Tablets Take Flight:

The Rise of Personal Electronic Devices & The Growing Cost of the FAA Ban on Technology Use During Takeoffs/Landings

Part A: Technology in Intercity Travel Study – 2013 Update
Chaddick Institute for Metropolitan Development

DEPAUL UNIVERSITY

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Note: This report supersedes the version released on May 22. See footnote i (pg. 11) for a summary of changes.

Executive Summary

This report evaluates newly-collected data to explore the growing dependence on electronic devices among airline travelers and the expanding consequences of the FAA's ban on the use of electronic devices during takeoff and landing. Observations of 1,688 passengers on 23 flights showed:

1. The use of portable devices is surging as travelers grow more dependent on tablets and other sophisticated devices. More than 35% of travelers are now engaged with devices at randomly selected points in time—up from 28% in 2012 and just 17.6% in 2010.

2. Tablet/e-reader use grew dramatically, rising from 8.4 to 10.7% of all randomly observed passengers between 2012 and 2013. At any given point, more than one in nine passengers is using a tablet.

3. Major advances in tablet/e-reader technology, the broadening demographic of technology users, and new, tech friendly investments by airlines are fueling the use of sophisticated lightweight devices.

4. More than 105 million hours of disrupted technological activity on domestic flights is projected in 2013—an estimated 104% increase since 2010—due to prohibitions on the use of devices during takeoffs and landings.

The evidence presented in this report suggests that the FAA's "go slow" approach to assessing the ban comes at a high cost to the traveling public. As more travelers seek to "power up", the FAA must be more deliberate in deciding whether to lift or modify its policy.

Figure 1
% of Airline Passengers Using Technology
at Randomly Selected Points
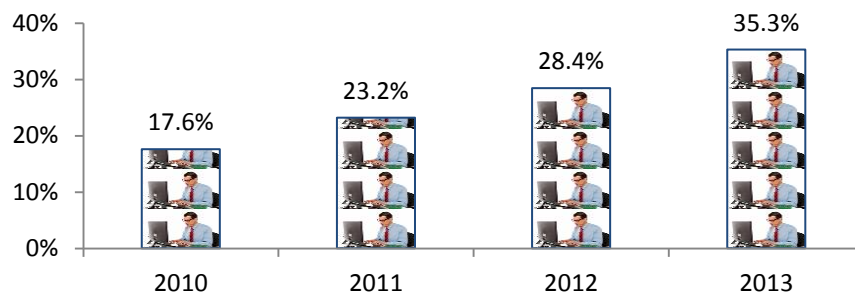
Introduction

The growing prevalence and sophistication of personal electronic devices used by passengers on commercial flights is dramatically changing the way Americans experience air travel. These personal devices, whether used for business or pleasure, enable travelers to do many activities that were once impossible, including watching videos, using social media, and surfing the internet.

With personal devices becoming more ubiquitous, policymakers and industry officials have increasingly called into question the Federal Aviation Administration's (FAA) policy on electronic devices during takeoffs and landings. Although the FAA does not explicitly ban electronic devices, its policy is routinely described as being a "ban" since it puts the burden of proof on the airlines to demonstrate that devices do not interfere with electronic navigation systems. Providing such proof would be complex and costly due to the enormously wide array of technological products available to the public. To date, no airline has attempted to provide such a demonstration.

This report presents newly-collected data from the Chaddick Institute's Technology in Intercity Travel Study to explore both the growing dependence on electronic devices among airline travelers and the expanding consequences of the ban. The study, now in its fourth year, evaluates information collected about how passengers are engaged with portable devices on intercity air, bus, and train trips. The study began in September 2009 and since then has grown to encompass 35,000 unique passenger observations (in which no passenger is counted more than once on a given trip) on 410 trips throughout the United States. More than 10,000 observations have also been made in Canada, Europe, and South America. No other dataset of this kind is known to exist.

The data is collected by field researchers who conduct visual surveys of fare-paying passengers on regularly scheduled trips. Team members pass through the aisles of rail coaches, buses, and airplanes and enter data regarding passenger activity, typically between 20 minutes and an hour after departure. To allow for greater consistency in comparisons between modes, the study considers only *weekday* departures. This year's data encompasses 117 departures, including:

- 23 commercial flights operating throughout the continental United States;
- 24 intercity Amtrak trains; 32 commuter trains;
- 16 conventional intercity bus departures (predominantly Greyhound and Trailways); and
- 22 curbside bus departures (Megabus/Coach USA).

Researchers measured the use of three basic features of electronic devices:

| **Table 1** |
| :---: |
| **Types of Activity Recorded** |

 1. ***Audio Activities***: Devices, such as cell phones or CD players, that can be used with earphones, speakers, or headsets, that are being used strictly for an audio function.

2. ***Visual or Audiovisual Activities on Devices, not including iPads, Kindles and other Tablet Use:*** Visual or audiovisual features, such as laptop computers, Blackberries and other smart phones, DVD players, and iPods. (This category includes any traveler looking at an LCD screen for the purpose of engaging in an activity more substantial than placing a phone call).

3. ***Visual or Audio-Visual Activities on iPads, Kindles and other Tablets:*** Same as Category 2 except focusing specifically on tablet usage. This final category was newly-introduced last year to better calculate how small and lightweight devices affect traveler behavior.

This year, the study team observed 1,688 passengers on 23 flights operated by six airlines.[1] This sample was larger than those of previous years (Figure 2). *Results for bus and train travelers will be summarized in the forthcoming Part B of this year's study.*

Figure 2
Number of Airline Travelers Visually Observed by Data
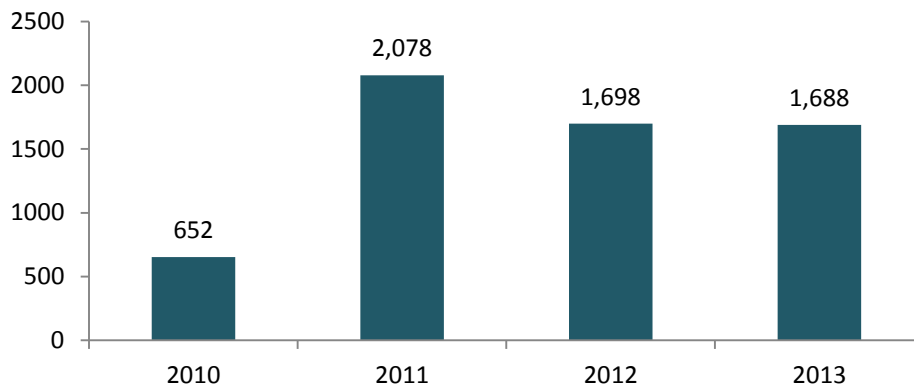
Note: data for 2010 - 12 was collected in the first quarter but also included flights from November/December of the previous year.   These results do not include two Alaska Airlines flights observed but excluded for reasons discussed in the Appendix. The inclusion of those flights raises the passenger count to 1,907.

Key Findings

The newly collected 2013 data allows for five major findings:

Finding 1: *The use of portable devices on U.S. domestic flights is surging as travelers grow more dependent on tablets and other sophisticated technological devices. Our observations show that 35.3% of travelers are now engaged with devices at randomly collected points. At the same time, travelers are gradually abandoning simpler devices, such as music players.*

The share of passengers engaged in using personal electronic devices rose for the fourth consecutive year. At randomly selected points, 35.3% of passengers are now engaged with technology, compared to 28.4% last year, 23.2% in early 2011, and just 17.6% in 2010. This marks the largest gain in absolute terms since data collection began in late 2009 (Figure 3). The gradual increases in technology—a growth of 24.3% between 2012 and 2013 alone—has had a compounding effect, resulting in more than double the technology usage since 2010.

It warrants emphasis that a greater share of passengers—perhaps as many as 90%[2]—use electronic devices at some point during their flight. By looking at usage at moments in time, however, the approach used in this report provides a more accurate portrayal of the *intensity of technological engagement* than studies focusing only on whether a device is used at some point during the trip.

Figure 3
% of Airline Passengers Using Technology
at Randomly Selected Points
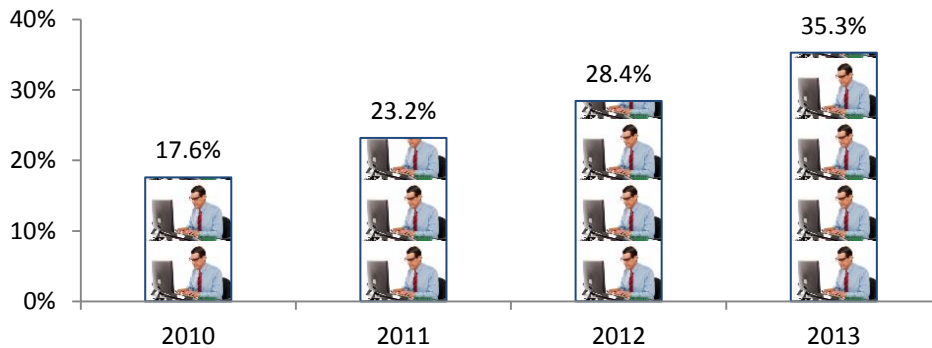
The growing prevalence of technology is more pronounced among passengers who use devices for *visual features* (i.e., features involving LCD screens, such as those on e-readers, tablets, or laptop PCs). The share of passengers engaged in visually oriented activities rose from 11.2% in 2011, 22.0% in 2012, to 25.2% this year (Figure 4). As we discuss in Finding 2 below, tablet/e-reader use rose at an even faster rate.

Figure 4
% of Airline Passengers Engaged with Visually Oriented (LCD) Tasks at Randomly Selected Points
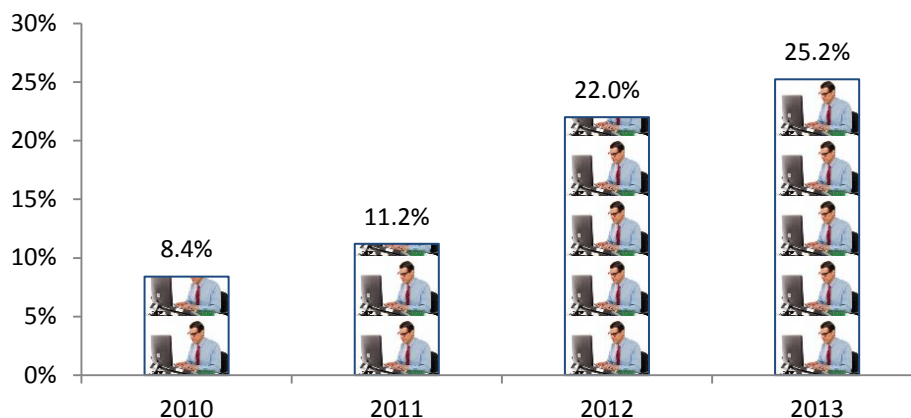

 Finding 2: *More than one in 9 passengers (10.7%) is now using a tablet or e-reader at randomly selected points. The rising prevalence of these devices marks the most fundamental shift in the way passengers allocate time on flights since our first report was issued in 2010.*

Whereas the overall technology use rose by 24% among airline travelers between 2012 and 2013, tablet/e-reader usage rose by more than 28%. That means that while slightly less than one in 12 passengers observed last year (8.4%) was using a tablet or e-reader, this year more than one in nine (10.7%) passengers used one (Figure 5).

Passenger activity has rapidly shifted away from less sophisticated devices, such as smart phones, to tablets and e-readers.   For example, tablets/e-readers accounted for 37.7% of all visually oriented tasks undertaken on personal devices last year, and this number has increased significantly over the past year to 42.3% of devices (Figure 6).

Figure 5

**% of Airlines Passengers Using Tablets/e-Readers
at Randomly Selected Points**
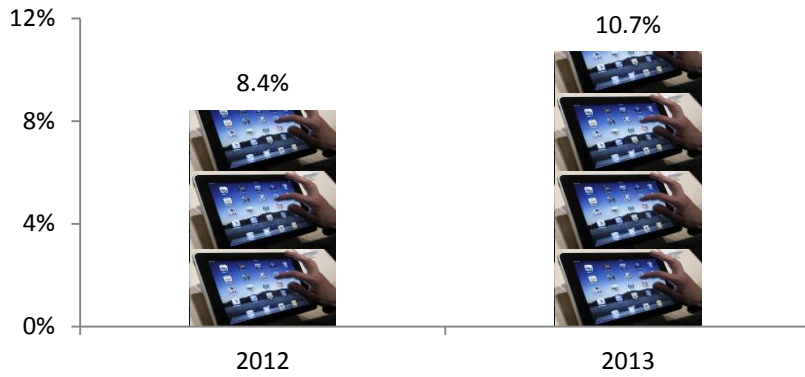
Note: data for 2012 was collected in the first quarter but also included flights from December of the previous year

Figure 6

**Share of Visually Oriented Electronic Tasks of Airline Passengers
Accounted for by Tablets and e-readers**
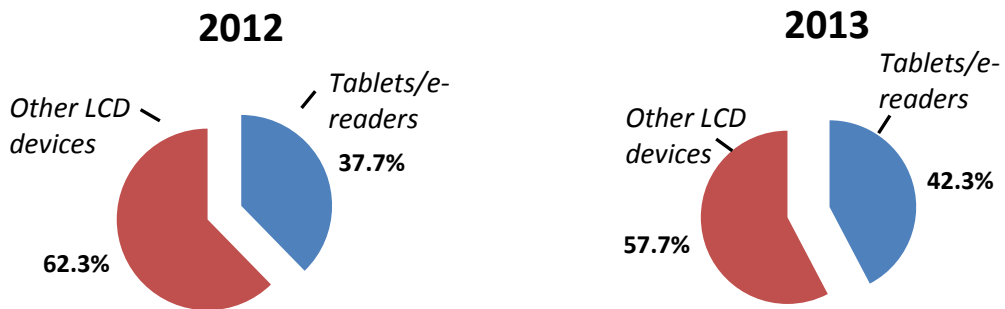
Finding 3: *Major advances in tablet/e-reader technology, the broadening demographic of technology users, and new tech friendly investments by airlines are fueling the use of sophisticated lightweight devices.*

Three factors have stimulated the dramatic rise in the devices on flights over the past years:

1. Advances in technology and availability of lightweight and flat devices: Tablets and e-readers represent a breakthrough in convenience for many airline travelers. Their space-saving qualities and ability to boot up quickly make these devices almost ideal for space-confined environments. Coach-class passengers on airplanes have little legroom and are more likely to be sitting next to other passengers compared to bus and train travelers, making the size of the device a critical consideration. Tablets and e-readers can be stored in a seatback or purse prior to takeoff and landing. Tray tables and the reclining seats of airlines are also comparatively better suited for tablets and e-readers than they are for laptops.

The long periods in which these devices can be used between battery charges is another advantage. Whereas power outlets are common on some buses and trains, airline travelers in the coach cabin generally must use devices without auxiliary power supply, making the long duration between charging particularly advantageous on long trips.

2. Broadening demographic profile of technology users: Personal electronic devices have long been a mainstay among business travelers. Over the past two years, however, their prevalence has grown sharply among pleasure travelers as well as lower-income and less educated populations. The Pew Charitable Trust shows that low-income groups have enjoyed dramatic increases in both tablet and e-reader ownership. The share of all Americans who own tablets rose from 19% in January 2012 to 31% in January 2013.[3] Similarly, our data of Greyhound travelers, who tend to be lower income and less educated, shows faster-than-average increases in use in recent years. As recently as two years ago, technology use by these travelers greatly lagged behind that of passengers on other modes of transportation. By 2013 (as will be discussed in Part B of this report), however, the margin had greatly narrowed.[4]

On commercial flights, the "democratization" of sophisticated technology manifested itself in the form of a diminishing gap in personal electronics use between business-oriented flights (dominated by higher income flyers) and pleasure-oriented flights observed several years ago. This year, we found for the first time that technology usage on flights to pleasure destinations exceeded that of flights to business destinations.

3. Investments in tech-friendly features by airlines: Airline cabins and gate areas are becoming increasingly tech-friendly due to investments by airlines. Consider that:

- Major airlines now accept mobile boarding passes stored on smart phones and other devices
- Airlines are gradually expanding work stations/kiosks at gates for use and charging of devices
- Airlines now send text messages to passengers to inform them of flight delays and gate changes
- Airlines offer programs to allow passengers to rent tablets for personal use at their seats
- Wi-Fi is competitively priced and available on many flights for $8 or less. An estimated 10% of airline passengers now use onboard WiFi service.

The growing prevalence of LCD screens in seatbacks in which personal devices can be connected is also fueling much of the growth.

Finding 4: *The number of hours of disrupted technological activity on domestic flights attributable to the FAA ban on the use of electronic devices during takeoffs and landings has grown by 104% since 2010. We project that 105.8 million hours of technological activity will be hindered as a result of the ban in 2013, compared to 51.7 million hours in 2010.*

The FAA prohibits an airline from allowing personal electronic devices to be used during takeoff and landing unless that airline can demonstrate that all of the different types of devices used by travelers have been tested to assure they do not interfere with electronic navigation systems. Due to the cost and difficultly of testing the many types of devices being sold, airlines have simply opted to prohibit the use of devices.

The consequences of this policy has grown sharply, due to both the rising number of airline travelers and their growing dependence on technological devices. Domestic air travel, measured in passenger enplanements, grew by 2.0% between 2010 and 2012, reaching 642,205,000 last year, and it is projected to remain flat 2013. Air travel is now at its highest level since before the 2008/2009 recession and is projected to reach an all-time high over the next several years. The share of passengers using devices at any randomly selected point, as previously shown, has more than doubled.

As a result growing dependence on technology, we estimate the number of hours of "disrupted technological activity" (hours in which travelers would prefer to use electronic devices but are precluded from doing so) has risen from 51.7 million hours in 2010 to 105.8 million hours in 2012 (Table 2). These estimates are made by multiplying the number of domestic enplanements by i) the share of passengers engaged with technology at randomly observed points during the flight when the ban is not in effect (e.g., 35.3% in 2013) and ii) the average duration of the ban (28 minutes).

Table 2
Effect of FAA Ban on Passenger Technological Activity

Year Ending	Hours of Disrupted Technological Activity on Domestic Flights
2010	51,706,054
2011	69,100,875
2012	85,113,569
2013*	105,816,793

*Projected based on FAA forecast.
Note: Data for 2010 - 12 was collected in the first quarter but also included flights from November/December of the previous year.

The results are based on several assumptions:

i) By our estimate, the ban prevents the use of devices 13 minutes during the takeoff phase of flights and 15 minutes during the landing phase, for a total of 28 minutes. These estimates are based on the elapsed time during a subset of the flights we sampled.

ii) Travelers would tend to use devices as intensely during takeoffs and landings as at other times during the trip. This assumption is based on our earlier finding that passengers tend to use technology in roughly equal proportion at different parts of flights.

These estimates should be regarded as conservative, considering that:

i) Passengers can gain access to 3G and 4G services on their personal devices as well as cell-phone signals when their planes are taxing or at low altitudes—precisely when the ban is in effect. This makes using technology more attractive at these times than when flying at high altitudes.

ii) These estimates do not include the hours the technology disruption associated with in-flight entertainment systems or airline sponsored tablet-rental programs, such as Alaska Airline's "DigEplayers" offering. Nor do they include the disruptions associated with the requirement that devices be turned off when flights encounter turbulence.

iii) These estimates do not include the many hours of technology disruption experienced by millions of non-revenue passengers and passengers on charter flights who fly annually. Nor do they include estimates of the disruption faced by *international* travelers. These travelers are not included in our passenger counts.

The assumption is also made that the ban does not dissuade people from using technology entirely on flights. It is possible that if the ban was lifted far more passengers would use technology during all portions of flights, particularly on shorter trips, than we observed.

Finding 5: ***The FAA faces growing pressure to relax its policy governing personal electronic devices due to rising load factors (which detract from the passenger experience), expanding investments in Wi-Fi systems, and a growing belief that the present policy is too rigid and inflexible to remain in the public interest.[1]***

A variety of technology-related factors, in addition to those mentioned in Finding 4, add to the pressure to have the ban lifted:

Rising Load factors: Airline load factors reached a record 82.4% in 2012—the highest level since World War II and 0.8% higher than in 2011. As more planes depart nearly or entirely full, waiting areas and airplane cabins have become more congested and stressful. In these environments, passengers often find social media and other digital activities provide a welcome relief from the commotion around them.

Underutilization of Wi-Fi, power outlets, and other amenities in airplanes: The ban on electronic devices reduces the effectiveness of airline investments in Wi-Fi systems and power outlets installed for the courtesy of passengers. This problem will worsen as increasing numbers of new generation planes, such as Boeing 787 airplanes, which are equipped with power outlets, enter service.   By the start of 2014, more than 75 of these "Dreamliners" are expected to be in service, resulting in significant underutilization of these amenities.

This problem is particularly acute on short-distance flights. The lack of time available to passengers to use in-flight Wi-Fi systems appears to be a particularly significant deterrent to the use of this amenity. Evidence has shown that the premium that passenger place on tech-friendly features of buses and trains has contributed to the shift in market share to these slower modes. As other Chaddick Institute reports show, the rising popularity of intercity bus service and traffic growth in short- and medium-distance corridors has been driven at least in part by their tech-friendly environments.

Questions about the safety benefits of the present policy: This study does not look closely at the evidence about the potential safety benefits associated with the FAA's present policy. Rather, it seeks to show that, as the *costs* of the ban escalates on account of growing dependence on personal

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[1] This finding as well as the final paragraph of this report have been substantially revised since the May 22, 2013 release of the study to provide a more balanced perspective on the potential safety risks associated with the use of portable electronic devices. The statement that "The National Aeronautics and Space Administration, for example, studied the ban and found no actual evidence that a consumer electronic device can affect airplane operations," which was based on secondary sources, has been deleted. The estimates of the level of "disrupted technological activity" presented in this section, however, have not changed.

electronic devices, reassessing whether the present policy should be retained without modification has become an important priority. At a minimum, the evidence suggests that the FAA needs to articulate why it feels that the evidence supports a continuation of its present policy, which has resulted in an across-the-board ban all devices during takeoff/landing regardless of the type of equipment involved, and consider a more nuanced policy.

This report does not seek to dismiss the evidence that exists about possible interactions between personal devices and navigation equipment.   Reports on the use of electronic devices on flights suggest that, on older model airplanes—particularly produced before the early 1990s—devices *can* provide electromagnetic interference with the navigation systems. Newer models tend to have safeguards against electromagnetic interference that largely eliminates the risks. (See Negroni for a non-technical summary of some of the evidence).[5]

Conclusion

The evidence presented in this report suggests that the FAA's "go slow" approach to assessing the ban comes at an underappreciated high cost to the traveling public in regards to technology use. We estimate that the number of hours of disrupted technological activity has more than doubled since 2010 and will reach more than 92 million hours annually this year.   Considering the value that many travelers place for using the Internet on flights—as is evident by the willingness to pay for using Wi-Fi systems even on short flights—the costs of this delay to the traveling public could well exceed several hundred millions of dollars annually.

As a technology revolution changes the way we spend our time when moving from place to place, and a rapidly growing number of people place a premium on technology use while en route, the FAA should carefully consider the implications that the ban has on "lost tech time" during takeoff and landing. Technology is often crucial for dealing with family and work-related emergencies, keeping businesses functioning smoothly, and lessening the stress of being away from home.

As airlines replace older aircraft with newer models that have navigation systems safeguarded against electromagnetic interference, it appears to be time to consider a more nuanced approach to policies regarding personal electronic devices at takeoff/landing. Evidence about why travelers are not permitted to "power up" on any types of airplanes should be persuasively presented to the public on a more deliberate timetable than has been done in the past.

Appendix
Methodology and Sample

DATA RECORDING PROTOCOL: Data was recorded as a code (based on the type of device each passenger is using) on smart phones, which have been programmed for airline mode. Data is then sent as a text message after arrival so the results can be consolidated. Please reference Table 1 earlier in this report for details on how we assign codes to each type of electronic device. The Institute purchases tickets for data collectors—who travel as regular fare-paying passengers on buses, planes, and trains—and collect data in real-time settings.

TIMING ON FLIGHTS: Data collectors collect information 10-15 minutes after devices are permitted to be activated. As a result, data collection often begins about 25-40 minutes after leaving the gate. Most of the variation in elapsed time since departure from the gate was due to the amount of time spent taxiing. Data is collected in a short interval since our objective is to obtain a "snapshot in time" of technology usage.

OMITTED FLIGHTS: We had to omit one flight this year since the data collector was not permitted to leave his/her seat due to turbulence. We also omit Business and First Class cabins, although our observations show that these cabins have considerably *higher* usage than coach cabins. We also omit Spirit Airlines due to the fact this carrier charges fees for carry-on baggage.

ONBOARD ENTERTAINMENT: We do <u>not</u> count passengers using onboard entertainment systems. This year, we did not encounter any flights in which passengers were connecting their personal device into such systems.

SPECIAL CIRCUMSTANCES: Data collectors developed a consistent response to these situations: When two passengers are using the same device, only the passenger most closely situated to the device is counted as using a device.
A. When a passenger is judged to be below grade-school age (5th grade or less), that passenger is excluded, although we have observed heavy usage among many younger passengers.
B. When a passenger is using a set of earbuds or headphones that is plugged into an electronic device, but that passenger appears to be sleeping, we classify that passenger as using an "audio device"

SAMPLE: Our sample includes representation of six of the seven largest U.S. carriers: Delta, United, American, US Airways, JetBlue and Alaska. We did not sample JetBlue, which ranks sixth, due to difficultly in fitting its flights into our travel schedule, but we did sample Virgin America. As previously noted, we sample only weekday flights to lessen the risk of sample-related biases. We also do not report our findings by carrier to avoid biases related to having small samples.

DigEplayers on ALASKA AIRLINES. We also omitted the two Alaska Airlines flights from the final analysis on account of the fact that the airline offered "DigEplayer" rentals (hand-held devices) to passengers on these trips. The data collectors could not easily distinguish between these pre-loaded entertainment devices and personal devices. The inclusion of these flights raises the cumulative percentage of

travelers engaged with technology to 37.0% and the percentage using tablets to 12.7%.

GEOGRAPHY.   By virtue of our geographic location in Chicago, roughly two third of our observations involve flights to/from Midway or O'Hare.   Even so, virtually all flights we observed have extensive connecting traffic to/from other cities.   Moreover, we maintain a high degree of consistency in the mix of flights we observe from year-to-year, ensuring that we have accurate year-over-year comparisons.

FLIGHTS OBSERVED. Noted on Table 3 below.

TABLE 3
LIST OF SCHEDULED FLIGHTS OBSERVED

Airline	Day/Date	Origin	Destination	Scheduled Departure
Alaska	Friday (03-22-13)	Chicago, IL	Portland, OR	5:10 PM
Alaska	Wednesday (04-03-13)	Seattle, WA	Chicago, IL	6:05 PM
American	Friday (3-8-2013)	Chicago, IL	Miami, FL	9:00 AM
American	Thursday (3-14-2013)	Miami, FL	Chicago, IL	3:35 PM
Delta	Tuesday (3-26-13)	Chicago, IL	Atlanta, GA	4:45 PM
Delta	Tuesday (3-26-13)	Atlanta, GA	Tampa FL	8:35 AM
Southwest	Friday (03-15-13)	Chicago, IL	Las Vegas, NV	9:55 PM
Southwest	Friday (03-08-13)	Chicago, IL	Greenville (GSO), SC	10:50 AM
Southwest	Friday (03-08-13)	Greenville (GSO), SC	Nashville, TN	1:50 PM
Southwest	Monday (03-11-13)	Nashville, TN	Boston, MA	10:45 AM
Southwest	Monday (03-11-2013)	Chicago, IL	Nashville, TN	8:20 AM
Southwest	Tuesday (03-12-2013)	Boston, MA	Washington, D.C.	1:45 PM
Southwest	Tuesday (03-12-2013)	Washington, D.C.	Chicago, IL	4:35 PM
Southwest	Thursday (3/21/2013)	Chicago, IL	Cleveland, OH	2:00 PM
Southwest	Thursday (3/21/2013)	Cleveland, OH	Baltimore, MD	5:00 AM
United	Wednesday (4-3-13)	Tampa, FL	Chicago, IL	6:00 AM
US Airways	Wednesday (3/20/2013)	Chicago, IL	Philadelphia, PA	9:45 AM
US Airways	Wednesday (3/20/2013)	Philadelphia, PA	Chicago, IL	7:42 PM
US Airways	Wednesday (3/20/2013)	Philadelphia, PA	Providence, RI	12:55 PM
US Airways	Wednesday (3/20/2013)	Providence, RI	Philadelphia, PA	4:40 PM
US Airways	Friday (3/8/2013)	Chicago, IL	Charlotte, NC	5:45 AM
US Airways	Friday (3/8/2013)	Charlotte, NC	Pensacola, FL	9:30 AM
US Airways	Wednesday (3/13/2013)	Pensacola, FL	Charlotte, NC	7:35 AM
US Airways	Wednesday (3/13/2013)	Charlotte, NC	Chicago, IL	11:45 AM

Other Recent Chaddick Studies on Technology Use

"Staying Connected *En Route*: The Growing Use of Tablets and other Portable Electronic Devices on Intercity Buses, Trains, and Planes"

Our 2012 study showing how the growing use of portable electronic technology among intercity air, rail, and bus passengers changing travel behavior.   Released January 2012.

"Who Rides Curbside Buses: A Survey of Passengers on Curbside Bus Lines in Six East and Midwest Cities"

Provides survey results from 750 curbside and conventional bus passengers in six cities, including analysis of how traffic is being diverted from other modes. Released June 2011.

Tablets and E-Readers Leap Past Music Players and Regular Cell Phones as "Technologies of Choice" on Commuter Trains.

A detailed look at the type of devices used by more than 2,000 travelers on Chicago commuter trains. Released on May 23, 2012.

For free downloads of these studies, please visit the publications area in Chaddick Institute web site at: http://las.depaul.edu/chaddick

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Schwieterman, Joseph P. and Lauren Fischer, "Privacy Invades Public Space: The Growing Use of Portable Electronic Technology on Intercity Buses, Trains and Planes," Chaddick Institute Policy Study, DePaul University, January 2011. See page 14 for a link to this study.

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[1] Observations were made on two Alaska Airlines flights in which tablets were rented to passengers through the DigEplayer program. See Appendix for discussion.

[2] Chaddick Institute surveys show that nearly 90% of intercity bus passengers use some form of technology on intercity trips. See "Who Rides Curbside Buses: A Survey of Passengers on Curbside Bus Lines in Six East and Midwest Cities," available at las.depaul.edu/chaddick. Although we have not conducted a similar survey of airline passengers, the socioeconomic characteristics of flyers suggest these travelers use technology at an even higher percentage. Moreover, as of December, 2012, 87% of American adults have a cell phone and approximately 45% have a smartphone (Pew Charitable Trust, 2012).

[3] See *Pew Internet: Per Internet and American Life Project*, available at http://www.pewinternet.org/Trend-Data-(Adults)/Device-Ownership.aspx

[4] Our results show a particularly rapid increase in technology use on conventional bus lines (such as Greyhound and Trailways) between 2012 and 2013. A large share of the passengers on these lines are low- and middle-income. See Part C of this 2013 update of the Technology in Travel Study (forthcoming).

[5]Christine Negroni, "Interfering With Flight?", *New York Times, January 17, 2011*, accessed on May 27, 2013 at http://www.nytimes.com/2011/01/18/business/18devices.html?_r=0