



Report to the Ranking Member,
Committee on Commerce, Science, and
Transportation, United States Senate

June 2019

COMMERCIAL AVIATION

Information on Airline IT Outages

Accessible Version

Information on Airline IT Outages

Highlights of [GAO-19-514](#), a report to the Ranking Member, Committee on Commerce, Science, and Transportation, United States Senate

Why GAO Did This Study

In recent years, the airline industry experienced several well-publicized IT system outages to reservation, check-in, flight planning, and other systems. Such outages can result in widespread disruption to air travel, inconveniencing passengers, who may be delayed or face out-of-pocket costs, and can also affect airlines' revenue and operations. Airlines are responsible for operating and maintaining their IT systems.

GAO was asked to review airline IT outages. GAO examined: (1) DOT's and FAA's roles related to airline IT outages and (2) what is known about these outages and their effects on passengers. GAO identified relevant federal laws and responsibilities and interviewed DOT and FAA officials. In the absence of DOT and FAA data to identify airline IT outages, GAO identified outages using open source documents for the 12 airlines reporting to BTS from 2015 through 2017 and validated these outages using a multi-step process with publicly available airline information, interviews with airline representatives, and FAA and DOT data. GAO also reviewed airlines' contracts of carriage, which are legally binding contracts between airlines and passengers, to understand how airlines accommodate passengers inconvenienced by IT outages, as well as 140 consumer complaints related to airline IT outages received by DOT from 2015 through June 2018.

View [GAO-19-514](#). For more information, contact Heather Krause at (202) 512-2834 or KrauseH@gao.gov.

What GAO Found

The Department of Transportation (DOT) and, within it, the Federal Aviation Administration (FAA) have limited roles overseeing or addressing the effects of outages from information technology (IT) systems that airlines rely on to schedule and transport passengers (e.g., reservation or flight planning systems).

- **FAA's operations and oversight.** At an airline's request, FAA may halt the operation of all or part of that airline's flights during an outage and work with the airline to reintegrate flights upon recovery. FAA does not directly oversee airline IT systems but works with airlines to ensure that airline data interfaces correctly with FAA's operational systems.
- **DOT's consumer protection.** Airline IT outages are not specifically addressed in DOT's consumer protections for passengers, although other protections may apply, such as restrictions on tarmac delays if a passenger is held on a flight during an outage. DOT oversees airlines' adherence to their contracts with passengers. These may include specific provisions such as refund procedures and responsibility for delayed flights, among other things. DOT also receives consumer complaints and uses complaint data to initiate investigations that may result in fines or enforcement actions.
- **DOT's data collection.** DOT requires large airlines to report information about on-time performance to the Bureau of Transportation Statistics (BTS), including the causes of flight delays and cancellations in several broad categories (e.g., airline caused, weather, and late-arriving aircraft).

Using multiple sources, GAO identified 34 IT outages from 2015 through 2017, affecting 11 of 12 selected airlines. No government data were available to identify IT outages or determine how many flights or passengers were affected by such outages. BTS data provide information to consumers about airline performance broadly but are not designed to identify the effects of individual events, such as the number of flight delays and cancellations resulting from IT outages. According to GAO's validation of multiple sources, however, about 85 percent of the identified outages resulted in some flight delays or cancellations. Because of limited data, information about how passengers have been inconvenienced from outages is largely anecdotal (see figure for examples of inconveniences). Further, airlines vary in what they provide to these passengers (e.g., food, hotel, or rebooking on another airline) when IT outages occur. Consumer complaints stemming from IT outages accounted for less than one percent of all complaints received by DOT from 2015 through June 2018, and according to agency officials, these complaints raised concerns similar to complaints resulting from other causes of flight disruption. Complaints reviewed by GAO included the lack of food, a hotel, or compensation, among other things.

Potential Passenger Inconveniences from Outages in Airline Information Technology



Source: GAO analysis of information from the airlines and media reporting. | GAO-19-514

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Abbreviations

BTS	Bureau of Transportation Statistics
DHS	Department of Homeland Security

DOT	Department of Transportation
FAA	Federal Aviation Administration
IT	information technology
NAS	National Airspace System
NTML	National Traffic Management Log
OPSNET	Operations Network
SEC	Securities and Exchange Commission

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June 12, 2019

The Honorable Maria Cantwell
Ranking Member
Committee on Commerce, Science, and Transportation
United States Senate

Dear Senator Cantwell:

In recent years, several information technology (IT) system outages at U.S. airlines have drawn public attention to the resulting widespread disruption to air travel. For example, in June 2018, American Airline's subsidiary PSA Airlines experienced an IT issue that led to the cancellation of about 3,000 flights over the following week and cost American Airlines an estimated \$35 million in pre-tax income, according to financial filings made by American Airlines.¹ Likewise, in 2016 an outage in the system that Delta Air Lines uses to check in and board passengers resulted in the cancellation of 2,300 flights over 3 days and cost the airline \$150 million in lost revenue, according to statements and financial filings made by the airline.²

Airline IT systems can include those that are used for flight and crew planning, passenger reservations or check-in, or for providing flight information to the Federal Aviation Administration (FAA), among others. As with any industry, airlines' IT investment decisions—including purchasing, maintaining, and operating these systems—are internal business decisions. Yet when these systems fail, they can delay or cancel flights and result in out-of-pocket expenses for passengers, who may have to pay for alternative travel, food, or lodging, or a combination of the three.

The Department of Transportation (DOT) has a role in ensuring that airlines adhere to certain consumer protections for passengers, such as providing timely refunds for canceled flights.³ DOT also requires large

¹American Airlines, Inc., *Investor Update* (Securities and Exchange Commission (SEC) Form 8-K) (July 11, 2018).

²Delta Air Lines, Inc., *Quarterly Report* (SEC Form 10-Q) (Oct. 13, 2016).

³For more information about DOT's oversight of airline consumer protections, see GAO, *Airline Consumer Protections: Additional Actions Could Enhance DOT's Compliance and Education Efforts*, [GAO-19-76](#) (Washington, D.C.: Nov. 2018).

airlines to report on their on-time performance to the Bureau of Transportation Statistics (BTS) and shares this information with consumers and others. Within DOT, FAA is responsible for ensuring the safe, efficient operation of the National Airspace System (NAS), including managing air traffic control.⁴

You asked us to review issues related to airline IT outages. This report addresses: (1) DOT's and FAA's roles in relation to such outages and their effects; and (2) what is known about airline IT outages, including the number of flights and passengers affected.

The scope of this report is focused on airline IT systems that affect passenger experiences, including systems related to reservations and check-in, as well as those used by airlines for flight planning and dispatch.⁵

To determine relevant DOT and FAA roles, we identified DOT and FAA authorities and responsibilities vis-à-vis airline IT outages in several areas, including operations, consumer protection, and critical infrastructure protection, by reviewing relevant laws, regulations, policies, and guidance, as well as our prior work. We interviewed DOT officials with BTS and the Office of the Assistant General Counsel for Aviation Enforcement and Proceedings, which oversees consumer protections and receives consumer complaints, as well as officials with FAA's Office of the Chief Information Security Officer, which advises the agency on matters relating to IT management and security.⁶ We also interviewed FAA officials with the Air Traffic Organization and its Systems Operations

⁴The NAS is a shared network of U.S. airspace; air navigation facilities, equipment, and services; airports or landing areas; aeronautical charts, information, and services; regulations and procedures; technical information; and manpower and material.

⁵Our scope excluded aircraft avionics (such as systems used by pilots for navigation); systems for in-flight operations (such as passenger Wi-Fi networks); and internal operations (such as company email systems).

⁶Through our review of relevant plans and an interview with DOT officials in the Office of the Secretary, we determined that airline IT systems are not included in federal plans for critical infrastructure protection; as a result, we excluded DOT's roles in this area from our review.

Services, which administers traffic management initiatives such as ground stops.⁷

To determine what is known about airline IT outages, including the number of flights and passengers affected, we assessed whether DOT data, including BTS and FAA performance and operations data could be used to identify such outages and their effects. We determined that these data were not designed, and could not be used, to comprehensively identify airline IT outages. However, these data provided some insight into flight disruptions (i.e., flight delays or cancellations) and ground stops caused by outages once we had identified outages through other sources and could look at data for specific dates.

In the absence of DOT or FAA data to identify airline IT outages, we validated a preliminary list of such outages that we developed using open source material from 2015 through 2017 for the 12 airlines that were required to report on-time performance information to BTS during this time period and two leading third-party IT providers (Amadeus and Sabre) that provide airlines with the types of IT services included in our scope.⁸ This validation was done using publicly available airline information (e.g., on websites and in press releases) and interviews with representatives from 11 of the 12 airlines, Amadeus, and Sabre.⁹ We also further corroborated some of these outages with FAA operations data and DOT consumer complaints. Through this process, we are confident that our list includes all airline IT outages large enough to garner national-level, multi-

⁷In general, when FAA initiates a ground stop, flights destined to arrive at the affected airport(s) are held at their departure point. These stops can be applied to a specific airport or affect an airline's entire fleet.

⁸The 12 airlines are Alaska, American, Delta, ExpressJet, Frontier, Hawaiian, JetBlue, SkyWest, Spirit, Southwest, United, and Virgin America. Because two carriers (Envoy and US Airways) were required to report on-time performance information to BTS in 2015 but not in 2016 or 2017, we excluded them from our scope.

⁹We requested interviews with all 12 selected airlines; 11 airlines agreed to be interviewed or provide written responses. One airline declined to be interviewed, although airline representatives provided context on the effects of airline IT outages on operations. Two airlines in our scope merged with other carriers prior to our review, and we interviewed representatives from the merged carrier (i.e., we interviewed SkyWest, which had merged with ExpressJet, and Alaska, which had merged with Virgin America).

day media coverage and an official response from an airline executive.¹⁰ To identify trends, if any, in IT outages, their potential causes, and effects on passengers, we interviewed representatives of the 11 airlines mentioned above, as well as other stakeholders, including an IT risk expert, three industry associations, and representatives from one employee union.

To understand how airlines accommodate inconvenienced passengers, we reviewed airline contracts of carriage for the nine airlines in our scope with applicable contracts. Airlines' contracts of carriage are the legally binding contracts between carriers and passengers and may include specific provisions such as refund procedures and responsibility for delayed flights, among other things. We reviewed passenger complaints received by DOT from 2015 through June 2018 stemming from airline IT outages to provide insight into what adverse effects passengers may have experienced as a result. We also interviewed the industry associations noted above and three consumer and passenger advocacy groups to identify any concerns regarding consumers affected by airline IT outages. See appendix I for more information on our scope and methodology.

We conducted this performance audit from February 2018 to June 2019 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

In the U.S. commercial airline industry, passengers travel on network, low-cost, and regional airlines. With thousands of employees and hundreds of aircraft, network airlines support large, complex hub-and-spoke operations, which provide service at various fare levels to many

¹⁰Our review (and validation process) was limited to airline IT outages occurring from 2015 through 2017. To provide updated information, we corroborated information from an online catalog of airline IT outages for 9 additional outages that occurred from January 2018 through January 2019 using publicly available airline or airport information or media coverage.

destinations. Low-cost airlines generally operate under a low-cost business model, which typically includes providing point-to-point service using fewer types of aircraft.¹¹ Regional airlines typically operate small aircraft—turboprops or regional jets with up to 100 seats—and generally provide service to smaller communities on behalf of network airlines.

Airlines rely on a wide variety of IT systems to schedule and transport passengers; some of these IT systems interface with networks operated by travel-booking sites, other airlines, and the FAA. These IT systems touch all phases of a passenger's travel experience, including booking, check-in, boarding, and baggage, as well as airline operations behind the scene, including flight planning, crew scheduling, and flight dispatch, according to FAA. In addition, aviation stakeholders explained that airline IT systems operate in a dynamic, data-intensive environment that demands around-the-clock availability and real-time information. In recent years, the introduction of new mobile applications and telecommunications infrastructure has added to the myriad systems and network connections now critical to an airline's operations.

Airlines face challenges in maintaining or enhancing their IT systems. For example, some airlines operate a web of IT systems that were developed over many years as manual systems transitioned to electronic and computer-processed functions. Replacing software and upgrading these older systems, such as reservations and crew scheduling, can be complicated undertakings as airlines serve millions of travelers and need to keep data flowing across their networks. For example, in its financial filings, Southwest pointed to the significant challenges and costs involved in introducing new IT capabilities while managing existing systems. Increasingly dependent on the use of IT systems to run its ongoing operations, the company recently completed a multi-year initiative to transition to a new third-party reservation system through Amadeus, among other investments.¹²

In addition, a wave of industry consolidation stemming from airline bankruptcies in the late 2000s has affected airline IT systems, requiring significant sustained focus among airlines on merging different IT

¹¹Our scope includes airlines defined by BTS as network carriers (Alaska, American, Delta, and United); low-cost carriers (Frontier, JetBlue, Spirit, Southwest, and Virgin America); and regional carriers (ExpressJet and SkyWest), as well as Hawaiian, which operates in a niche market.

¹²See Southwest's *Annual Report* (2019).

infrastructures necessary to support worldwide flight operations without interruption. For instance, we previously found that United struggled to integrate computer and reservation systems following its merger with Continental in 2010, although the airline has subsequently completed this transition, according to airline representatives.¹³ Likewise, in 2015 American pointed to its reliance on technology when discussing principal risks posed by the integration of its computer, communications, and other technology systems with those of US Airways following the merger of the two airlines.¹⁴

Additionally, some airlines rely on regional partners or third-party IT providers to help manage certain IT systems, such as reservations, crew scheduling, and flight dispatch, further adding to the variety of systems that airlines depend on to run their operations.¹⁵ Moreover, the airline industry is going through a transformation as it shifts to digital merchandizing and retailing to better serve consumers, a process which requires access to real-time information, according to an industry stakeholder.¹⁶ Finally, the speed of technology evolution has accelerated, making it a constant and iterative process to keep systems refreshed and operating in sync, a situation that poses additional challenges, according to a stakeholder.

Passengers may be affected by an airline IT outage in different ways depending, in part, on the type and severity of the outage—for example, whether the outage stems from a software glitch or a hardware failure—

¹³GAO, *Airline Mergers: Issues Raised by the Proposed Merger of American Airlines and US Airways*, [GAO-13-403T](#) (Washington, D.C.: Jun. 19, 2013). According to airline representatives, as United completed various steps of its integration with Continental, the complexity of the systems was reduced and reliability improved.

¹⁴American Airlines, Inc., *Annual Report* (SEC Form 10-K), Dec. 31, 2015. According to airline representatives, American subsequently merged key systems, including those involved in operations and crew management (i.e., for pilots and flight attendants).

¹⁵For examples of this reliance on other parties, see the financial disclosures mentioned above for American Airlines and Southwest Airlines, as well as Delta Air Lines, Inc., *Annual Report* (SEC Form 10-K), Feb. 23, 2018 and United Continental, Inc., *Annual Report* (SEC Form 10-K), Feb. 22, 2018.

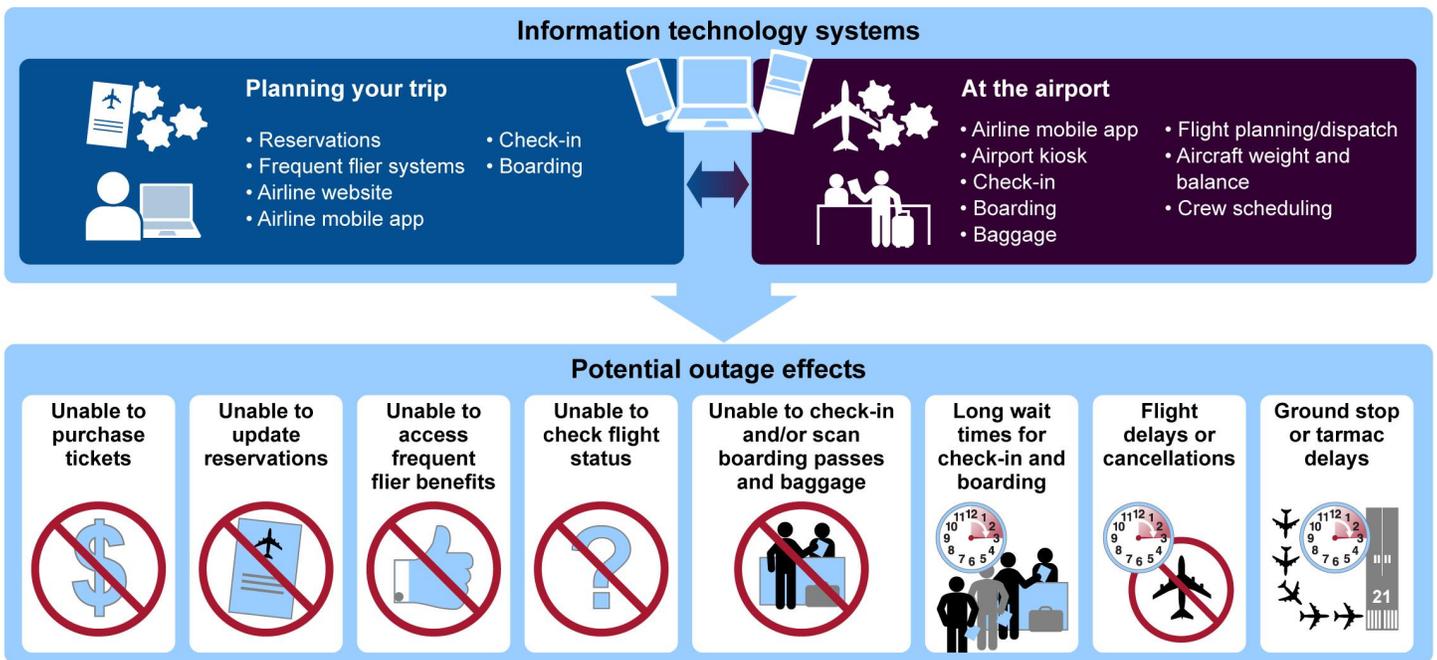
¹⁶We have previously reported on industry efforts to develop new standards and capabilities for optional services to be more widely available for purchase online, such as early boarding, wireless internet access, and preferred seating with more legroom. See GAO, *Commercial Aviation: Information on Airline Fees for Optional Services*, [GAO-17-756](#) (Washington, D.C.: Sept. 20, 2017).

and the system affected. (See fig. 1.)¹⁷ Effects can range from standing in line to be checked in by a ticket agent instead of using a mobile application to delayed and canceled flights if a hardware failure forces the airline to ground all of its flights until the system is back online. System failures may have cascading effects across other airline IT systems or operations, as well. For example, an outage in a flight dispatch system could cause hours-long delays for subsequent flights. Likewise, aviation stakeholders noted that crew positioning can hinder recovery from an outage as delayed flight crews “time out,” further extending the effects of an outage.¹⁸ In addition to these effects, passengers and airlines can also face higher costs from delayed or canceled travel, including increased operational expenses facing airlines as crews and aircraft sit idle, as well as indirect costs, such as those faced by travelers as their itineraries are delayed or canceled.

¹⁷This list of IT systems was compiled from our review of the types of systems that were affected by airline IT outages from 2015 through 2017.

¹⁸FAA has promulgated regulations regarding required rest periods for flight crews, including pilots. Therefore, the members of a flight crew could be “timed out” if a flight disruption causes them to be on duty through their allowable flight time, which—for pilots—begins when they are required to report for duty and lasts 8 or 9 hours. (See RIN 2120-AJ58 under 14 C.F.R. Parts 117, 119, and 121.)

Figure 1: Examples of Airline Information Technology (IT) Systems and Potential IT Outage Effects



Source: GAO analysis of information from the airlines and media reporting. | GAO-19-514

FAA and DOT Have Limited Roles in Overseeing Airline IT Systems and Addressing Effects from Outages on Passengers

FAA’s Role Is Primarily Initiating Traffic Management Initiatives Requested by Airlines

FAA plays a key, but limited, operational role in responding to airline IT outages. As previously noted, FAA is responsible for ensuring the safe, efficient operation of the NAS. Agency officials we interviewed emphasized that airline IT outages have a limited effect on FAA’s management of the NAS because such outages tend to affect the demand for airspace, not its capacity. As a result, FAA officials explained that if flights are delayed or canceled because of an airline IT outage, the NAS is often less congested for those that remain flying.

However, in managing the air-traffic control system, FAA is responsible for initiating and administering traffic management initiatives (such as a ground stop) if requested by an airline experiencing an IT outage.¹⁹ For example, an airline might request that FAA initiate a ground stop if the airline is unable to report flight dispatch information to the FAA, such as the weight and balance of aircraft. FAA works with airlines to accommodate flights back into the NAS when the outage is over. Once an airline recovers from an outage, FAA may also need to initiate traffic management initiatives if demand exceeds capacity in the system—potentially causing delays both for the airline that experienced the outage, as well as others.

FAA does not routinely collect data about airline IT outages—which fall outside of its management of the NAS, according to agency officials—although it does collect data on NAS operations, which could include some information about these events. Specifically:

- The National Traffic Management Log (NTML)—the real-time narrative log of NAS traffic management initiatives kept by air traffic controllers—includes information about ground stops or other initiatives such as time the stop was put in place, affected airports, and when the initiative was lifted. Log entries may also include additional information about the outage, if such information is provided to air traffic control by the airline experiencing it.
- The Operations Network (OPSNET) system, among others, collects operational data, including air traffic operations and delay data to analyze the performance of the FAA’s air traffic control facilities. However, according to agency officials, data on the effects of airline IT outages (including delay and cancellation data related to airline IT outages) are discarded because information about airline-caused flight disruptions do not provide instructive information to FAA about whether the agency is efficiently operating the NAS.

FAA does not directly oversee airline IT systems related to reservations, check-in, baggage, and boarding or their use, according to agency officials. These systems are managed by the airlines themselves. For airline IT systems that interface with FAA’s operational systems, such as automated systems used in air traffic control, FAA works with airlines to

¹⁹These traffic management initiatives are done at the request of airlines for outages that result in significant effects on airlines’ schedules.

ensure that any output (i.e., data feeds) interfaces correctly with the agency's systems. FAA may provide observations to the airline if its IT systems are not providing accurate information, such as if crews are not being correctly scheduled and tracked, fuel plans are not accurate, or flight plans are not correctly calculated and observable.

For Passengers, DOT Helps Ensure Compliance with Consumer Protections, Which May Be Triggered by Certain Airline IT Outages

DOT's Office of the Assistant General Counsel for Aviation Enforcement and Proceedings and its Aviation Consumer Protection Division are responsible for helping ensure airlines' compliance with passenger protection requirements and educating passengers on their rights. Airline IT outages are not specifically addressed by any of DOT's consumer protection regulations.²⁰ Rather, when these outages occur, they may trigger broader consumer protections afforded passengers.²¹ For example, airlines are required by DOT's interpretation of the statutory prohibition on unfair and deceptive practices to provide refunds for flights that are canceled or *significantly delayed* if a passenger declines any

²⁰However, the FAA Reauthorization Act of 2018 includes a requirement that in the event of a widespread disruption, such as an airline IT outage, the affected airline provide information on its website about whether and how the airline is arranging for accommodations and amenities. Pub. L. No. 115-254, § 428 (2018).

²¹While U.S. airlines' business practices were largely deregulated following the Airline Deregulation Act of 1978, a number of consumer protections for airline passengers (i.e., "consumer protections") are in place at the federal level. Federal statutes have also authorized DOT to regulate certain areas affecting passengers. For example, DOT has the authority to stop airlines from engaging in unfair or deceptive practices, or unfair methods of competition, and may promulgate consumer protection regulations under that authority. (See 49 U.S.C. § 41712.) Some consumer protections are in federal statute, such as the Air Carrier Access Act of 1986, as amended, which prohibits airlines from discriminating against individuals based on a disability.

rerouting that the airline may offer.²² In the case of delay, however, what amounts to a significant delay is not defined in this policy, and as discussed below, individual airlines may or may not set their own thresholds.²³ According to agency officials, DOT is currently conducting a review of air carriers' handling of involuntary changes to passengers' travel itineraries.²⁴ DOT also regulates compliance through its tarmac delay rule, which requires airlines to mitigate or avoid consumer harm in the event of a lengthy tarmac delay.²⁵ In addition to these consumer protection regulations and policies, DOT oversees airlines' compliance with obligations included in airline contracts of carriage or customer

²²In response to comments by some airlines and airline associations in a 2011 rulemaking proceeding, DOT rejected their assertions that carriers are not required to refund a passenger's fare when a flight is canceled if the carrier can accommodate the passenger with other transportation options after the cancellation. 76 Fed. Reg. 23110, 23129 (April 25, 2011). DOT stated that it finds it to be manifestly unfair for a carrier to fail to provide the transportation contracted for and then to refuse to provide a refund if the passenger finds the offered rerouting unacceptable (e.g., greatly delayed or otherwise inconvenient) and he or she no longer wishes to travel. Since at least the time of an Industry Letter of July 15, 1996, DOT's Office of the Assistant General Counsel for Aviation Enforcement and Proceedings has advised carriers that refusing to refund a non-refundable fare when a flight is canceled and the passenger wishes to cancel is a violation of 49 U.S.C. 41712 (unfair or deceptive practices) and would subject a carrier to enforcement action.

²³In the 2011 rulemaking proceeding, DOT stated that it had been persuaded by the airline industry that there should not be a "significant delay" threshold because delay can be influenced by many factors, a number of which may be beyond the airlines' control. 76 Fed. Reg. 23110, 23129 (April 25, 2011). DOT further stated that it would continue to monitor how carriers apply their non-refundability provision.

²⁴This review is being carried out in consultation with the Aviation Consumer Protection Advisory Committee (ACPAC) in response to a mandate in the FAA Reauthorization Act of 2018. Pub. L. No. 115-254, § 414 (2018).

²⁵A major requirement of the tarmac delay rule is that the airline's plan contain an assurance that it will not permit an aircraft to remain on the tarmac for more than 3 hours for a domestic flight, or 4 hours for an international flight, before allowing passengers to deplane, subject to exceptions for safety, security, and direction from air traffic control. See 14 C.F.R. § 259.4 and 49 U.S.C. § 42301.

service plans.²⁶ These contracts and plans must be publicly posted by airlines on their websites.

As we have previously reported, DOT helps ensure airlines' compliance with its passenger protection requirements by educating airlines on new regulations or clarifying existing regulations, responding to airlines' questions, and reviewing airlines' consumer service policies.²⁷ According to DOT officials, the agency encourages proactive reporting of incidents by airlines, such as airline IT outages, including a brief description of the incident and any steps taken by the airline to provide accommodation to affected consumers. DOT also receives and investigates complaints from passengers and uses complaint data to identify which airlines to inspect and whether to begin investigations that may result in fines or enforcement actions. According to agency officials, DOT received 126 complaints that explicitly mentioned a domestic airline IT outage from 2015 through 2017.²⁸ These complaints involved five such outages. For comparison, in all, the agency received between 17,000 and 21,000 complaints per calendar year during that timeframe, according to DOT's *Air Travel Consumer Report*.²⁹ According to DOT officials, complaints that explicitly mentioned an airline IT outage largely mirror in substance those received for other causes of flight disruptions. (These complaints are discussed in more detail below.)

According to DOT officials, no investigations have been carried out focusing solely on airline IT outages, but DOT investigations have included airline IT outages that contributed to violations of DOT's

²⁶According to the DOT Inspector General, Congress, DOT, and the Air Transport Association (ATA) in 1999 agreed that airlines should have an opportunity to improve their customer service without legislation. Toward that end, ATA and its member airlines committed to preparing customer service plans. See DOT Inspector General, *Airline Customer Service Commitment*, CC-2001-090 (Washington D.C.: Feb. 13, 2001). These plans include provisions that might provide consumer protections to passengers inconvenienced by airline IT outages, such as requirements to notify passengers about delays and cancellations, disclose cancellation policies, and identify services provided to mitigate passenger inconveniences due to cancellations and missed connections. In 2011, DOT required certain provisions to be included in airline customer service plans and required airlines to adhere to their customer service plans. See 14 C.F.R. Part 259.

²⁷According to DOT data, DOT inspected 12 to 14 U.S. airlines annually—most multiple times—at 51 domestic airports from 2015 through 2017. See [GAO-19-76](#).

²⁸DOT also received 14 complaints stemming from a domestic airline IT outage in June 2018.

²⁹See DOT, *Air Travel Consumer Report* (Feb. 2016, Feb. 2017, and Feb. 2018).

consumer protection regulations. For example, DOT found that an IT outage affecting Delta's operational systems, including gate management and flight dispatch systems, caused significant surface congestion and resulted in a violation of tarmac delay regulations. This violation was among those included in enforcement proceedings resulting in a civil penalty and consent order to the airline.³⁰

Finally, to monitor airline on-time performance and baggage handling and to provide information to consumers, DOT requires certain airlines to report data to BTS monthly, including the causes of flight delays and cancellations.³¹ However, the causes are grouped into broad categories and do not specify IT outages as a cause. BTS, which is an independent statistical agency within DOT, publishes summary data from reporting air carriers on the number of domestic on-time, delayed, canceled, and diverted flights on its website. DOT's Office of Aviation Enforcement and Proceedings also publishes a monthly *Air Travel Consumer Report* with this information. We discuss these data in greater detail below.

Information on Airline IT Outages and Their Effects Is Limited, but Suggests That Outages Result in a Range of Passenger Inconveniences

³⁰See *U.S. Department of Transportation, Delta Air Lines Order 2019-2-22*, Docket OST-2019-0001 (February 28, 2019).

³¹BTS has tracked on-time performance data on selected domestic flights operated by air carriers since 1987; in 2003, it also began collecting information on the causes of flight delays and cancellations. Beginning in 2018, the threshold for reporting carriers was lowered from those with at least 1.0 percent of scheduled service domestic passenger revenues to those with at least 0.5 percent, causing the number of carriers reporting carriers to rise from 12 to 18. 81 Fed. Reg. 76800, 76826 (Nov. 3, 2016).

We Identified 34 IT Outages Affecting Almost Every Domestic Airline in Our Review

Using a variety of information sources, we identified 34 airline IT outages from 2015 through 2017 affecting 11 of the 12 airlines in our review.³² No government data, academic literature, or other information source could be used to determine a comprehensive count of airline IT outages, and information is also limited regarding the types, causes, and effects of these incidents. Additionally, airlines do not regularly share detailed data about their IT outages publicly, such as the number of flights or passengers affected or the technical cause of the outage, although general information about these incidents is sometimes provided on their websites and social media accounts or to the press.³³

To identify airline IT outages in the absence of other sources of information, we validated a preliminary list of outages developed through a review of open source information, including media coverage. This preliminary list was validated through a combination of interviews with the airlines and third-party IT providers and a review of publicly available airline information, FAA NTML log entries, and DOT consumer complaints. Through our validation process, airline representatives and others identified additional airline IT outages that had not been reported or acknowledged publicly by airlines or third-party IT providers, reflecting the variation in quantity or quality of information available regarding these events.³⁴ For example, we found more information about IT outages that had nationwide or multi-day consumer or operational effects because these incidents garnered more coverage—and often an official airline response—as compared to those that were of shorter duration or affected a regional carrier or smaller number of flights, passengers, or airports. Additionally, we found less or incomplete information on outages at third-

³²Airline outages have continued to occur as illustrated by an online catalog of airline IT outages, which identified 11 additional outages that occurred from January 2018 through January 2019. While outside our scope, we were able to validate 9 of these outages using publicly available airline or airport information or media coverage. We did not carry out a thorough analysis to develop a full list of outages occurring during this timeframe.

³³Some airline representatives stated they considered information related to the cause, duration, and system associated with an IT outage proprietary.

³⁴For example, one airline shared information on more than 20 additional outages not previously identified in our review, most of which lasted less than 2 hours or resulted in no flight delays or cancellations.

party IT providers and regional carriers because their effects were dispersed across multiple airlines.

We found that the number and severity of flight disruptions associated with the airline IT outages we identified varied widely. About 85 percent (29 of 34) of our identified outages resulted in some flight disruptions, including 5 outages we identified that caused over 800 delays or cancellations.³⁵ However, we were unable to verify the exact number of disrupted flights caused by each outage. At least 14 outages resulted in a ground stop, some of which lasted for several hours, according to a review of FAA's NTML logs.³⁶ We identified seven outages that had no associated flight disruptions, although they inconvenienced customers in other ways. For example, during these incidents customers experienced problems buying tickets online, checking into flights on an airline's website, or using frequent flier benefits.

Because no comprehensive data are available on airline IT outages and their related effects, we could not compare these incidents with the effects on flights caused by other disruptive events, such as severe weather like hurricanes or snowstorms. However, FAA analysis of two of the IT outages that caused over 800 flight disruptions found that the number of delays or cancellations resulting from these outages was on par with or worse than those caused by severe weather in the same months the outages occurred.³⁷ Likewise, representatives from one airline stated that operational effects from airline IT outages are comparable to severe weather events, although outages occur much less frequently. An

³⁵We lack detailed information that would allow us to compare the number of flight disruptions resulting from airline IT outages with overall airline performance. We found that airlines operated over 17 million flights from 2015 through 2017, of which 19 percent were delayed or canceled based on a review of BTS data. However, we lack information on the exact number of delays and cancellations resulting from airline IT outages for the reasons discussed in the next section. In addition, we lack a baseline by which to compare flight disruptions resulting from airline IT outages because we did not catalog all of the incidents that led to delays and cancellations in our review, such as severe weather or airport-related problems.

³⁶NTML logs, which are not publicly available, may refer to an airline IT outage in the narrative if the airline shares this information with FAA during the event and the controller includes this information in the log, as mentioned above.

³⁷FAA conducted this analysis at our request for 3 of the 34 airline IT outages we identified. Since there is no source of FAA data that can identify an airline IT outage, we selected 3 outages with a range of flight disruptions for comparative analysis. FAA noted that it was not possible to definitively assess the effects of these outages.

aviation industry representative noted that these events are typically unexpected, hindering the ability of airlines to react and recover. By contrast, disruptions from weather may be forecast ahead of time, allowing airlines to prepare for predicted disruptions, including accommodating customers, adjusting flight crews and schedules, and pre-positioning aircraft, according to the same representative.

The airline IT outages we identified were caused by a range of IT and infrastructure issues, according to airline representatives we interviewed and official press statements.³⁸ These issues included hardware failures, software outages or slowdowns, power or telecommunications failures, and network connectivity issues, among others. In several instances, an IT issue in one airline system had cascading effects across other systems not affected by the initial outage. For example, a large volume of online traffic shut down an airline's website and subsequently disrupted the airline's reservations and check-in systems. Representatives from six airlines, an IT expert, and four other aviation industry stakeholders pointed to a variety of factors that could contribute to an outage or magnify the effect of an IT disruption. These factors ranged from underinvestment in IT systems after years of poor airline profitability, increasing requirements on aging systems or systems not designed to work together, and the introduction of new customer-oriented platforms and services.

Representatives from airlines we interviewed also described some of their IT system investments and risk mitigation efforts undertaken in response to an outage or to address potential disruptions, such as investing in new backup systems or technologies.³⁹ For example, five airlines have sought to reduce vulnerability by expanding IT operations beyond a single data center or moving them to the cloud, which allows for the delivery of computing services through the Internet. Likewise, two airlines described efforts to ensure connectivity and reduce the effects of IT disruptions by using multiple telecommunications network providers. Several airline representatives and an IT expert said that these airline IT investments are aimed at enhancing overall system functionality as well as revenue. However, the IT risk expert we spoke with noted that carrying out major

³⁸We requested from the selected airlines after-incident reports or other technical accounts that may provide details on the specific cause of the IT outages we identified, but the airlines did not provide these reports and deemed them proprietary.

³⁹We interviewed or received written responses to our questions from 11 of the 12 airlines in our scope.

upgrades to their IT systems can be challenging because these systems are always in use. Additionally, according to stakeholders we interviewed, airlines employ a variety of contingency planning and recovery strategies to respond to unforeseen technical issues, including IT outages. For example, one airline described incorporating routine system testing, artificial intelligence, and outage drills into planning for system disruptions to avoid outages or speed recovery. Airline efforts to increase the resiliency of their IT systems, such as those described above, could prevent or lessen the impact of such outages.

BTS Data Broadly Capture Flight Delays and Cancellations

BTS data capture the causes of flight delays and cancellations in several broad categories, which do not isolate flight disruptions resulting from airline IT outages and do not reflect the root cause of flight disruptions. As previously mentioned, BTS collects on-time performance data from the airlines, including the causes of flight delays and cancellations.⁴⁰ On a monthly basis, certain airlines are required to report at least one cause of delay (in minutes) for each flight delayed 15 minutes or more from the following five categories: air carrier, extreme weather, NAS, security, and late arriving aircraft.⁴¹ Similarly, for each flight that was canceled, airlines are required to report the cause from one of four categories: air carrier, extreme weather, NAS, and security. BTS guidance instructs airlines to report flight delays that are within the control of the airlines in the air-carrier category. Also included in the air-carrier category, according to the guidance, are more than 40 other potential causes of delays or cancellations, such as aircraft maintenance, baggage, terminal operations, and crew matters. As a result, flight disruptions from IT outages are indistinguishable from other airline-caused issues within this category.

Additionally, delays caused by airline IT outages may be captured in a category other than air carrier because of how airlines can report the causes of flight delays based on BTS guidance. For example:

⁴⁰14 C.F.R. § 234.1.

⁴¹14 C.F.R. § 234.4.

- **Multiple causes for a delay.** Airlines have the option to report either just the main cause or all the causes for a flight delay as long as the airline consistently applies the same method in its monthly report to BTS. Also, if there is more than one cause for a flight delay that starts at the same time, airlines are required to report the cause that lasted the longest. As a result, delays caused by an airline IT outage may be attributed to other categories if they happen at the same time as other issues affecting an airline's operations, such as poor weather or airport conditions.
- **Late arriving aircraft delays.** Airlines can report a flight delay in the late arriving aircraft category if the previous flight arrived late and caused the next flight (on the same aircraft) to depart late. Airlines are not required to provide additional information on the cause of the delay for the previous flight (air carrier, NAS, security, or extreme weather). As a result, delays from incidents that can cause ripple effects on an airline's operations, such as an IT outage or severe thunderstorms, may be attributed to the late arriving aircraft category.
- **NAS delays.** Airlines can report delays in the control of the FAA, airport operators, or state and local officials in the NAS category, which includes ground stops, flight volume delays, and air traffic control issues, among others. However, BTS guidance does not specify how airlines should report delays caused by ground stops requested by the airlines, including after an IT outage. As a result, these delays may be captured in the NAS category.

BTS data are collected to provide general information on the quality of airline performance to consumers and to improve airline scheduling, rather than detailed information about specific flights or events.⁴²

Consequently, these data provide limited insight into the effects of individual events, including airline IT outages, both because flight

⁴²In a 2002 rulemaking, DOT considered some additional information reporting requirements but concluded that reporting the initial causes of flight delays captured in the late arriving aircraft category are not critical to data users and reporting the initial causes of delay could be confusing. 67 Fed. Reg. 70535 (Nov. 25, 2002). With regard to scheduling, DOT officials noted that airlines had previously used BTS data to enhance operations and to track flight disruptions, but currently rely on other sources of data for this purpose.

disruptions may be captured in more than one category and because the data do not allow for the isolation of effects for affected flights.⁴³

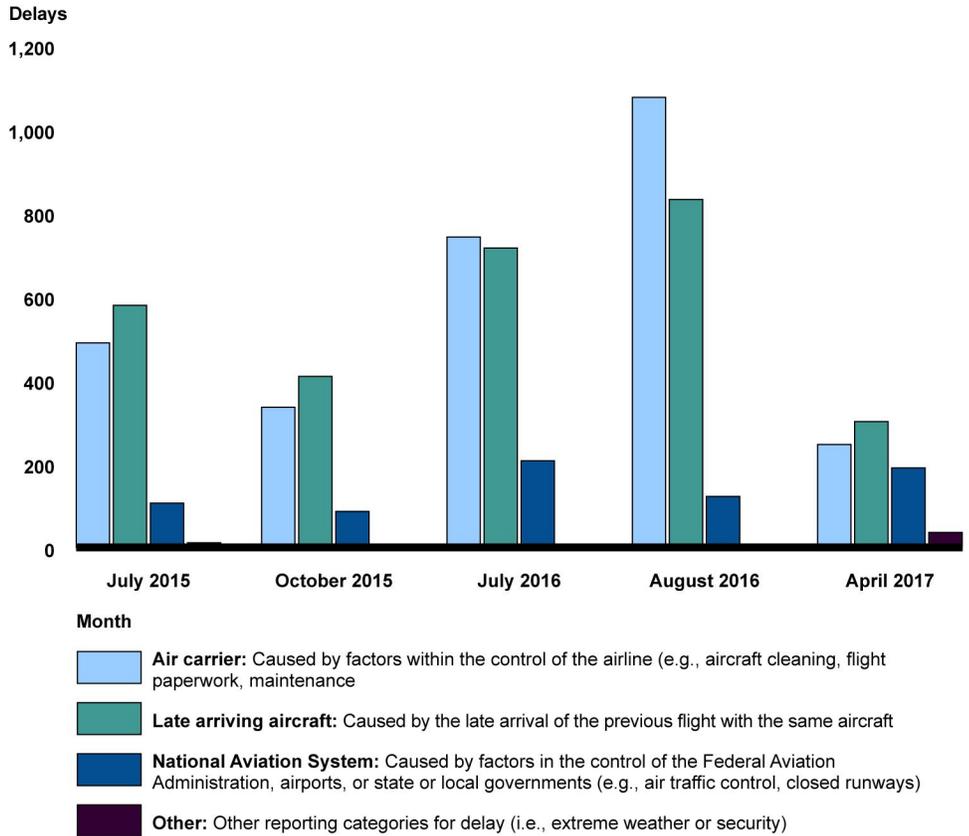
We reviewed BTS data for most of the airline IT outages we identified and found, for example, that for 3 outages, airlines reported the largest total number of flight delays in the NAS causal category on the day that the airline requested a ground stop because of the outage—rather than in the air-carrier category. In addition, we reviewed BTS data for the 5 outages we identified where the airline involved delayed or canceled at least 800 total flights and found that airlines spread the causes of flight delays and cancellations across several categories, primarily air carrier, late arriving aircraft, and NAS for the first day of these outages.⁴⁴ For example, we found that airlines attributed 44 percent of all reported flight delays to late arriving aircraft for these days.⁴⁵ (See fig. 4).

⁴³For our analysis, we reviewed airline IT outages that airline representatives or other airline sources confirmed to have resulted in flight delays or cancellations. For IT outages that affected flights over several days, we reviewed data on the first day in which the outage occurred. We excluded outages at third-party IT providers because their effects are dispersed among multiple airlines.

⁴⁴Flight disruptions for these outages ranged from about 800 to about 8,000, according to press reports and airline-provided information.

⁴⁵We previously reported that BTS information on the causes of flight delays provided consumers with an incomplete picture of the underlying causes of flight delays. We reported that in 2007 the largest source of system-wide delay—late arriving aircraft—masked the original source of these delays, which could have included severe weather, the airline, security, or the NAS, or a combination of one or more of these sources. See GAO, *National Airspace System: DOT and FAA Actions Will Likely Have a Limited Effect on Reducing Delays during Summer 2008 Travel Season*, [GAO-08-934T](#) (Washington, D.C.: July 15, 2008).

Figure 2: Airline-Reported Causes of Flight Delays for Airline Information Technology (IT) Outages Affecting over 800 Total Flights (2015–2017)



Source: GAO analysis of airline information for IT outages resulting in delays or cancellations of more than 800 total flights and Bureau of Transportation (BTS) data for the first day of these outages. | GAO-19-514

Data table for Figure 2: Airline-Reported Causes of Flight Delays for Airline Information Technology (IT) Outages Affecting over 800 Total Flights (2015–2017)

Month	Air carrier	Late arriving aircraft	National Aviation System	Other
Jul 2015	489	579	106	11
Oct 2015	335	409	86	0
Jul 2016	742	716	207	6
Aug 2016	1076	832	122	0
Apr 2017	246	301	190	36

DOT officials did not see a need for additional reporting requirements on flight delays and cancellations caused by airline IT outages given the effects of such events are not unique when compared to other causes of

flight delay and because these incidents involve a small portion of consumer complaints received by DOT. Aviation stakeholders we spoke to told us that airlines track flight disruptions for internal purposes such as managing operations and scheduling. For example, representatives from one airline said that the airline tracks delays and cancellations associated with IT outages and other issues internally to identify patterns and reoccurring issues that need improvement, such as scheduling, staffing, and maintenance. DOT officials noted that obtaining more detailed information on the causes of flight delays and cancellations would require a cost and benefit analysis to determine whether the benefit from collecting the data would exceed the airlines' cost to report the data. Officials also noted that the agency has undertaken efforts to provide additional information to consumers.⁴⁶ Notably, to provide more insight into the underlying causes of delay attributed to late arriving aircraft, BTS began calculating the original causes of delays in the late arriving aircraft category and providing these data on its website in response to a recommendation made by the DOT Inspector General in 2013.⁴⁷

Information on the Effects on Passengers Is Largely Anecdotal and Illustrates Varied Passenger Experiences

No data are publicly available to quantify with any degree of precision the number of passengers affected by airline IT outages, and only one airline provided this type of information to us.⁴⁸ Airline contracts of carriage set the minimum accommodations passengers are entitled to when their flights are delayed or canceled, which could include refunds, rebooking, or other amenities, such as food or meals. However, there is no

⁴⁶The FAA Reauthorization Act of 2018 includes a provision for DOT to review the categorization of delays and cancellations in response to adverse weather conditions by September 2019. Pub. L. No. 115-254, § 413 (2018).

⁴⁷These data are based on BTS calculations that proportionally assign delay minutes reported by the airlines in the other causal categories (air carrier, NAS, security, and weather). As a result, the original cause identified is not based on reporting, but rather a calculation. See DOT OIG, *More Comprehensive Data Are Needed To Better Understand The Nation's Flight Delays and Their Causes*, AV-2014-016 (Washington, D.C.: Dec. 18, 2013).

⁴⁸This airline provided information on the numbers of their passengers on delayed or canceled flights for five outages—one of which occurred in their own IT system(s) affecting nearly 8,000 passengers and four other outages at a regional partner and third-party IT providers, respectively, affecting between nearly 1,000 and nearly 12,000 of the airline's passengers.

comprehensive information about the accommodations that were actually received by passengers, and available information is largely anecdotal.

Even with respect to the same IT outage, different people may be affected differently. For example, passengers may be affected by the complexity of the NAS and their individual circumstances. According to an airline representative we spoke with, an airline may be able to quickly rebook affected passengers on a different airline for one destination, for example, but may have difficulty rebooking passengers for another destination if other flights are full. Further, while network airlines have hub-and-spoke networks that include a number of route options or frequent service between cities, others—particularly point-to-point or low-cost carriers—may have more limited service, further constraining the ability to rebook individual passengers. Finally, passengers travel for different reasons and their tolerance for disruption can differ, as well, according to DOT officials. Thus, someone flying to visit a friend may have a different tolerance for delay than someone traveling for a job interview, they noted.

Airlines are required by DOT to provide refunds for canceled—and significantly delayed—flights if a passenger chooses to cancel his or her trip.⁴⁹ Beyond these requirements, however, airlines are not obligated to provide accommodations for flight disruptions such as cancellations and delays unless specified in an airline’s contract of carriage, according to DOT.⁵⁰ These contracts govern what, if anything, a passenger is entitled to, although airlines may offer additional accommodations to inconvenienced passengers.⁵¹ Generally accommodations received by inconvenienced passengers could include rebooking on the same airline

⁴⁹As mentioned earlier, DOT considers an airline failure to provide a refund for a canceled flight to be a violation of 49 U.S.C. § 41712 (DOT’s general authority prohibiting unfair or deceptive practices). Accordingly, passengers are entitled to such refunds, according to DOT, if the flight is canceled and the passenger chooses to cancel the trip.

⁵⁰By contrast, there are consumer protections addressing passengers who are denied boarding involuntarily (i.e., they are “bumped”) or those affected by long tarmac delays, when passengers do not have an opportunity to get off an airplane on the ground at an airport. For example, an airline must provide compensation to passengers who are bumped, with the amount varying based on the type of flight (e.g., foreign or domestic) and availability of alternate transportation. See 14 C.F.R. § § 250.5 and 259.4, respectively.

⁵¹We found that airlines’ customer service plans did not provide passengers with greater protections or the right to more amenities than were included in airline contracts of carriage vis-à-vis airline IT outages.

or alternate travel; refunds or compensation in the form of money or other benefits (e.g., credit for later travel); and amenities such as hotel stays and food, according to their contracts of carriage. Airlines can—and in some cases do—go above and beyond the obligations set forth in their contracts of carriage, as illustrated by some examples below.

Accommodations Included in Airlines' Contracts of Carriage Vary

To better understand the accommodations that passengers may have received as the result of airline IT outages, we reviewed airlines' contracts of carriage for the airlines in our scope with applicable contracts.⁵² None of these contracts addressed IT outages directly, but flight disruptions caused by outages would be covered under the broader contract terms addressing cancellations and delays. We found that the contracts vary in terms of what accommodations are provided for, as well as the extent to which airlines have discretion in providing them. For example, while several airline contracts include provisions to provide hotel vouchers, transportation to the hotel, or meals, other airlines—notably several low-cost carriers—do not. Likewise, some airlines establish set time thresholds for when they are obligated to provide a certain accommodation (e.g., after a delay of at least 4 hours), while others do not. Specific accommodations we identified in our review of airline contracts of carriage are discussed below, and table 1 further details some of the variation that we found.

⁵²This analysis included 9 of the 12 airlines required to report to BTS from 2015 through 2017. We excluded 2 regional airlines (ExpressJet and SkyWest) that operate under the contracts of carriage of their mainline partners, as well as Virgin America, which merged with Alaska in 2018 and no longer has a separate contract of carriage.

Table 1: Examples of Accommodations to Be Provided to Airline Passengers Affected by Cancellations or Delays (Required Duration of Delay, if Applicable)

Airline ^a	Alternate travel		Refund of unused portion of ticket		Amenities	
	Rebooking on a different airline	Other transportation (e.g., rail)	Flight cancellation	Flight delay	Hotel stay	Food
Alaska	Yes, discretionary	Yes, discretionary	Yes	Yes (2 hours)	Yes (4 hours)	^b
American	No ^c	No	Yes	Yes (1 hour)	Yes	^b
Delta	Yes, discretionary	Yes, discretionary	Yes	Yes (90 minutes)	Yes (4 hours)	^b
Frontier	No	^b	Yes ^d	Yes ^d	^b	^b
Hawaiian	^b	^b	Yes ^d	Yes ^d	Yes (4 hours)	Yes (4 hours)
JetBlue	^b	No	Yes	Yes (1 hour)	Yes (6 hours)	Yes (6 hours)
Southwest	^b	No	Yes	Yes	^b	^b
Spirit	No	^b	Yes (2 hours)	Yes (2 hours)	Yes	^b
United	Yes, discretionary	Yes, discretionary	Yes ^d	Yes ^d	Yes (4 hours) ^e	Yes (“extensive”)

Source: GAO analysis of selected airline contracts of carriage (February 2019). | GAO-19-514

^aNo airline provided for monetary compensation to passengers affected by cancellations or delays for domestic flights in its contract of carriage, although Alaska and JetBlue provided for travel vouchers for such passengers in some circumstances.

^bAccommodation was not addressed in the contract of carriage.

^cHowever, American will rebook a passenger on a different airline or provide for ground transportation if he or she is diverted to a different airport than the passenger’s original origin or destination, according to the airline’s contract of carriage.

^dFrontier, Hawaiian, and United consider certain groups of cities identified in their contracts of carriage to be the same point (e.g., Chicago and Milwaukee, San Francisco and Oakland, Colorado Springs and Denver). Their contracts of carriage do not provide for refunds if the airlines are able to provide transportation to the specified alternative city.

^eUnited’s contract of carriage does not provide for hotel stays to passengers who are diverted to airports within certain city groups (e.g., Burbank, Los Angeles, Ontario, or Orange County), among other exceptions.

- **Alternate transportation.** All nine airlines in our analysis provide for rebooking on their own airline in the event of a flight delay or cancellation such as might be caused by an airline IT outage, although Frontier includes certain airports near a passenger’s original destination as acceptable alternatives in its contract of carriage. Under this exception, for example, Frontier could rebook a passenger on a flight to Tampa if he or she had originally planned to travel to Orlando, or vice versa, in the event of a flight disruption. Three of the airline contracts of carriage we reviewed provide for travel on a different airline—or the use of alternate ground transportation—typically at their discretion, and a fourth airline provides for alternate

transportation if a passenger's flight has been diverted to a different airport. Airline representatives with two low-cost carriers described their unsuccessful efforts to develop agreements with network airlines to facilitate the rebooking of passengers on another airline.

- **Refunds for cancellations.** If a flight is canceled and no alternative is available—or if available flights are not acceptable to the passenger—all nine airlines in our analysis provide for refunds, although three airlines may instead reroute passengers to nearby cities. Under their contracts of carriage, airlines typically provide refunds for the unused portion of a ticket in the event of flight disruptions. If, for example, passengers have already completed the outbound portion of a roundtrip ticket, they would receive a partial refund for the unused, return portion, rather than the entire ticket. Finally, three airlines (Hawaiian, Southwest, and United) offer passengers the option of travel credits in lieu of a refund in their contracts of carriage.
- **Refunds for delays.** The majority of airlines in our review provides refunds or flight credit for flight delays, although refunds in some cases could be contingent on the absence of an acceptable alternative, such as being rebooked on a subsequent flight or to an alternate airport. As mentioned above, DOT requires airlines to provide refunds for flights that are “significantly delayed” but does not define how long such a delay is and instead relies on a case-by-case determination. Four of the contracts we reviewed establish a specific timeframe for the delay after which a passenger is entitled to a refund, while the others do not establish such a threshold. For example, a passenger flying on Alaska Airlines could request and receive a refund for a flight disruption lasting at least 2 hours, and passengers on Delta are entitled to a refund, if requested, after a 90 minute delay. By contrast, airlines without a defined threshold for a delayed flight have discretion for when passengers would be eligible for refunds, particularly with regard to nonrefundable tickets.⁵³
- **Hotel stay.** The majority of airlines in our review provide for hotel stays in their contracts of carriage (and ground transportation to the hotel), to varying degrees, although two low-cost carriers (Frontier and Southwest) do not. The contracts of carriage for seven airlines include a hotel stay for passengers inconvenienced by flight disruptions, and of these

⁵³Passengers may travel using cheaper, nonrefundable tickets, rather than paying the fully refundable fare. If these passengers wish to change or cancel their flight reservations, they may be charged fees to do so. In 2017 we found that these fees ranged from \$0 to \$200 (each way). See [GAO-17-756](#).

- four stipulate that passengers have to be away from home or from their points of origin or destination;
- five require that the flight disruption span certain hours (e.g., 10pm to 6am); and
- one includes credit for a long-distance phone call.

Four of the contracts we reviewed include additional provisions for hotel stays (or other accommodations) to passengers with disabilities or other needs. For example, under its contract of carriage, American will provide amenities to maintain the safety and welfare of certain passengers if they are delayed (e.g., customers with disabilities, unaccompanied children, the elderly, or others with special needs or circumstances).

- **Food.** Three airlines in our review provide for meals for passengers inconvenienced by flight disruptions in their contracts of carriage. For example, JetBlue’s contract of carriage provides for meal vouchers or pizza for flight delays of 6 or more hours.⁵⁴ In addition, airlines may deliver meals or offer other amenities to passengers waiting for delayed or canceled flights, even in the absence of the promise of food in the contract of carriage. In these cases, additional accommodations may be publicly announced on airline websites, by social media accounts, or through statements to the press, or they may be provided directly to individual flights or passengers at the airport. For example, in response to severe thunderstorms in 2017, Delta had pizza delivered to passengers waiting in airports across the Southeast.
- **Monetary compensation or travel credit.** Inconvenienced passengers are not entitled to monetary compensation in the case of a flight delay or cancellation in the United States, and none of the airlines in our review includes such compensation in their contracts of carriage.⁵⁵ Nevertheless, two airline contracts of carriage include provisions for travel credit—above and beyond a refund—for flight

⁵⁴Contracts of carriage for both Hawaiian and United also provide for meals after a 4-hour or “extensive” delay, respectively.

⁵⁵By contrast, in the European Union, airlines are required to provide a set amount of compensation when a flight is canceled, delayed, or when passengers are denied boarding against their will. The amount of compensation depends on the length of the delay and the distance to be traveled. See *Regulation (EC) No 261/2004 of the European Parliament and of the Council of 11 February 2004*.

disruptions. JetBlue's contract of carriage provides for travel credit for canceled or delayed flights with several tiers, depending on the timing of the cancellation or length of the delay.⁵⁶ For example, passengers delayed over 6 hours are entitled to \$250 credit for future travel on JetBlue. Likewise, Alaska's contract provides for a discount code for future travel (and a letter of apology) for passengers delayed longer than 2 hours. Although not included in Delta's contract of carriage, the airline provided \$200 in travel vouchers to all customers with flight disruptions lasting at least 3 hours for two of the IT outages we identified, according to airline representatives.

Consumer Concerns Stemming from Airline IT Outages

As mentioned above, collecting and analyzing passenger complaints is one way DOT helps ensure that an airline fulfills its obligations included in its contract of carriage and customer service plan, as well as any additional accommodations that may be publicly offered. Our review of passenger complaints filed with DOT stemming from airline IT outages found that they included complaints related to the lack of monetary compensation for delayed or canceled flights and refusals to refund other expenses, such as rental cars or missed hotel or cruise reservations, among other concerns.⁵⁷ For example, complaints related to a Southwest outage in 2016 included several related to lack of compensation or other amenities, such as food or hotel stays offered by the airline. As noted above, Southwest's contract of carriage does not provide for compensation, food, or hotel stays in the event of a delay or cancellation. Complaints filed after the Delta outage of 2016 acknowledged receipt of a \$200 travel voucher in compensation or a hotel voucher, but pointed to other non-refunded expenses incurred or difficulties in redeeming these vouchers.

The three consumer or passenger advocacy groups with whom we spoke raised several concerns with regard to passengers inconvenienced by

⁵⁶According to JetBlue's contract of carriage, for cancellations where alternate transportation is not available within one hour, passengers receive compensation in the form of travel credits, ranging from \$50 to \$100 depending on when the flight was canceled. Likewise, credits for delays range from \$75 to \$250, depending on the length of the delay.

⁵⁷We reviewed airline IT outage-related passenger complaints received by DOT for six domestic outages from January 2015 through June 2018.

airline IT outages. Stakeholders we spoke with responded to these concerns and addressed how airlines respond to IT outages.

- *Passengers may not receive the same accommodations.* In the absence of requirements for accommodations or compensation, passengers are dependent on whether or not the affected airline chooses to be generous, according to the consumer advocates we interviewed. They also noted that mileage plan or first class passengers may receive more accommodations than others, even when passengers are affected by the same underlying outage, as may be true in other circumstances, as well. Representatives from one airline told us that they attempt to promptly address the needs of all of their passengers but acknowledged that accommodations may vary depending on passenger circumstances, including passenger status (e.g., frequent-flyer program members or VIP travelers).
- *Airline obligations toward affected passengers may be confusing for passengers.* According to consumer advocates we spoke with, even if a passenger understands that an airline's contract of carriage lays out its obligations to passengers affected by an IT outage, these contracts are often lengthy and difficult to understand. As noted above, our review of DOT complaints stemming from airline IT outages found that many passengers expected to receive compensation or other accommodations in response to these events, although such accommodations were not included in contracts of carriage. We reported in 2017 that airlines committed to reviewing their contracts of carriage to see if they could be simplified.⁵⁸
- *Contracts of carriage may not clearly exclude IT outages from force majeure events, according to consumer advocates.* Flight disruptions caused by extreme weather, terrorism, and other events that are seen as being beyond the control of the airline are typically treated as special situations in airline contracts of carriage, and as a result, inconvenienced passengers may not receive accommodations that

⁵⁸In 2017 we reported that airlines had committed to reviewing their contracts of carriage to see if they could be simplified to improve transparency, according to a representative from an airline advocacy group. See [GAO-17-756](#).

they otherwise might.⁵⁹ Consumer advocates voiced concerns that airline IT outages might be treated as events outside the airline's control (i.e., Acts of God or *force majeure* events) given ambiguity in how these exceptions are defined. We found that IT outages were not explicitly included among *the force majeure* events identified in the contracts of carriage we reviewed. In interviews and written statements, representatives with four of the airlines in our review varied in the extent to which they characterized airline IT outages as incidents in the control of the airline, but generally indicated that passengers would be accommodated as if the outages were.

Agency Comments

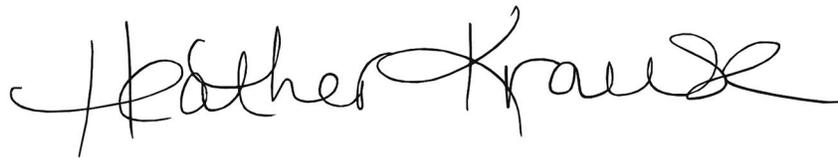
We provided the Department of Transportation (DOT) with a draft of this report for review and comment. DOT responded by email and provided technical clarifications, which we incorporated into the report as appropriate.

We are sending copies of this report to the appropriate congressional committees, the Secretary of the Department of Transportation, and other interested parties. In addition, the report is available at no charge on the GAO website at <http://www.gao.gov>.

⁵⁹To assist passengers in understanding the regulations that govern air travel, DOT explains common terminology on its aviation consumer protection website. It includes *force majeure* event, explaining that such events are those outside of the carrier's control that can alter a carrier's schedule resulting in flight delays, schedule changes, and flight cancellations. Usually these events include weather conditions, acts of God, or any other event not reasonably foreseeable by the carrier and not within the airline's control. DOT reminds consumers that each airline has its own contract of carriage with its own terms and definitions. For more information, see DOT, *Common Terms in Air Travel*, <https://www.transportation.gov/airconsumer/common-terms-air-travel>.

If you or your staff have any questions about this report, please contact me at (202) 512-2834 or KrauseH@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix II.

Sincerely yours,

A handwritten signature in black ink that reads "Heather Krause". The signature is written in a cursive style with a large, prominent initial 'H'.

Heather Krause
Director, Physical Infrastructure Issues

Appendix I: Objectives, Scope, and Methodology

Our objectives for this report were to: identify (1) the Department of Transportation's (DOT) and Federal Aviation Administration's (FAA) roles, if any, in relation to airline IT outages and their effects and (2) what is known about these outages, including the number of flights and passengers affected.

The scope of this report focuses on those airline IT systems that affect passenger experiences, including systems related to reservations and check-in, as well as those used by airlines for flight planning and dispatch. Our scope excluded IT systems involved in avionics (such as aircraft navigation systems); in-flight operations (such as passenger WiFi networks); and internal operations (such as company email systems). Our analysis included the 12 airlines that were required to report on-time performance information to DOT's Bureau of Transportation Statistics (BTS) from 2015 through 2017,¹ including network carriers (Alaska, American, Delta, and United); low-cost carriers (Frontier, JetBlue, Spirit, Southwest, and Virgin America); regional carriers that provide service for partner airlines (ExpressJet and SkyWest); and Hawaiian, which provides a niche service.² Given the role of third-party IT providers, we also included Amadeus and Sabre in our scope.

To identify relevant DOT and FAA authorities and responsibilities vis-à-vis airline IT outages in several areas, including operations, oversight, and data-collection, we reviewed relevant laws, regulations, policies, and

¹Two carriers (Envoy and US Airways) were required to report performance information to BTS in 2015 but not in 2016 or 2017. We excluded them from our scope.

²According to BTS, network airlines operate a significant portion of their flights using at least one hub where connections are made for flights to down-line destinations or spoke cities. Low-cost airlines operate under a low-cost business model, with infrastructure and aircraft operating costs below the overall industry average. Regional carriers typically provide service from small cities, using primarily regional jets to support the network carriers' hub and spoke systems.

guidance, as well as prior GAO work addressing agency roles.³ We interviewed DOT officials with

- BTS, which collects data on airline on-time performance, and
- the Office of the Assistant General Counsel for Aviation Enforcement and Proceedings and its Aviation Consumer Protection Division, which oversee consumer protections and receive consumer complaints.⁴

We also interviewed FAA officials with the Office of the Chief Information Security Officer, which advises the agency on matters relating to IT management and security. Within FAA's Air Traffic Organization, we interviewed officials with Systems Operations Services, which administers traffic management initiatives including ground stops, and its National Airspace System (NAS) Operations and Office of Performance Analysis.⁵ These two offices are responsible for programs related to air traffic control systems and assessing the performance of the NAS, respectively.

Through our review of relevant plans and an interview with officials in DOT's Office of the Secretary, we determined that airline IT systems are not included in federal plans for critical infrastructure protection. According to DOT officials, outages in these systems do not have the potential to reach established thresholds for potential casualties or

³Prior GAO reports include *National Airspace System: DOT and FAA Actions Will Likely Have a Limited Effect on Reducing Delays during Summer 2008 Travel Season*, [GAO-08-934T](#) (Washington, D.C.: July 15, 2008); *Airline Passenger Protections: More Data and Analysis Needed to Understand Effects of Flight Delays*, [GAO-11-733](#) (Washington, D.C.: Sept. 7, 2011); *Commercial Aviation: Information on Airline Fees for Optional Services*, [GAO-17-756](#) (Washington, D.C.: Sept. 20, 2017); and *Airline Consumer Protections: Additional Actions Could Enhance DOT's Compliance and Education Efforts*, [GAO-19-76](#) (Washington, D.C.: Nov. 20, 2018).

⁴DOT has the authority to stop airlines from engaging in unfair or deceptive practices, or unfair methods of competition, and may promulgate consumer protection regulations under that authority. See 49 U.S.C. § 41712. For more information about DOT's oversight of airline consumer protection, see [GAO-19-76](#).

⁵In general, ground stops occur when flights destined to arrive at the affected airport(s) are held at their departure point. These can be applied to a specific airport or affect an airline's entire fleet.

damages.⁶ By contrast, air traffic control systems and airports are included in sector-specific plans addressing critical infrastructure protection in the case of a terrorist attack or other natural or manmade disaster.⁷

To determine what is known about airline IT outages, we reviewed DOT data sources, including BTS and FAA performance and operations data,⁸ as well as passenger complaints received by DOT in response to airline IT outages from 2015 through August 2018. We also conducted interviews with or received written responses from 11 (of 12) airlines in our scope,⁹ and interviewed other stakeholders, including third-party IT system providers Amadeus and Sabre; an IT risk expert (Robert Charette); industry associations, including Airlines for America (A4A), the Regional Airline Association (RAA), and Airports Council International (ACI); and employee union representatives with the Air Line Pilots Association (ALPA).

We determined that DOT and FAA data were not designed, and could not be used, to comprehensively identify airline IT outages. To identify airline IT outages in the absence of detailed DOT or FAA data, academic literature, or internal (proprietary) airline data on these incidents, we validated a preliminary list of such outages developed using open source

⁶Critical infrastructure are those systems and assets, whether physical or virtual, so vital to the United States that their incapacity or destruction would have a debilitating effect on security, national economic security, national public health or safety, or any combination of those matters. USA Patriot Act of 2001, Pub. L. No. 107-56, §1016(e), 115 Stat. 272, 401 (codified at 42 U.S.C. § 5195c(e)).

⁷*The Presidential Policy Directive/PPD-21—Critical Infrastructure Security and Resilience* (Washington, D.C.: Feb. 12, 2013); the Department of Homeland Security's (DHS), *National Infrastructure Protection Plan (NIPP) 2013: Partnering for Critical Infrastructure Security and Resilience* (Washington, D.C.: 2013); and DHS and DOT, *Transportation Systems Sector-Specific Plan* (Washington, D.C.: 2015) establish DOT's role in protecting critical infrastructure.

⁸We assessed the extent to which airline IT outages could be identified—or their effects measured—in several sets of operational data including, FAA's Aviation System Performance Metrics (ASPM), Operations Network (OPSNET), National Traffic Management Log (NTML), and Airline Service Quality Performance (ASQP).

⁹Two (of 12) airlines in our scope merged with other carriers prior to our interviews, so did not respond separately: ExpressJet with SkyWest and Virgin America with Alaska. One airline declined to be interviewed, although airline representatives provided context on the effects of airline IT outages on operations.

material that included media coverage and publicly available airline sources for outages from 2015 through 2017. Specifically, we

- searched GAO subscription databases (e.g., ProQuest, Nexis, and EBSCO) to create a preliminary list of 37 airline IT outages from media coverage;
- performed additional searches of articles and official airline websites to collect more information on and corroborate incidents identified;
- provided our list of identified IT outages to the 12 airlines in our scope and two third-party IT providers (Amadeus and Sabre) for confirmation; and
- corroborated 20 of the identified IT outages with FAA's National Traffic Management Log's (NTML) log entries and DOT's consumer complaint data.

Through this process, we were able to corroborate 34 airline IT outages from 2015 through 2017, and we are confident that our list of outages includes all of the outages large enough to garner national-level, multi-day media coverage and an official response from an airline executive.¹⁰ While accurate, our list is not comprehensive because three airlines and a third-party IT provider identified additional outages that we did not find in our preliminary search, including one airline that shared information on more than 20 additional outages. We did not include these additional outages in our count to ensure that our methodology was consistent.

To account for outages that may have occurred subsequent to our review, we identified an online listing of airline IT outages and validated 9 of 11 of the outages included from 2018 through January 2019 using publicly available airline or airport information or coverage in at least 3 media sources.¹¹ This list and our validation process provides evidence that airline IT outages continued to occur during this timeframe, but does not

¹⁰We excluded three outages we identified initially from media reporting because these outages fell outside the scope of our review based on additional information provided during interviews or by airline representatives about the outage cause or IT system affected. Additionally, one airline opted to verify only the IT outages that resulted in 100 or more delayed flights or 25 or more canceled flights.

¹¹The catalog of outages is presented by Sungard, an IT service provider. See Sungard Availability Services, *Airline Outages Timeline, 2007–Present*, <https://www.sungardas.com/en/industry/airline-outages-timelines/> (accessed Mar. 8, 2019).

match the rigor applied to the identification of outages we identified from 2015 through 2017. As a result, we are not confident that this list identified all of the outages large enough to garner national-level, multi-day media coverage and an official response from an airline executive.

Once we had identified airline IT outages through other sources and could look at data for specific dates, we were able to use DOT and FAA data to provide additional insight into flight disruptions (i.e., flight delays or cancellations) and ground stops caused by outages. For example, we requested that FAA conduct analysis on 3 of the 34 outages we had identified to determine what FAA operational data could reveal about the effects of these outages. We selected these 3 outages to reflect a range of flight disruptions for comparative analysis, including variations in size and cause of the outage. We also assessed the extent to which the effects on passengers could be seen in the BTS on-time performance data reported by airlines. For these data, we sought to determine the cause and magnitude of delays and cancellations for each outage. We also reviewed NTML log entries for the dates of known outages to further identify potential information, including incidents of ground stops. Finally, to obtain more information about the potential effects on passengers resulting from these events, we reviewed consumer complaints to DOT stemming from airline IT outages. These complaints were provided to us by DOT's Aviation Consumer Protection Division and include reference to the associated outage.

To understand how airlines accommodate inconvenienced passengers, we reviewed airline contracts of carriage for 9 of the 12 the airlines in our scope. These contracts are the legally binding contracts between carriers and passengers and may include specific provisions such as refund procedures and responsibility for delayed flights, among other things. We excluded two regional airlines (ExpressJet and SkyWest) that operate under the contracts of carriage of their mainline partners and Virgin America, which merged with Alaska in 2018 and no longer has a separate contract of carriage. In addition to the stakeholders mentioned above, we also interviewed consumer or passenger advocacy groups, including representatives with the Consumers Union, the National Consumers League, and Travelers United to identify any concerns regarding consumers affected by airline IT outages.

We conducted this performance audit from February 2018 to June 2019 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our

findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

In addition to the individual named above, other key contributors to this report were Jonathan Carver, Assistant Director; Molly Laster, Analyst-in-Charge; Neha Bhatt; David Hooper; Rich Hung; Delwen Jones; SaraAnn Moessbauer; Emily Mussey; Josh Ormond; Corinne Quinones; Pamela Snedden; James Sweetman, Jr.; and Elizabeth Wood.

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