the account holder’s online account. Not surprisingly, within days, each of the annuity accounts was fully depleted with the attacker transferring all of the money to offshore accounts.</p>

11. Authentication bypass

Description	Attack technique in which normal authentication mechanisms are circumvented to gain unauthorized access to a system.
Types / Variations	The techniques themselves are quite diverse. The results can be accomplished by exploiting vulnerabilities in code, misconfigurations, or inherent functionality of the authentication architecture.
Frequency	Factor in 6% of breaches in caseload
Impact (data loss)	Factor in <1% of records compromised in caseload
Associated Industry	Common to all types of organizations.
Associated Threat Sources	Predominately malicious external sources
Associated Threat Actions and Vectors	Can be a stand-alone attack method but is often used in combination with other techniques and/or to introduce malware (especially <i>Packet Sniffers</i> and <i>Backdoor or Command/Control</i>) into the victim environment. Often associated with/accomplished by buffer overflow attacks. Applications (especially custom) and remote access programs and services are common vectors.
Associated Assets and Data	Almost always targets applications, servers, and network devices.
Indicators	Routine log monitoring (specifically audit for processes that start outside of standard security context or session); odd log entries that look like artifacts from a buffer overflow; IDS/IPS.
Mitigators	Secure development practices; application and network vulnerability scanning; penetration testing; web application firewall.
Case Example	<p>When a European credit union began receiving a rash of calls from customers about missing funds, Verizon IR was brought in to locate and contain the problem. The credit union offered the typical suite of online services to customers via a custom application developed by a third party.</p> <p>Log entries showed all funds transferred out of the customer accounts were sent to one of two foreign accounts. Many of the affected customers had not logged in prior to the transfers, which eliminated stolen credentials as the likely type of attack. Further investigation revealed numerous anomalies in the logs surrounding authentication.</p> <p>A review of the application's authentication system identified how the attacker gained access to customer accounts. While the banking application properly handled login attempts (either granting or denying access), the design had a fatal flaw that allowed a savvy attacker to bypass authentication altogether. After a failed login attempt, users were directed to a link containing a string similar to ".../validUser=0/..." By changing this string to ".../validUser=1/..." and entering it into a browser, the attacker was treated like an authenticated user and granted access. Using this method, he stole over 280,000 Euro from the credit union's customers.</p>

12. Physical theft of asset

Description	The act of physically stealing an asset.
Types / Variations	Thieves can make off with information assets in any number of ways and can do it discretely, in plain sight, or through the use of force. We differentiate physical theft based on where it occurred (determines which controls are relevant).
Frequency	Factor in 6% of breaches in caseload
Impact (data loss)	Factor in 2% of records compromised in caseload
Associated Industry	Common to all types of organizations
Associated Threat Sources	Malicious external sources are most likely but incidents involving insiders and partners occur as well.
Associated Threat Actions and Vectors	<p>Usually a stand-alone attack method, but we have worked cases in which an asset was stolen, tampered with, and then returned as part of a larger attack scenario. Though stolen assets are usually scrapped and sold, criminals sometimes attempt to access data. In these circumstances (usually highly targeted attacks), any number of tools and techniques can be used.</p> <p>For vectors, see Table 8 on page 26 of 2009 DBIR. Within our caseload, physical theft most commonly occurs in publicly accessible areas or external locations.</p>
Associated Assets and Data	Relevant to any and all assets and data. More common with mobile assets (i.e., laptops) and offline data (i.e., portable media).
Indicators	Missing assets; suspicious activity (the guy walking out the door with an arm full of equipment might not be doing his normal job); unescorted, unbadged people in corporate facilities; alarm system; signs of break-in or tampering; video surveillance; visitor logs.
Mitigators	Mitigators based on the fact that most thefts occur in external locations or publicly accessible areas. Remote/mobile workforce policy (details acceptable use and protection of mobile assets); standard system access control (i.e., password-protected screensaver with timeout); file or disk-based encryption; consider using asset tracking and/or remote wiping for highly sensitive assets; security and awareness training; challenge suspicious activity; restrict use of sensitive assets in publicly-accessible areas; standard physical security controls for enterprise facilities; secure storage areas/cabinets/racks/containers.
Case Example	<p>A rail transportation company was notified (due to fraud) of a suspected breach in several of their ticketing kiosks. The kiosks accepted credit and debit cards from passengers and were located in various stations throughout the rail transit system. A third party who originally sold and implemented the kiosk solution also managed the day-to-day operation using VNC through an encrypted site-to-site VPN.</p> <p>Having recently worked a similar case involving kiosks in which a compromise originated through the VPN support connection, the investigation began there. In this case, however, this scenario was ruled out. Physical inspection of the kiosks revealed signs of tampering and investigators found numerous unconnected hard drives stacked within the housing. This was the state of each kiosk identified by fraud patterns but none of the company's other kiosks contained additional hardware. Furthermore, the extra hard disks were of a different make than those standard to the kiosk platform. Obviously, something was amiss.</p> <p>Several workers inside the station remembered seeing uniformed technicians working on the kiosks on several occasions. However, they were certain that the name on their uniforms was not the same as the third party responsible for supporting the kiosks. These details were turned over to local law enforcement, which set up surveillance. A week later, the three-man criminal ring was arrested attempting to access the kiosks.</p> <p>Unfortunately, the kiosks were found to be retaining complete magnetic-stripe sequences sufficient for counterfeit from each payment card transaction they handled. In total, about 15,000 payment cards were compromised among the hard disks stolen during the operation.</p>

13. Brute-force attack

Description	An automated process of iterating through possible username/password combinations until one is successful.
Types / Variations	There are several types of brute-force attacks (i.e., against cryptographic keys) but here we focus only on those against log-in credentials. Within that space, there are also quite a few techniques ranging from dictionary-based tools to complex search algorithms.
Frequency	Factor in 4% of breaches in caseload
Impact (data loss)	Factor in 7% of records compromised in caseload
Associated Industry	Relevant to all types of organizations but more common to the Retail and Food & Beverage industries within our caseload.
Associated Threat Sources	Predominately malicious external attackers although the technique can be (and sometimes is) used by insiders and partners.
Associated Threat Actions and Vectors	Can be a stand-alone attack method but is often used in combination with other techniques and/or to introduce malware into the environment. Commonly followed by <i>Unauthorized Access via Weak or Misconfigured ACLs</i> to compromise additional systems. The vector of attack is any system or application that requires log-in.
Associated Assets and Data	Almost always targets applications, servers, and network devices.
Indicators	Routine log monitoring; numerous failed login attempts (especially those indicating widespread sequential guessing); help desk calls for account lockouts.
Mitigators	<p>Technical means of enforcing password policies (length, complexity, clipping levels); account lockouts (after x tries); password throttling (increasing lag after successive failed logins); password cracking tests; access control lists; restrict administrative connections (i.e., only from specific internal sources); two-factor authentication; CAPTCHA.</p> <p>We very often see this used to gain an initial point of entry. Attackers then exploit weak access control to move around the internal network and find sensitive systems and data. Therefore, refer to mitigators listed under <i>Unauthorized Access via Weak or Misconfigured ACLs</i> to help contain this activity.</p>
Case Example	<p>A large e-commerce retailer contracted Verizon to conduct an investigation into recent fraud reports and determine if a data breach had occurred within their online portal. Investigators examined access logs from the e-commerce application and found over 600,000 failed attempts to authenticate to the online shopping cart. This all occurred within a two-day period in the previous month and originated from a single IP address in southeast Asia.</p> <p>Well, as the old saying goes, the 600,003rd time's a charm. The attacker landed on the correct combination and nabbed 50,000+ credit card numbers, usernames and passwords, and other personal information. A review of the application's settings showed they allowed for infinite authentication attempts. Interestingly, the application was configured to log failed attempts, which clearly showed a dictionary-style brute-force attack. Failed passwords appeared in an alphanumeric, sequential order.</p>

14. RAM scraper

Description	RAM scrapers are a fairly new form of malware designed to capture data from volatile memory (RAM) within a system.
Types / Variations	Difficult to classify types as the functionality is rather new.
Frequency	Factor in 4% of breaches in caseload
Impact (data loss)	Factor in 1% of records compromised in caseload
Associated Industry	To date, mainly observed in the Retail and Hospitality industries.
Associated Threat Sources	Predominately malicious external sources, but sometimes involves a trusted partner connection.
Associated Threat Actions and Vectors	Samples to date were installed by a remote attacker after gaining access to the system. Several involved <i>Unauthorized access via default credentials</i> through third party remote administrative services. Often seen in conjunction with other types of malware, particularly <i>Backdoor or Command/Control</i> which attackers utilize to retrieve captured data.
Associated Assets and Data	Almost always installed on servers (especially Point-of-Sale) that process, store, or transmit payment card data.
Additional Notes	Heightened awareness around security issues and increased regulatory requirements are pushing many organizations to minimize data retention or encrypt data that must be retained whether in storage or in transit. RAM scrapers circumvent such controls and capture data in memory where it must be decrypted to be read and processed.
Indicators	<p>Unusual system behavior or performance; presence of large or unusual files (ramdump files and perl scripts); sudden changes in free disk space; registry monitoring; system process monitoring; routine log monitoring; presence of other malware on system; AV disabled.</p> <p>During investigations involving suspected malware we commonly examine active system processes and create a list of all system contents sorted by creation/modification date. These efforts often reveal malicious files sitting in the Windows\system32 and user temp directories.</p>
Mitigators	Best defense is to keep remote attackers from owning the system. Other mitigators include host IDS (HIDS) or integrity monitoring; tokenization (mitigates attack on a POS server but data still exists on the POS terminal or wherever it is tokenized).
Case Example	<p>A resort and casino located in the northeast United States received notification of fraud patterns indicating them as Common Point of Purchase. Upon arrival, Verizon IR collected evidence for offsite analysis, including a POS server and other servers used by the hotel for guest registration and other business functions.</p> <p>Analysts discovered four files on the POS server known to be associated with RAM Scraping malware observed in cases involving several other merchants in the area. These four files—A0011817.exe (WinMgmt.exe), A0011818.bat (install.bat), A0011819.exe (dnsmgr.exe), and Far.exe—resided in a Windows system restore point directory, indicating they previously resided on the system in an active state but were archived during a recent system restore operation. Dates on the files showed they had been introduced to the system less than one week prior to the first occurrences of fraud.</p> <p>The RAM scraper dumped the contents of the server's live memory into a file named dumper.dll in the Windows system subdirectories. Interestingly, the malware used strictly defined GREP expressions to query only payment card numbers rather than creating full memory dumps. This, of course, is designed for more efficient operation and use of disk space. The perpetrator returned at regular intervals through a backdoor to collect cardholder data dumped from the POS server's memory.</p>

15. Phishing (and endless *ishing variations)

Description	A social engineering technique in which an attacker uses fraudulent electronic communication (usually email) to lure the recipient into divulging information. Most appear to come from a legitimate entity and contain authentic-looking content. The attack often incorporates a fraudulent website component as well as the lure.
Types / Variations	Phishing attacks vary greatly by types, tactics, and targets. As mentioned in the description, email is the main medium, but not the only one. Some phishing attacks request that information be sent via reply while others direct recipients to a website. They are often widely dispersed like spam but targeted varieties exist such as “spear phishing” (aimed at a particular organization) or “whaling” (aimed at VIPs or executives). Though phishing commonly targets consumers, in corporate data breach scenarios the target is usually employees.
Frequency	Factor in 4% of breaches in caseload
Impact (data loss)	Factor in 4% of records compromised in caseload
Associated Industry	Relevant to all types of organizations but more common to the Financial Services and Technology Services industries within our caseload.
Associated Threat Sources	Predominately malicious external sources although instances involving insiders have occurred (see case example).
Associated Threat Actions and Vectors	Successful phishing attacks are often followed by <i>Unauthorized access via stolen credentials</i> . Email is the primary vector.
Associated Assets and Data	Humans are the target of phishing but the goal is gaining access to other information assets or external accounts. They are typically received on end-user systems and authentication credentials and personal information are the most-compromised data types.
Indicators	Difficult to detect given the quasi-technical nature and ability to exploit human weaknesses. Unsolicited and unusual communication; instructions to provide information or take actions contrary to policies; requests outside of normal workflow; poor grammar; a false sense of urgency; email logs.
Mitigators	General security awareness training; clearly defined policies and procedures; do not “train” staff to ignore policies through official actions that violate them; policies regarding use of email for administrative functions (i.e., password change requests, etc); train staff to recognize and report suspected phishing messages; verify suspect requests through trusted methods and channels; configure email clients to render html emails as text; anti-spam.
Case Example	<p>In a rather interesting phishing case, a large accounting firm contacted Verizon to investigate an unauthorized disclosure of sensitive company information. The salaries and personal details of hundreds of employees were posted on a public website and an email with the same information was sent to all company employees. The email came from an external address and purported to be from the Director of Human Resources.</p> <p>When evidence proved that the HR director was not the source, the case grew more complicated. While interviewing staff a critical piece of new evidence came to light. A few months prior, an email was sent to all HR employees informing them about a weekend upgrade to an internal HR application. It claimed that a password change would be necessary and provided a link. The email came from “ICT-admin@victimname.com” and looked authentic. Several employees admitted to having clicked on the link (which showed an internal address but which actually took them to an external site) and entered their current and new credentials.</p> <p>Using those legitimate credentials, the attacker semi-randomly probed internal HR systems, gaining access to several. The source of the leak was traced to a file server used by the HR group. A document containing the exposed information had been exported from an internal application eight months prior to the incident and stored on the shared drive, which was against policy.</p> <p>Extensive review of log files allowed Verizon to trace this activity to an internal system within another business unit. The user of that system, a contract worker, was questioned and determined to be the culprit. The motive of the crime seems to be a mixture of mischief and resentment.</p>

Conclusion

We hope the conclusion readers take from this report is a clearer understanding of how data breaches occur and how to prevent them. If we have failed in conveying that message, then no concluding words we provide here will atone for that error. Furthermore, we hope to have illustrated that incidents are rarely one-dimensional; they result from a series of actions that occur both inside and outside the organization. Mitigation strategies are also rarely one-dimensional. Preventing the incident means breaking this chain at some point before compromise. The good news is that there are usually multiple ways to do this and multiple chances to do it. The bad news is that we're not incredibly proficient at recognizing those chains of events until long after the critical one has occurred. We can, however, improve matters and Verizon believes strongly that better information is foundational to that improvement.

Undoubtedly, astute readers will find gaps within our recommended lists of indicators and mitigators in the catalogue above. Though we did not intend to exhaust all possibilities, we likely omitted controls that provide some level of effectiveness against the threat actions discussed. We invite readers to supplement our supplemental report by posting them on our [blog](#)⁵. We also refer readers to our general recommendations within the 2008 and 2009 DBIRs.

Finally, there are a few lessons of which we are always reminded when digging into breach data:

- You cannot detect everything
- You cannot prevent everything
- Striving for perfection in any one control is inefficient and introduces single-point of failure dependencies. Layer controls for superior effect and efficiency. In general, this can be accomplished through the following:
 - Deter cybercrime through policies and penalties that reflect its serious and costly nature. This can work at the national and organizational level.
 - Keep criminals from entering networks in the first place.
 - If they get in, keep them from finding data (by not having it or protecting it).
 - If they get in and manage to find data, keep them from getting it out.
 - If they get in, find data, and get it out, detect and respond to this in a timely and effective manner.
- Controls that break the incident chain early in its progression and/or work against many sub-chains are typically more efficient (even if they are less effective against a particular event). For instance, loose-grained access control applied to routers, firewalls, and other network devices are extremely efficient due to the large number of known and unknown problems they mitigate.

⁵ <http://securityblog.verizonbusiness.com/2009/12/01/2009-dbir-supplemental/>

Appendix A: Comparison of Verizon IR dataset to DataLossDB

The observation is often made regarding the dataset behind the DBIR that it is a biased sample. We agree and begin every report with such a disclaimer. The question, of course, is **how much bias exists**⁶ and how much it changes the conclusions drawn from our sample. This is an extremely difficult question to answer as there are not many large breach datasets publicly available for comparison. For those familiar with public breach disclosures, the most likely candidate is the **DataLossDB**⁷ run by the Open Security Foundation.

DataLossDB is a community research project aimed at documenting known and reported data loss incidents worldwide. Not only does the database contain information on several thousand incidents, it can be downloaded freely for some very useful (and fun) analysis. We'd like to thank the Open Security Foundation for managing the project as well as all those who volunteer their time keeping it loaded with fresh data.

Because we commonly receive questions about how our dataset compares to DataLossDB, we decided to run some numbers and include them in this supplemental report. The purpose is not to compare the quality of the two datasets; we believe both sources are useful for risk management and decision-making. Rather, the purpose of this appendix is to briefly examine what similarities and differences exist and to explore what they might mean. Again, a tip of the hat goes to the Open Security Foundation for allowing us to satisfy our curiosity and publish the findings in this report.

Table 3. Verizon IR and DataLossDB Dataset Overview

	Verizon IR	DataLossDB
Number of breaches	592	2332
Number of compromised/lost records	516,108,232	721,657,540
Time span of dataset	2004-2008	2000-2009 ⁸

⁶ <http://securityblog.verizonbusiness.com/2008/07/07/bogus-biased-or-believable/>

⁷ <http://datalossdb.org/>

⁸ Most incidents reported are within this range although their "Oldest Incident Contest" produced an entry from the early 1900s.

Methodology

In comparing the two datasets, there are some hurdles to overcome. First, there is some overlap (we work cases that are included in DataLossDB). We have made no attempt to extract those or modify information (let's just say that press releases and our investigative results don't always concur). Second, the datasets do not use the same framework for classifying incidents. To overcome this, we mapped categories used by DataLossDB to our own classification framework and "translated" the 2300+ incidents it contains to allow a same-to-same comparison. This process was not done without difficulty and results in a certain amount of "lossiness."⁹ Using these methods, we were able to compare the following:

- Industry
- Breach Source
- Threat Category
- Asset Class
- Data Type

Semantics aside, there is one main difference between our dataset and DataLossDB that should be kept in mind while examining the figures: Incidents included in the DBIR involve actual data compromise. Many incidents reported to DataLossDB are "data-at-risk" scenarios where the organization was required to disclose but data never actually fell into the hands of the bad guys. Such incidents can still be costly to the organization involved and it's good that DataLossDB includes them—but we simply aren't usually called in to investigate those types of cases. This has a huge effect on the statistics.

In an effort to partially control for this, we present a third column for comparison in which DataLossDB entries involving lost assets, improper disposal, and postal mail errors ("Lost x", "Disposal x", "Snail Mail" in DataLossDB) were removed. While far from perfect, we determined it to be a reasonable (and easy) method of making the DataLossDB a bit more similar in nature to our own dataset. These modified statistics appear under the "DataLossDB-MOD" column in the tables below.

In this appendix, we mapped categories used by DataLossDB to our own classification framework and "translated" the 2300+ incidents it contains to allow a same-to-same comparison.

⁹ DataLossDB breach type "Hack" obviously maps to our threat category "Hacking." Others are not so obvious but are discernable. Sometimes the mapping simply cannot be made and is denoted by "ND" for "Not Distinguishable."

Dataset Comparison

When comparing the two datasets, the obvious place to start is what types of companies are represented within each. Table 4 gives insight into how Verizon's caseload differs from the bulk of publicly disclosed incidents contained in DataLossDB.

Table 4. Dataset Comparison – Industries Represented.

Industry	Verizon IR	DataLossDB	DataLossDB-MOD
Retail	54%	8%	9%
Food & Beverage	19%	ND ¹⁰	ND
Financial Services	16%	21%	21%
Technology Services	11%	6%	7%
Manufacturing	5%	6%	6%
Business Services	3%	3%	3%
Education	3%	19%	20%
Healthcare	<1%	13%	13%
Hospitality	2%	1%	<1%
Government	1%	20%	17%
Other/Misc	3%	4%	4%

Significant differences occur in the Retail, Food & Beverage, Education, Healthcare and Government sectors. We speculate there are various reasons for this. Regulatory requirements surely have an effect; under PCI, breaches involving payment card data are more likely to need or require a third party investigation. This results in a higher proportion of Retail and Food & Beverage within our caseload. Incident trends within these industries make a difference too. For instance, reducing DataLossDB to Government only will achieve a much lower percentage of hacking-related incidents. This impacts our dataset because it is more likely that an organization will require outside IR assistance following a complicated network intrusion than a stolen laptop, etc. Undoubtedly other factors are at play and further explain these differences.

¹⁰DataLossDB includes Food & Beverage establishments within the Retail category.

Table 5. Dataset Comparison – Breach Source.

Breach Source	Verizon IR	DataLossDB	DataLossDB-MOD
External	73%	56%	79%
Internal	18%	35%	19%
Partner	38%	4%	0%

Since publishing the original DBIR in 2008, we've received more feedback (covering the entire emotional spectrum) about our findings regarding breach sources than any other. Our data challenges established security dogma, which holds that most incidents are perpetrated by insiders. We won't dive into that maelstrom here but you can refer to the 2009 DBIR for our analysis on the matter. Instead, we'll simply direct attention to Table 5, where there are three things to note on this topic:

1. There is a huge disparity in the percentage of breaches attributed to partners. We believe this has something to do with categorization but has much to do with perspective. The involvement of a third party is often discovered only during investigation and often omitted from public disclosures because it is not pertinent to alerting entities affected by the breach.
2. The DataLossDB dataset, while not as dramatic, also reinforces an external breach source majority. We find this interesting.
3. The modified DataLossDB dataset nearly mirrors our own. We find this fascinating.

Incidents that result in data compromise and that prompt disclosure or outside investigation are most likely to be perpetrated by external threat agents.

The agreement between these large historical datasets increases our confidence in the following assertion: Incidents that result in data compromise and that prompt disclosure or outside investigation are most likely to be perpetrated by external threat agents.

The assertion should be read carefully as it contains important qualifiers. Neither of these datasets contains unknown incidents. Neither contains undisclosed incidents that were investigated internally. Perhaps such incidents differ in quality than those contained within our caseload and DataLossDB. Perhaps they don't. Without data, neither hypothesis can be tested. We must manage according to what we know and then try to prepare for what we do not know. Table 5 represents a large sample of what we know.

Table 6. Dataset Comparison – Threat Category

Threat Category	Verizon IR	DataLossDB	DataLossDB-MOD
Hacking	60%	18%	25%
Malware	32%	1%	1%
Deceit	10%	ND	ND
Misuse	22%	12%	17%
Physical	14%	35%	49%
Error	3%	31%	5%
Environmental	<1%	0%	0%
Unknown	NA	4%	2%

While the two datasets have similar messages with regard to the sources of data breaches, they speak very differently about the types of threats that cause them. Our caseload is much more hacking/malware heavy whereas DataLossDB tips toward physical attacks (theft, etc.) and errors (accidental disclosure). The translation process surely has some affect but, overall this stems from the difference between incidents that put data-at-risk vs. incidents that result in actual compromise.

Our caseload is much more hacking/malware heavy whereas DataLossDB tips toward physical attacks (theft, etc.) and errors (accidental disclosure).

The modified DataLossDB seems to be less informative when discussing threats. It is no wonder that error drops sharply when incidents of lost assets, improper disposal, and postal mail errors are removed from the dataset.

Note that DataLossDB does not have a category similar to Deceit (threats utilizing deception and misrepresentation). Their FraudSE category sounds like a match but actually fits much better with our category of Misuse. Such incidents are certainly represented but are probably reported simply as thefts or hacks (nobody wants to disclose that they were duped into opening the door for the criminal). This is another area where the investigator's perspective helps discern important details.

Table 7. Dataset Comparison – Asset Class

Asset Class	Verizon IR	DataLossDB	DataLossDB-MOD
Online data	93%	30%	32%
Networks and devices	4%	ND	ND
End-User devices	9%	30%	41%
Offline data	6%	26%	9%
Not Distinguishable	NA	13%	18%

Mapping assets between the datasets was challenging since DataLossDB does not have a category for assets (disclosure reports focus on the type of data exposed rather than the type of system). For certain “Breach Types”, the asset is discernible (i.e., stolen laptop), but for others, it is not as obvious. The result is significant amounts of “Not Distinguishable” assets.

The skew of the Verizon dataset is obvious and follows the higher percentages within Hacking and Malware. It is interesting to note that the DataLossDB asset class distinctions are separated nearly equally between online data (information on a web or file server), offline data (data on paper or removable media), and end-user devices (laptops, desktops).

Table 8. Dataset Comparison – Data Type

Data Type	Verizon IR	DataLossDB	DataLossDB-MOD
Payment card data	84%	14%	17%
Personal Information	31%	89%	87%
Authentication credentials	17%	ND	ND
Account number	16%	11%	10%
Intellectual property	9%	ND	ND
Corporate Financial data	5%	11%	9%
Medical information	3%	9%	8%
Monetary Assets / Funds	11%	ND	ND
Other/Misc ¹¹	26%	11%	11%

There may be no better indicator of the different nature of the datasets than the types of data exposed by the incidents they contain. Verizon is obviously biased towards breaches of a “financial” nature (payment card data) while DataLossDB is geared more towards exposures of personal information (i.e., social security numbers). It is also very interesting to note the differences for Authentication Credentials, Intellectual Property, and Monetary Assets where Verizon has visibility into breaches that would not normally require disclosure to the public.

¹¹ Verizon has a category for “Other” and DataLossDB has one for “Miscellaneous”. Due to classification differences, it is doubtful that the two contain similar data types and are thus not very useful for comparison.

Conclusions

In addition to the details discussed above, reviewing and comparing these datasets has highlighted several important concepts.

- 1. Disclosure and information sharing is beneficial to risk management.** It does not take much analysis of either dataset to find information useful for decision-making. Had the incidents not been reported, collected, and shared, we would not have access to the information.
- 2. Voluntary, anonymous reporting of incidents that do not require disclosure would benefit the community.** As discussed above, many incidents are never reported. We do not know how big a slice of the total “incident pie” this represents. We do not know if such incidents differ significantly in nature from those that do require disclosure. The more we know, the better we can manage.
- 3. The biases of both datasets can be understood and used.** While neither dataset represents a perfect sample, interpreting the data within context can be very beneficial.
- 4. A common taxonomy for classifying incidents would improve data analysis.** One of the significant challenges to this exercise, and one of the significant challenges facing our industry, is removing equivocality. We track different data points and use different terminology. A common mode of classifying incidents and collecting metrics would go a long way towards furthering information risk management as a discipline.

www.verizonbusiness.com

© 2009 Verizon. All Rights Reserved. MC13626 12/09

The Verizon and Verizon Business names and logos and all other names, logos, and slogans identifying Verizon's products and services are trademarks and service marks or registered trademarks and service marks of Verizon Trademark Services LLC or its affiliates in the United States and/or other countries. All other trademarks and service marks are the property of their respective owners.

