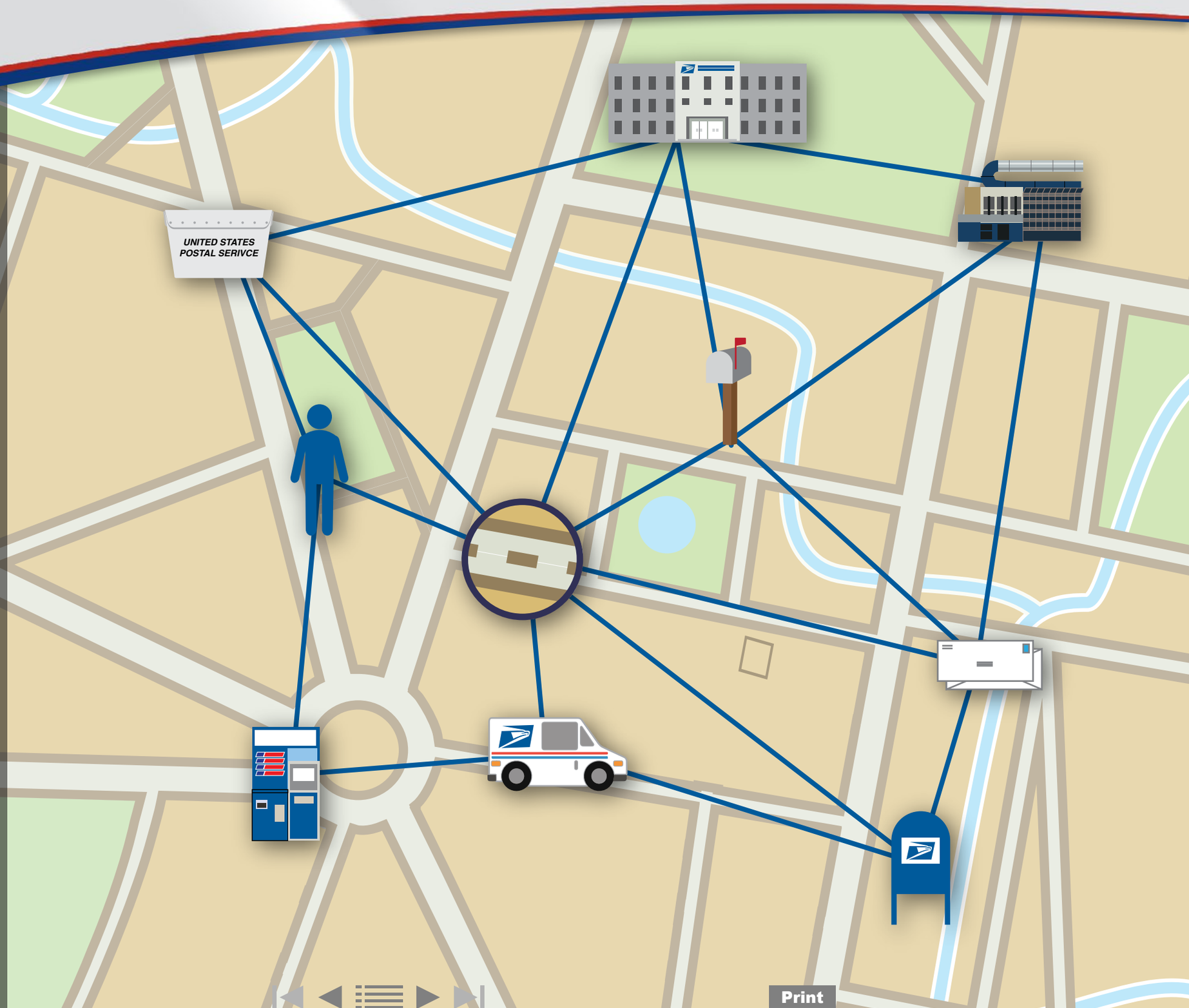
OFFICE OF INSPECTOR GENERAL
UNITED STATES POSTAL SERVICE

The Internet of Postal Things

RARC Report

Report Number
RARC-WP-15-013

August 3, 2015



OFFICE OF INSPECTOR GENERAL
UNITED STATES POSTAL SERVICE

Executive Summary

The Internet of Things (IoT) — sensor technologies that enable physical objects to collect and communicate data through the Internet in real time — is one of the latest technology advances taking hold in many industries. Cisco estimates that worldwide IoT applications will yield more than $19 trillion in value by 2022, $4.6 trillion of which will be in the public sector.

The current proliferation of IoT applications is fueled by a convergence of factors such as ubiquitous connectivity and the decreasing cost and improved performance of sensors and analytics. These technology trends are coupled with increased customer demand for more data on the products and services they purchase. The flow of information is becoming increasingly critical to the flow of things.

Interconnecting its vast and rich infrastructure could provide the U.S. Postal Service the opportunity to develop a beneficial Internet of Postal Things (IoPT). This paper, developed in conjunction with IBM, explores this idea. In particular, it examines the implications of IoT for the Postal Service, identifies an initial set of possible IoPT applications that the Postal Service could develop, and outlines a strategic framework for effective IoPT implementation.

IoT technologies could help the Postal Service develop applications to protect and enhance its core business through cost savings, operational efficiencies, new products and services, and ultimately, a better customer experience. Over time, they could also create new revenue opportunities and foster new business models.

Highlights

The Internet of Postal Things (IoPT) — instrumenting the postal infrastructure with low-cost sensors to enable them to collect, communicate, and act upon a broad variety of data — could help the Postal Service generate operational efficiencies, improve the customer experience, and develop new services and business models.

Interconnecting the postal network can provide endless opportunities for new, smarter applications, especially in the areas of delivery, transportation and logistics, building management, and government services.

Based on successful market practices and given the Postal Service's current strategic focus on fleet renewal and sustainability, IoPT initiatives aimed at cost savings in fleet maintenance and building management could have priority.

At the same time, through pilots and partnerships with suppliers, local governments, and customers, the Postal Service could experiment with new business concepts such as a "connected mailbox" and new services to local communities.

The development of an open platform where data are stored, managed, and shared, as well as strong privacy and security policies will be key to the successful implementation of an IoPT.

The main IoPT applications identified in the paper were categorized into four key areas:

- ***Transportation and logistics*** applications to monitor the status and performance of vehicles throughout the value chain. These applications aim to, for example, reduce fuel costs, limit the need for manual intervention such as in maintenance, and optimize how people, systems, and assets work together.

- ***Smarter postal buildings*** that encompass systems to better manage energy usage, building security and safety, and reduce maintenance costs.

- ***Enhanced mail and parcel services*** that include applications to protect and improve the core business. Sensors generate new data that increase the value of products for senders and recipients and enable the creation of new services.

- ***Neighborhood services*** centered on applications that use IoT technologies to leverage the presence of postal vehicles and carriers in the same areas every day. "Connected" vehicles and carriers with handheld devices can become platforms able to support the collection of data and the provision of both postal and government services to local communities.

The deployment of IoPT should start with applications that are technologically proven and capable of generating measurable benefits. Use cases in the area of transportation and logistics — such as predictive maintenance for the next generation of delivery vehicles — and smart buildings management would meet these requirements. At the same time, the Postal Service should conduct small scalable pilots to test the viability of promising yet unproven concepts. Two good examples are the "connected mailbox," as a key element of future parcel delivery strategies, and smart cities — where postal vehicles could collect data as part of cities' environmental and mobility projects.

Implementing and managing an IoPT system will require the Postal Service to build a platform to seamlessly link the physical infrastructure to digital data flows into a single integrated network. The platform would be secure, scalable, and interoperable with the Postal Service's legacy infrastructure and third party systems.

Making data collected through the postal infrastructure available to customers — governments, shippers, entrepreneurs, or e-commerce and logistics operators — through the platform could enable novel forms of worksharing and collaboration. The IoPT platform could then become the hub of an ecosystem of business and government partners that integrates postal applications into their value chains to create new services for postal customers and citizens alike.

In order to implement IoPT, appropriate data privacy and security policies would have to be established. Although not the focus of this paper, such policies are key to ensure the capture and use of data in IoPT is not intrusive to citizens, and does not reduce the level of privacy or security needed in this ever-changing world. We suggest the Postal Service start experimenting with Internet of Things technologies to enhance, streamline, and modernize its business, as well as develop new business models to stay relevant in the digital age.

Executive Summary

Table of Contents

Observations

Appendices

Table of Contents

Observations

Introduction

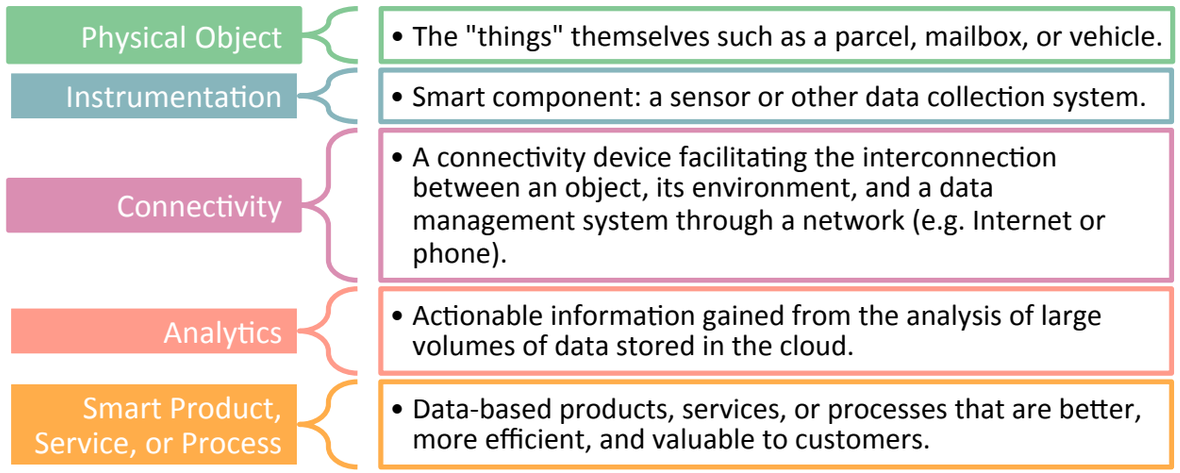
There are already more Internet-connected devices in the world than there are people, and this number is expected to grow to over 100 billion by 2050.[1] This explosion in connectivity — termed "the Internet of Things" (IoT) — has the potential to be transformative. Beyond the current hype around popular consumer applications such as fitness tracker wristbands, Google Glass, and Apple Watch, sensor-based systems can collect and analyze a large amount of information in support of a variety of business goals. IoT is already creating real value for organizations that have strategically adopted it to better control and manage assets, increase efficiency, cut costs, generate new revenue, and improve the customer experience.[2] Cisco estimates that IoT applications will bring over $19 trillion in value worldwide by 2022.[3]

Interconnecting the vast and rich postal network would provide the Postal Service with the opportunity to develop an "Internet of Postal Things" (IoPT). IoPT could help protect the core letter, parcel, and retail businesses by generating cost savings, operational efficiencies, and user value. Over time, it could also create new revenue opportunities and foster new business models. This paper explores a vision for the future, discussing possible areas of IoT applications and next steps for the Postal Service to pursue in order to implement IoPT.

The Internet of Things Defined

The Internet of Things might be better described as "Things on the Internet" — interconnected networks of uniquely identified physical objects embedded with sensors that collect, communicate, and act upon a broad variety of data such as location, temperature, motion, or performance.[4] These "smart objects" collect and communicate data that can be analyzed for better tracking and management of assets in real-time, efficiency improvements, and the creation of better and smarter products, services and processes.[5] Figure 1 illustrates the major components of the IoT value chain.

Figure 1: The IoT Value Chain



1 IBM Institute for Business Value, *Device Democracy: Saving the Future for the Internet of Things*, September 2014, http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?subtype=XB&infotype=PM&appname=GBSE_GB_TI_USEN&htmlfid=GBE03620USEN&attachment=GBE03620USEN.PDF#loaded.

2 Cisco, *The Internet of Everything: A $19 Trillion Opportunity,* 2014, http://www.cisco.com/web/services/portfolio/consulting-services/documents/consulting-services-capturing-ioe-value-aag.pdf.

3 Cisco, *Internet of Everything: A $4.6 Trillion Public-Sector Opportunity,* 2013, https://internetofeverything.cisco.com/sites/default/files/docs/en/ioe_public_sector_vas_white%20paper_121913final.pdf, p. 6.

4 Alexander Ilic, "The Internet of Things and Its Implications for our Business," (presentation at UPU/OIG Forum on the Internet of Things, Bern, Switzerland, November 6, 2014).

5 Cisco, *The Internet of Everything: A $19 Trillion Opportunity*.

IoT is not a new concept, but only recently has there been a confluence of factors — ubiquitous connectivity and the decreasing cost and improved performance of sensors, and analytics — that make it technically and economically feasible on a wide scale.[6] This opens up a new opportunity for businesses, especially for infrastructure-rich organizations like the Postal Service.

The Rationale for an Internet of Postal Things

Three features of the Postal Service and the postal market suggest it could benefit from IoPT.

A vast infrastructure. The Postal Service has a vast infrastructure of both stationary and mobile objects (Figure 2) that crisscross the United States daily, creating a seemingly infinite number of connections. Many of these objects do not currently "talk," meaning they do not collect and communicate data. The density and reach of this network affords an almost unlimited potential for IoPT applications. Imagine the data collection potential of 200,000 vehicles traveling the same routes 6 days a week, over 1.2 billion miles annually.[7] This could create an information network to complement the physical network. Additionally, the aging infrastructure provides an opportunity to replace old assets with sensor-enabled ones. The Postal Service plans to acquire about 10,000 vehicles over the next 2 years, and there is also a huge opportunity to continue to upgrade aging buildings to create a more sustainable facilities infrastructure.[8]

Experience in data collection and analytics. The Postal Service has demonstrated competence in managing large datasets, creating data-driven processes and products, and experimenting with sensors. It manages enormous amounts of data generated by its processing machines that sort the billions of pieces of mail that pass through America's mail system, gathering 1 billion tracking data points every day.[9] It also recognizes the importance of being an information business and has started building the foundation of an IT architecture to deliver actionable analytics that improve decision-making and increase customer value.[10] Additionally, the Postal Service is already using some IoPT applications to meet strategic goals regarding mail visibility and process optimization, such as utilizing RFID tags to measure service standards for international mail and equipping carriers with Mobile Delivery Devices (MDD) that include multiple sensors.[11]

---

6 For more information on these enabling factors, please see Appendix A.

7 The postal infrastructure comprises a unique combination of both stationary and mobile assets, each type serving different purposes when it comes to data collection. Stationary objects can continuously collect data in a specific location, offering a level of granularity that may be important for some purposes. Mobile objects, on the other hand, may only collect a point from each location once a day but can collect data from multiple locations. This is useful for data that need to be collected across a wider geographic area but with less frequency. Michael Ravnitzky, in discussion with the authors, September 18, 2014.

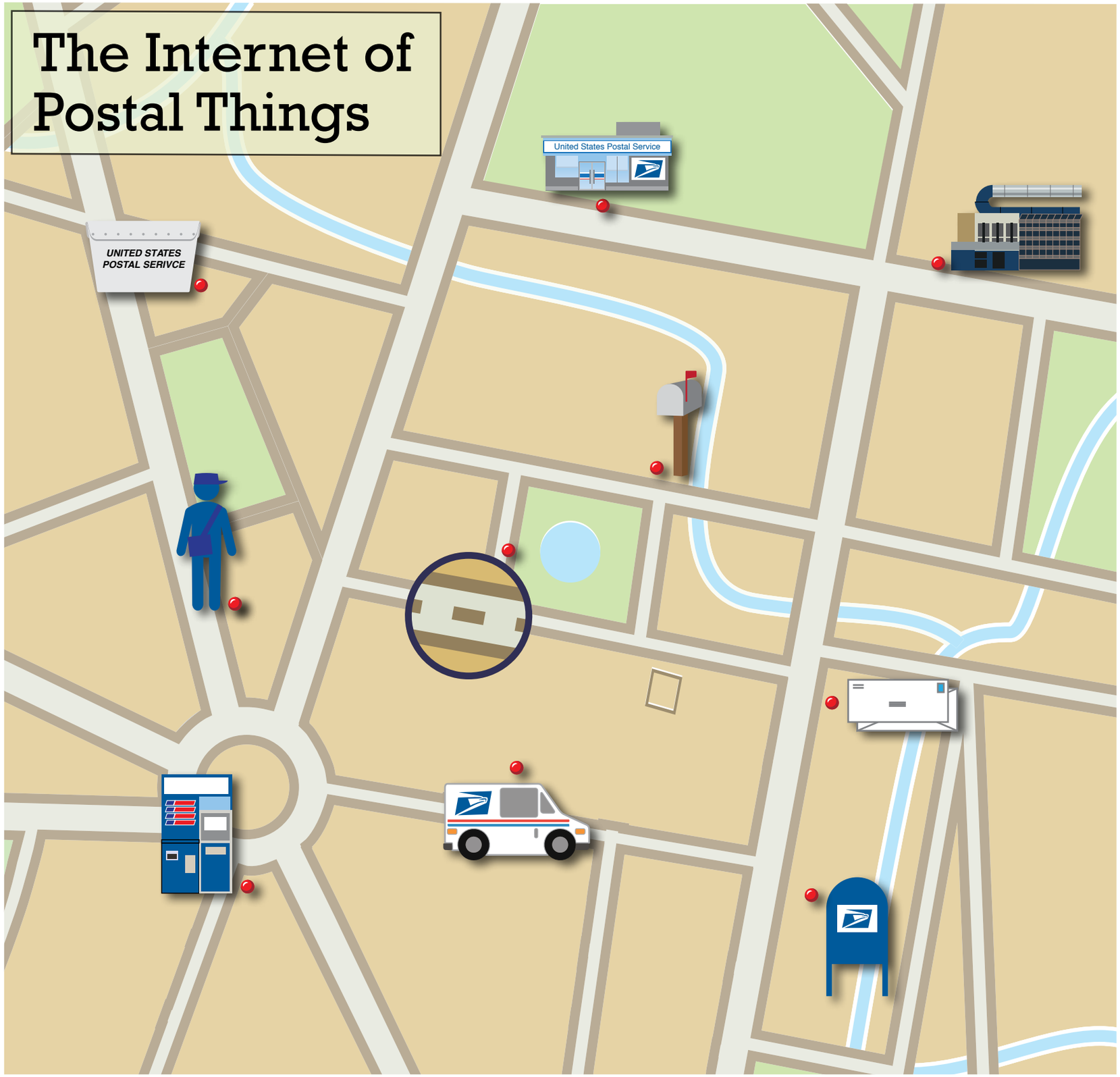
8 "Request for Information RHD Vehicles," *FedBizOpps.gov*, October 9, 2014, https://www.fbo.gov/?s=opportunity&mode=form&id=2f9534d530acfe39f5abd7c7f566cce6&tab=core&_cview=0.

9 Cindy Waxer, "Digital SOS: How technology can save the USPS," *Computerworld*, December 8, 2014, http://www.computerworld.com/article/2855146/digital-sos-how-technology-can-save-the-usps.html.

10 Jim Cochrane, "CIO Updates," (presentation to MTAC, August 19, 2014), https://ribbs.usps.gov/mtac/documents/tech_guides/2014/presentations/opensessions/Aug2014CIOUpdate_COCHRANE.pdf.

11 The Postal Service's strategic goals, "Delivering Results, Innovation, Value and Efficiency" (DRIVE), specify that the organization "Optimize Network Operations," "Optimize Delivery Operations," and "Achieve 100% Product Visibility." IoPT applications, such as RFID tags on mailpieces and smart devices in the hands of carriers could be used to meet these goals. The Postal Service is one of the 37 operators participating in UNEX, the RFID-based system for measuring international mail quality standards. UNEX was created in the mid-90s by International Post Corporation (IPC) *Measuring international letter service performance through UNEX*, IPC, http://www.ipc.be/en/operational-services/quality%20excellence/unex. The Postal Service is equipping carriers and operations staff with MDDs, and has already deployed 181,000 such devices. Jason Miller, "Advanced Mobile Devices Pave USPS' Way Toward Internet of Things," *Federal News Radio*, June 3, 2015, http://www.federalnewsradio.com/537/3869015/Advanced-mobile-devices-pave-USPS-way-toward-Internet-of-things.

Figure 2: Number of Postal "Things" -- hover over icons for more information



* "Total Retail Facilities" includes both postal managed and nonpostal managed retail locations.
** "Employees" includes both career and non-career employees.

Source: Postal Facts 2014.

Customer demand for information. There is strong demand from postal customers for more data and an improved customer experience. Parcel customers, for example, expect tracking information, anticipated delivery dates, multiple choices in terms of shipping options and locations, and a simplified returns process. Options such as same day delivery and dynamic real-time rerouting have the potential to grow in importance as consumers continue to buy more items online.[12] Direct mailers also demand more information, including real-time notification of the delivery of their mailpiece and whether the recipient wants to continue receiving similar mail from that mailer.[13] UPS and many global posts are already responding to these trends, letting parcel customers select time windows or reschedule deliveries.[14] The use of sensors on the vehicle, mailbox, carrier handheld device, or the mailpiece itself would facilitate these services by providing better real-time control over processes and asset locations and availability.

Identifying and Prioritizing IoPT Applications

The Postal Service's infrastructure provides numerous opportunities for interconnection and data collection. To identify an initial set of possible IoPT applications, the U.S. Postal Service Office of Inspector General, in collaboration with IBM, conducted extensive research consisting of not only a review of recent IoT reports, relevant case studies, and OIG audits, but also

- Twenty interviews with Postal Service representatives, representatives from other government agencies, IoT solutions suppliers, trade organizations, consultants, and postal experts.[15]
- An international discussion forum that the OIG co-organized with the Universal Postal Union in November 2014 to learn about strategies and best practices from international postal operators, as well as private sector companies that have started to deploy IoT solutions.[16]
- An online brainstorming exercise conducted by the IBM Academy of Technology, which gathers IBM technical leaders from 35 countries.[17]

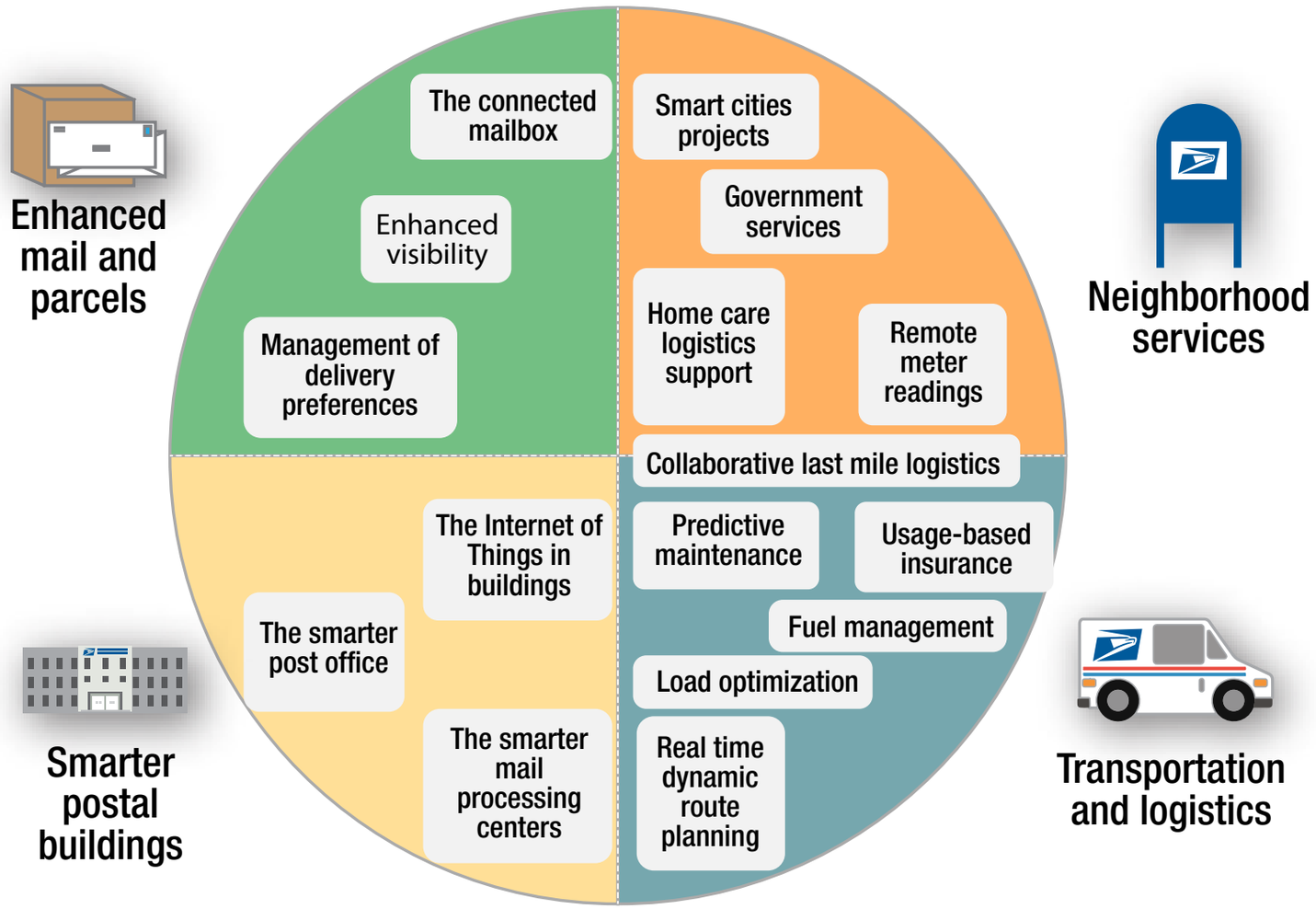
Introduction Video:
The Internet of Postal things

Although the list of potential IoPT applications is seemingly endless, the research team selected 16 IoPT applications with the greatest potential to leverage postal assets. The following section discusses these 16 applications, organized into four different areas (Figure 3), and how in the coming years they could solve concrete problems and bring significant benefits to the Postal Service and its customers.

---

12 OIG, *Enriching Postal Information: Applications for Tomorrow's Technologies,* Report No. RARC WP-14-006, January 13, 2014, https://www.uspsoig.gov/sites/default/files/document-library-files/2014/rarc-wp-14-006.pdf, pp. 7-8.
13 OIG, *International Postal Big Data: Discussion Forum Recap*, Report No. RARC-IB-14-002, May 12, 2014, https://www.uspsoig.gov/sites/default/files/document-library-files/2014/rarc-ib-14-002.pdf, p. 4 and OIG, *Strengthening Advertising Mail by Building a Digital Information Market*, Report No. RARC-WP-14-002, December 11, 2013, https://www.uspsoig.gov/sites/default/files/document-library-files/2013/rarc-wp-14-002.pdf.
14 For example, UPS My Choice allows customers to track packages, reschedule deliveries, and choose time windows. For more information on My Choice, see product website at http://www.ups.com/mychoice/welcome.html.
15 A list of IoT reports can be found in Appendix D. Appendix C offers a complete list of names, titles, and dates for all interviews conducted as part of this research.
16 "Internet of postal things offers food for thought," *UPU*, November 17, 2014, http://noticias.upu.int/no_cache/nd/internet-of-postal-things-offers-food-for-thought/.
17 For more information about the IBM Academy of Technology, see http://www-03.ibm.com/ibm/academy/about/about.shtml.

Figure 3: IoPT Areas of Application and Selected Use Cases



Source: OIG and IBM analysis.

Transportation and Logistics

Communicative sensor systems on vehicles — also called “vehicle telematics” — allow the tracking of vehicle location and condition through geographic information systems (GIS) and other data. In addition to location, onboard sensors continuously monitor a variety of vehicle performance data, including but not limited to information on brake condition, tire pressure, fuel consumption, and engine performance. Sensors can also help monitor drivers and encourage, for example, safe and fuel-efficient driving habits.

Box 1: UPS ORION

UPS's project ORION is a major IT initiative that started more than 10 years ago. The project involves embedding 200 sensors in each truck to remotely monitor vehicles' performance and drivers' behavior and select the most efficient routes. By 2017, UPS projects that ORION will monitor 55,000 routes.

As Jack Levis, senior director of process management at UPS, put it: "We've really gone from a trucking company with technology to a technology company with trucks." Over the past 5 years, ORION has helped halve (from 240,000 to 120,000) annual preventative maintenance inspections for its 100,000-vehicle fleet.

UPS has also seen that dynamic routing reduces by 7-8 miles the length of each route — which the company says translates into fuel savings worth $300-400 million per year across the country.

The logistics sector has been an early adopter of vehicle telematics — as exemplified by UPS's ORION (On-Road Integrated Optimization and Navigation) initiative (see Box 1).[18] The Postal Service will soon start to renew its fleet — one of the largest civilian fleets in the world.[19] The time is right to equip new vehicles with sensors that could help significantly reduce fuel, maintenance, and transportation costs.

We discuss here six of the most promising transportation applications.

Video 1: Vehicle Telematics Vnomics Case Study

Predictive Maintenance

Predictive maintenance systems monitor vehicle sensors' data and trigger alerts when it is not within acceptable ranges, allowing for early detection of equipment defect. Problems are spotted and fixed before they would surface in normal maintenance inspections, dramatically reducing the number of scheduled visits.[20]

Implementing predictive maintenance would create cost efficiencies for the Postal Service by reducing labor costs — both regular hours and overtime — at the Vehicle Maintenance Facilities (VMFs) and the total number of inspections.[21] IBM estimated that if extended to the whole Postal Service fleet it might save 7 percent of current costs, or $70 million per year.[22] Higher savings might be achieved in the longer-term if the Postal Service were to reorganize its VMFs.

Fuel Management

The Postal Service spent $926 million in FY 2012 for fuel on more than 15,000 highway contract routes (HCR), which include long haul (for example, coast to coast) routes.[23] Using sensors on HCR vehicles to monitor actual fuel consumption would lead to better management of these contracts. More importantly, sensors could also help incentivize contract drivers as well as its own carriers to adopt fuel-efficient behavior; educating drivers to improve fuel economy could reduce fuel expenses by up to 30 percent.[24] .

Usage-Based Insurance

Sensors can be used to monitor safe driving behavior, as the insurance company Progressive has shown with its Snapshot product.[25] Fleet managers are increasingly considering usage-based insurance (UBI) models to incentivize safe driving — the

18 S. Rosenbush and L. Stevens, "At UPS, the Algorithm Is the Driver," *The Wall Street Journal*, February 16, 2015, http://www.wsj.com/articles/at-ups-the-algorithm-is-the-driver-1424136536; M. Frank, "How Telematics Has Completely Revolutionized the Management of Fleet Vehicles," *Entrepreneur*, October 20, 2014, http://www.entrepreneur.com/article/237453; and A. Bernard, "Data Delivers Customer-Service, Optimization Results for UPS," *Data Informed*, June 6, 2014, http://data-informed.com/data-delivers-customer-service-optimization-results-ups/.

19 U.S. Postal Service, "Fuel Efficient Vehicles," https://about.usps.com/what-we-are-doing/green/factsheets/fuel-efficient-vehicles-111118.pdf, and A. Medici, "Postal Service wants to buy a high-tech, flexible fleet," *Federal Times*, April 8, 2015, http://www.federaltimes.com/story/government/management/facilities-fleet/2015/04/07/postal-service/25406141/.

20 S. Hilton, "IoT and Predictive Maintenance," *Bosch ConnectedWorld Blog*, February 15, 2013, http://blog.bosch-si.com/categories/manufacturing/2013/02/iot-and-predictive-maintenance/.

21 In the freight industry predictive maintenance typically reduces maintenance costs by 20 to 25 percent, while 70 to 75 percent of breakdowns are eliminated and downtime reduced by 35-45 percent. This source does not provide figures for delivery vehicles. "Predictive maintenance benefits for the freight logistics industry", *IBM Travel & Transportation Industry*, 2015, http://public.dhe.ibm.com/common/ssi/ecm/tt/en/tte03009usen/TTE03009USEN.PDF

22 The IBM estimate is based on OIG, *"Vehicle Maintenance Facility Efficiency – Capital Metro and Pacific Areas,"* Report No. DR-AR-13-007, September 30, 2013, https://www.uspsoig.gov/sites/default/files/document-library-files/2013/dr-ar-13-007.pdf. IBM considers that predictive maintenance could eliminate 'over budget' spend on vehicle maintenance estimated in the OIG report at 7 percent of maintenance expenses. Per the same report (p.9) Postal Service vehicle maintenance expenses totaled $1.1 billion in FY 2012. For a description of the benefits of predictive maintenance see OIG, *Delivery Vehicle Fleet Replacement*, Report No. MA-14-005, June 10, 2014, https://www.uspsoig.gov/sites/default/files/document-library-files/2014/dr-ma-14-005.pdf.

23 OIG, "Highway Contract Routes – Miles per Gallon Assessment", Report No. NO-AR-14-008, May 27, 2014, https://www.uspsoig.gov/sites/default/files/document-library-files/2014/no-ar-14-008.pdf, p. 1.

24 Ibid., p.20. Assuming HCR and delivery vehicles use about 400 million gallons of fuel every year, a lower, easier to achieve 10 percent reduction could generate about $120 million in annual savings.

25 Snapshot is a device plugged into a car's diagnostic port that measures a variety of factors related to driving and driving conditions, to assess risky driving habits and likelihood of being in an accident. "The fair way to pay for car insurance," *Progressive,* 2015, https://www.progressive.com/auto/snapshot/

safer the driving behavior, the lower the premiums.[26] The Postal Service might consider the feasibility of a UBI model, and possibly reward the safest-driving carriers with a share of the savings in insurance costs.

Load Optimization

Sensors could help reduce transportation costs in other ways such as in capacity planning and load optimization.[27] Sensors could capture the volumetric weight of parcels and help ensure that each truck is full and the space optimized. This would help, for example, reduce the number of trucks traveling a given HCR route.

Real-Time Dynamic Routing

The Postal Service and other postal and logistics companies are using "static" georouting software, which, before delivery starts, calculates the shortest route based on the day's delivery or pickup addresses. Dynamic routing systems, such as those tested by DHL's SmartTruck program, are different as sensor-based information is used to recalculate routes "on the fly" based on new events. Data on the truck's location are combined with, for example, real-time data on traffic jams, weather, or new delivery or pick-up requests.[28] The Postal Service could deploy such systems to facilitate Sunday parcel deliveries, or same-day deliveries of groceries and other goods.

Collaborative Last Mile Logistics

The continued growth of e-commerce has increased the number of delivery vehicles driving along the same routes every day.[29] This causes not only inefficiencies, but also bottlenecks and environmental concerns in already congested cities and streets. The situation may get worse in the future, as new providers of local delivery services, such as regional shippers like LaserShip or new local platforms such as UberRush, continue entering the market.

Collaborative logistics could help address these issues as it involves the coordination of last mile deliveries across multiple carriers. Sensors collecting data on trucks' location, space availabilities, and local traffic conditions would be analyzed in real time to determine for each parcel which vehicle would handle final delivery in city centers most efficiently. This could benefit both carrier companies and postal operators. Carriers may wish to outsource the last mile delivery of a parcel if putting fewer, fuller delivery vehicles on the road reduced the end-to-end cost of transporting and delivering parcels. The carrier driving the last mile would also benefit by having greater volume on the truck, offering more revenue for the fixed cost of traveling down that road. Reducing the presence of trucks serving the last mile would also benefit local governments looking to reduce traffic density and carbon dioxide emissions.

The Belgian and Dutch posts have both recently launched first attempts at collaborative city logistics projects. Parcels from multiple carriers are consolidated at warehouses outside city centers for the post to deliver the last mile, similar to the Postal Service's Parcel Select service.[30] The Belgian Post estimates that their project saves about 30 percent of the total miles driven.[31] PostNL uses electric delivery vehicles for its trial and plans to extend the service to same-day deliveries from local

---

26 "Usage-Based Insurance Overcoming Privacy Concerns, Gaining Traction," *Insurance Journal,* September 5, 2015, http://www.insurancejournal.com/news/national/2014/09/05/339731.htm.

27 For a case study on the use of volumetric weight data by SingPost, see "More data yields greater efficiency and better service," *Postea*, http://www.postea.com/qubevu/documents/QubeVuStories_SingPost.pdf.

28 http://www.dpdhl.com/en/logistics_around_us/from_our_divisions/dhl_smarttrucks.html

29 As shown in Figure 3, this application belong to two areas, "transportation and logistics" and "neighborhood services," as it serves both operational and environmental policy purposes.

30 Parcel Select is the Postal Service's suite of workshared ground services. Parcel Select DDU is frequently used by other shippers such as UPS and FedEx to take packages the last mile.

31 "bpost set to expand urban logistics project to Brussels," *Postandparcel*, December 1, 2014, http://postandparcel.info/63493/news/innovation/bpost-set-to-expand-urban-logistics-project-to-brussels/ and Karl Vadaszffy, "City Affairs," *Postal Technology International*, March 2015, pp. 32-36.

retailers. Additionally, in Italy, carriers, truck manufacturers, and IT suppliers have launched a project called Urbelog, which involves working with cities such as Turin and Milan to explore the feasibility of optimized multi-carrier urban deliveries.[32]

Collaborative logistics can help posts fortify their position as the last mile delivery partner of choice, especially in congested downtowns. To scale up these projects, they will need to use sensors on vehicles and parcels to optimize the coordination of pickups, parcels consolidation, and deliveries. By leveraging IoPT, the Postal Service could develop collaborative logistics platforms to manage last mile deliveries in both large cities and rural areas.

Enhanced Mail and Parcel Services: the Connected Mailbox

In addition to improving transportation, sensors could also improve the delivery experience for customers and the value of the mail piece for senders. The main goals that emerged from our research as being the most valuable to both senders and recipients include enhanced visibility of the mail piece, better management of delivery preferences, increased convenience, and supporting the development of new services. The following section presents a use case, the connected mailbox, which would help meet these goals.

Concept and Benefits

"The mailbox in use today was designed over 100 years ago," U.S. Postal Service New Products and Innovation VP, Gary Reblin, recently said. "We need to bring it into the 21st century."[33] In fact, instrumenting mailboxes, including cluster boxes, could help address a number of operational issues, as well as create a wide range of opportunities for the Postal Service.

Video 2: The Connected Mailbox Signée Use Case

A smart mailbox equipped with sensors would be able to collect and transmit in real-time a variety of postal and non-postal data, such as mail delivery and pick up time, temperature, and data on the external environment. Additional smart features could be a locking mechanism and a temperature control system manageable remotely through an app. Finally, the box would be available in larger sizes to accommodate parcels. The benefits of a newly designed, larger, and smart mailbox would be the following:

- Reducing the operational cost of missed delivery. As the sensor would be able to scan the barcode or read the RFID tag on a registered letter or a parcel, this would generate an electronic delivery confirmation that could replace the traditional hand scanning and delivery signature. It would also allow packages to be delivered securely to the larger mailbox, even if residents are not at home, reducing operational costs for the Postal Service and eliminating the inconvenience of a trip to the post office for the customer.[34]

- Enabling new services. Controlling temperature would allow for the delivery of grocery or temperature-sensitive medicines throughout the day. New services with social value for local governments and citizens could also be envisaged. For instance,

32 M. Marciani and P. Cossu, "How the URBeLOG project will enable a new governance model for city logistics in Italian metropolitan areas," *Procedia - Social and Behavioral Sciences,*151 (October 30, 2014), http://www.sciencedirect.com/science/article/pii/S1877042814054640, and Marco Annoni, "7475," *Market Place of the European Innovation Partnership on Smart Cities and Communities,* https://eu-smartcities.eu/commitment/7475.

33 "USPS testing new generation mailbox," *PostCom Bulletin 05-15*, January 29, 2015.

34 In the United Kingdom for instance, 10 percent of parcel deliveries fail the first time, a reality that comes at significant cost. See "One in 10 UK home deliveries failed in June, industry data suggests," *Post and Parcel*, July 25, 2014, http://postandparcel.info/62031/news/markets/one-in-10-uk-home-deliveries-failed-in-june-industry-data-suggests/, and "Missed deliveries costing UK e-commerce three quarters of a billion each year," *Post and Parcel*, August 28, 2014, http://postandparcel.info/62446/news/markets/missed-deliveries-costing-uk-e-commerce-three-quarters-of-a-billion-each-year/.

the mailbox of an elderly resident could send an alert to a local government office or a relative if the person has not picked up the mail for a certain number of days.[35]

- Increasing security and convenience for recipients. During our research, several interviewees mentioned that recipients value receiving real-time delivery notification for important items such as parcels or registered mail.[36] The connected mailbox would be able to send this type of information directly to customers' phones in the form of a text message. In addition, the remote access feature would allow customers to give family members or neighbors temporary or permanent access to their box. This locking feature would, for example, allow the mailbox owner to leave items, such as house keys, for pick-up by family members or enable neighbors to pick up mail while the recipient is away.

- Closing the "feedback loop" for senders. The connected mailbox would allow senders not only to know exactly when their (advertising or transactional) mail was delivered, but also when it was retrieved from the mailbox, thereby providing full visibility and a feedback loop that is beneficial to all — senders, recipients, and the Postal Service.[37]

The Smart Mailbox as a Potential Source of New Revenue

Several posts are already working on updating the mailbox model to better match customer expectations of convenience and information. Since 2012, the Postal Service has enabled P.O. Box holders to receive text messages when mail was delivered to their box.[38] It has also tested a service whereby mail pieces are scanned before delivery to let recipients know what will be delivered into their mailbox.[39] It is piloting "Nextgen Mailbox/Delivery Receptacles" (larger parcel boxes that are both standalone and cluster boxes).[40] It could extend this concept to different environments: office buildings, campuses, apartments, homes, urban areas, and rural areas. A customer could rent or buy from the Postal Service (or from an authorized partner) a connected box that would be installed on the curb or near apartment or house doors.

The connected mailbox could generate revenue from renting the mailbox to households, or selling the mailbox and charging a monthly service fee. If 5 percent of the 117 U.S. million households rented such a box for $3 a month, the product would generate $210 million a year in revenue.[41] Fees could also be customizable, depending on the features embedded in the mailbox and customers' needs. In addition, customers might shift business from other carriers to the Postal Service to take advantage of a large secure box.

In Europe, the connected mailbox is a real value proposition postal operators are working on. La Poste and mailbox manufacturer Renz have successfully tested connected parcel boxes in a few buildings in Paris.[42] Renz and competitor Signée have announced plans to enter the European market in 2016 with a smart mailbox for deliveries and returns.[43] The Federation of European Direct

35 This would be an automated version of a service recently tested by the Postal Service in Marion, OH. See Michael J. DeCicco, "New mailbox-marking program to keep an eye on seniors in Marion," *Southcoasttoday.com*, November 2, 2014, http://www.southcoasttoday.com/article/20141102/NEWS/141109839.
36 Michael Ravnitzky, in discussion with the authors, September 18, 2014, and Leon Pintsov, in discussion with the authors, September 25, 2014.
37 The importance of closing this feedback loop, and possible mechanisms for doing so, are discussed in detail in OIG, *Strengthening Advertising Mail by Building a Digital Information Market*.
38 "PO Boxes – Leading the way," *U.S. Postal Service*, August 8, 2013, http://about.usps.com/postal-bulletin/2013/pb22369/html/cover.htm.
39 "USPS developing mail and package notification services," *Postandparcel*, May 19, 2015, http://postandparcel.info/65152/news/it/usps-developing-mail-and-package-notification-services/.
40 "Next generation mailbox undergoes testing," *Postalnews.com*, January 20, 2015, http://postalnews.com/blog/2015/01/20/next-generation-mailbox-undergoes-testing/.
41 Or $126 million a year assuming a lower 3 percent penetration rate, which could be achieved in perhaps two or three years.
42 "Renz connecte les boîtes à colis," *Usine Nouvelle*, October 16, 2014, http://www.usinenouvelle.com/article/innovation-digitale.N290661. In the United States, Simple Elements LLC has put forward a similar concept, called Mr. Postman, http://simpleelements.us/2.0/mr-postman/.
43 "Reportage présentant le projet de boîte à colis connectée Concierge de la start-up Signée," YouTube video, from a presentation given on February 19, 2015, posted by "Signée France," February 25, 2015, https://www.youtube.com/watch?v=sJ75WKbEblw.

and Interactive Marketing has expressed its interest in a connected mailbox as a tool to increase the value and visibility of direct mail.[44] Deutsche Post DHL has also highlighted the benefits of equipping parcel boxes with sensors in the future.[45]

In February 2015, La Poste launched its PostAccess remote front door management system.[46] From an app, users control access to their door equipped with an intelligent locking system. The door's iBeacon sensor detects identification data from the person's wearable or mobile phone, triggering the door to open.[47] The same system could be extended to manage access to mailboxes and increase the security both of the mailbox and the carrier.[48]

Additionally, the value to consumers of a connected box would increase if several operators had access to it. A trial is being run in Belgium by three of Europe's largest parcel operators to test this concept. The pilot is presented as "a world first collaboration in the field of smart package boxes shared amongst multiple carriers."[49]

Smarter Postal Buildings

The Internet of Things in Buildings

The Postal Service can instrument buildings with a network of sensors that monitor temperature, the condition of HVAC systems, and the presence of people in specific areas (like hallways or meeting rooms), among other things. This can be fed into a data management system that provides building managers with real-time actionable data that help

- Reduce energy costs, through better management of energy usage by, for example, setting lights to turn off automatically, or reducing air conditioning in unused spaces.
- Cut maintenance costs, through proactive detection and fixing of anomalies or deficiencies, for example in HVAC units, lighting systems, or processing machines.
- Increase safety and security through, for example fire detection, access control, and linking up with emergency services for more rapid responses.[50]

---

44 Sébastien Houzé, (presentation, UPU/OIG International Forum on the Internet of Postal Things, Bern, November 6, 2014).
45 DHL Trend Research and Cisco Consulting Systems, "*Internet of things in logistics*", April 2015, http://www.dhl.com/content/dam/Local_Images/g0/New_aboutus/innovation/DHLTrendReport_Internet_of_things.pdf, p. 21. DHL has already introduced Paketkasten, large parcel boxes that can be rented or purchased by German households. For a description of the Paketkasten offerings, see https://www.paket.de/pkp/appmanager/pkp/desktop?_nfpb=true&_nfxr=false&_nfxr=false&_pageLabel=pkp_portal_page_info_depotbox. These boxes are also being tested in apartment buildings owned by Germany's largest housing company, Deutsche Annington. "DHL parcel delivery boxes now in apartment buildings," *Deutsche Post DHL*, March 27, 2015, http://www.dpdhl.com/en/media_relations/press_releases/2015/dhl_parcel_delivery_boxes_now_in_apartment_buildings.html.
46 "La Poste to launch digital locking product next month," *Postandparcel*, December 4, 2014, http://postandparcel.info/63521/news/it/la-poste-to-launch-digital-locking-product-next-month/.
47 For more information on beacons and other IoT technologies, see Appendix A.
48 Clayton Bonnell, in discussion with the authors, December 1, 2014, and Ihosvani Rodriguez, "Coveted 'master key' at root of robbery of mail carrier," *Sun Sentinel*, September 15, 2013, http://articles.sun-sentinel.com/2013-09-15/news/fl-mail-carrier-master-key-20130915_1_mail-carrier-bruce-parton-master-key.
49 The trial is carried out by ParcelHome in partnership with DHL Parcel, DPD (Groupe La Poste), and GLS (Royal Mail Group). "ParcelHome launches three-month trial for intelligent letterbox," *Postandparcel*, May 27, 2015, http://postandparcel.info/65298/news/parcelhome-launches-three-month-trial-for-intelligent-letterbox/.
50 IBM, *Smarter Buildings*, http://www.ibm.com/smarterplanet/us/en/green_buildings/overview/index.html.

According to consulting firm Meemori, the world market for the Internet of Things in buildings will nearly quadruple over the next 5 years, from $23 billion in 2014 to $85 billion in 2020.[51] The Postal Service's efforts to cut its energy bills have already achieved significant results, with a 31 percent reduction in facility energy use since 2003.[52] Old HVAC systems (typically the largest energy-consuming component) were replaced and energy-efficient roofs were installed on some facilities.[53] The Postal Service also created an energy use reporting tool and tested real-time energy monitoring at selected facilities.[54] The availability of new sensor-based technologies provides the opportunity for the Postal Service to go one step further, by developing a comprehensive "smart building" strategy.

According to IBM, such a strategy could generate savings that would cover the cost of the initial investment within the first 2 years. IBM estimated that the cost of turning a large facility into a "smart building" could range from $25,000 to $50,000. This compares to savings of approximately $40,000 a year for a 100,000 sq. ft. building, or $0.40 per sq. ft.[55] Eighty percent would come from reduced maintenance costs and 20 percent from energy savings. If this figure were to be applied to the Postal Service's 195 million square feet nationwide, the potential savings would reach $78 million, representing 15 percent of its total energy bill.[56]

Video 3: A Day in the Life of a Smart Building

The Smarter Post Office

Large retailers and bank branches are starting to embrace sensor technologies such as iBeacon, wearable devices, and other sensors to improve the retail experience. For example, Wells Fargo's Digital Labs is testing new processes, where the transaction (such as a bank deposit) is initiated on a mobile device and completed in a bank branch.[57]

Transposed to the post office, IoPT could reduce the number and duration of tasks that a customer performs at the counter. It could therefore help reduce waiting lines and the operational costs of time-consuming services. Beacons use geolocation to identify when an object, such as a smartphone, is nearby. A beacon in a post office could automatically send a push notification to a customer's smartphone via a postal mobile app.[58] The app could direct the user to the right counter depending on his or her needs and allow the customer to supply helpful information or pre-fill forms, such as customs forms for international mail. This information provided by the customer would be automatically displayed on clerk's screen. The postal app could also facilitate payments through a customer's postal wallet.

---

51 Memoori, "The Internet of Things in Smart Buildings 2014 to 2020," http://www.memoori.com/portfolio/internet-things-smart-buildings-2014-2020/. Market estimates measure "[the cost] of adding connectivity through sensors to existing or newly installed building systems, as well as [revenue generated by] related network hardware and IoT data services that the BIoT would enable to generate."

52 U.S. Postal Service, *Annual Sustainability Report 2014*, http://about.usps.com/what-we-are-doing/green/report/2014/.

53 Tom Day (Chief Sustainability Officer, U.S. Postal Service), in discussion with the authors, September 24, 2014.

54 The Postal Service has put in place an Enterprise Energy Management System at large facilities and a central utility bill verification and payment system that captures data at more than 5,400 facilities. U.S. Postal Service, *Annual Sustainability Report 2014.*

55 Adam Houck, IBM, in discussion with the authors, December 4, 2014.

56 "Facilities and energy," *U.S. Postal Service*, http://about.usps.com/what-we-are-doing/green/html/2014-sustainability-report/sustainabilityreport2013_010.htm. These estimates are consistent with industry statistics that show that smart buildings average savings of 10-25 percent on building energy consumption. Accenture, *Energy-Smart Buildings, Demonstrating how information technology can cut energy use and costs of real estate portfolios* 2011, http://nstore.accenture.com/corporate-marketing/ccr/2010-2011/Accenture-Energy-Smart-Buildings.pdf, p. 9. If the largest facilities with a total square footage of 30 million sq. ft. were equipped first, the annual savings would add up to $12 million.

57 Miranda Hill, "Exploring Innovation with Wells Fargo Labs," *The Wells Fargo Blog*, September 26, 2014, https://blogs.wellsfargo.com/news/2014/09/exploring-innovation-wells-fargo-labs/.

58 Beacons can determine if and where a customer is located in the store. Essentially, beacons set a "geofence" determined by a radius from the sensor. If a smartphone enters that geofenced area, the beacon can automatically push notifications and special offers to that smartphone to entice the user into the store or assist that user.

There are many other options for sensor applications within a post office. For example, wearables could help clerks identify the location in the back office of a parcel available for pickup, allowing them to find items faster which improves overall efficiency and increases customer convenience. Additionally, scales with integrated 3D imaging sensors could calculate the correct postage based on weight and dimensions of mailpieces in order to prevent revenue leakage by ensuring that the correct postage has been paid.

The Smarter Mail Processing Center

Applied to pieces of mail transporting and processing equipment — such as pallets, sorting machines, conveyor belts, and forklifts — IoPT systems could create efficiencies in the postal supply chain by providing management greater visibility of asset utilization and location. This would help better assess machine use, prevent damage, and reduce idle time. In sorting facilities, sensor systems could replace manual scans to track the movement of containers.[59] Additionally, wearable sensor-based augmented reality solutions can help employees locate objects in warehouses or sorting centers efficiently by providing a digital display that shows employees what items they need, where those items are located within a processing center, and how many they need.[60]

Neighborhood Services

With postal vehicles and letter carriers going to the same neighborhoods every day, the Postal Service could combine IoT technologies with its knowledge of — and proximity to — local communities to provide services to support "smart cities" initiatives, help federal and local governments expand access to their services, and provide value-added services to disadvantaged citizens.

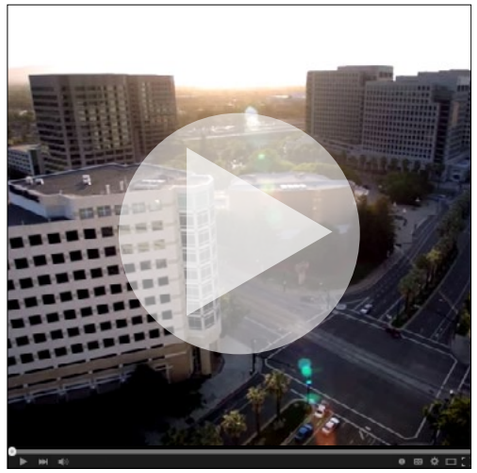
Smart Cities Need Local Partners

Many cities have started using digital technologies, including connected sensors, to collect data that can help city councils engage and provide better services to citizens, reduce costs and resource consumption, and better forecast urban flows. Nevertheless, the success of these efforts will depend on the ability to gather real-time, reliable, and consistent data from multiple fixed and mobile data points.[61]

Currently, large U.S. cities, such as Chicago and New York, are embarking on smart cities projects based on a few common elements (see Appendix B):

- Data are collected mainly from city assets such as streetlight poles or trash cans.[62]
- Data are shared with third parties through an open data platform to promote maximum usage by citizens, researchers, software developers, or public interest groups.

Video 4: How Sensor Data Help Create Sustainable Cities: San Jose, CA Case Study



59 The Postal Service is currently exploring this idea. "Radio Frequency Identification (RFID) Feasibility Study," Solicitation Number: 3A-15-A-0110, June 3, 2015, *FedBizzOpps.gov*, https://www.fbo.gov/index?s=opportunity&mode=form&id=db43d5ab00a330767775b1a6faf54c51&tab=core&_cview.

60 For use cases, see OIG, *Seeing the Future: Augmented Reality and the Postal Service*, Report No. RARC-IB-15-002, April 6, 2015, https://www.uspsoig.gov/sites/default/files/document-library-files/2015/rarc-ib-15-002.pdf; DHL Trend Research/Cisco Consulting Services, *Internet of Things in Logistics*, 2015, http://www.dhl.com/content/dam/Local_Images/g0/New_aboutus/innovation/DHLTrendReport_Internet_of_things.pdf; and "DHL successfully tests Augmented Reality application in warehouse," January 26, 2015, http://www.dhl.com/en/press/releases/releases_2015/logistics/dhl_successfully_tests_augmented_reality_application_in_warehouse.html.

61 In 2010, a paper from the U.S. Postal Regulatory Commission's Michael J. Ravnitzky foresaw a role for the Postal Service in this space: "Mobile sensors mounted on postal trucks could collect and aggregate a variety of important data" such as "air pollution levels, weather data, sensing of chemical and biological agents, and areas of weak phone service." M. Ravnitzky, *Offering Sensor Network Services Using the Postal Delivery Vehicle Fleet*, U.S. Postal Regulatory Commission, 2010, http://www.prc.gov/sites/default/files/papers/Ravnitzky%20Postal%20Sensors%20Paper%20070910-MJR-1_1191.pdf

62 Federal agencies have also explored the potential of such systems. NOAA National Weather Service's National Mesonet Program Alliance collects data from fixed and mobile assets. Weather data from trucking fleets or delivery vans are used to fill gaps between fixed automated weather stations, http://www.gst.com/news/pressreleases/global-science-technology-inc-wins-contract-continue-and-expand-national-mesonet.

- Partnerships between universities, agencies, nonprofit organizations, and private sector IoT providers are developed to pilot services and applications.

The Postal Service's extensive infrastructure could exponentially expand cities' data-gathering capability, automatically collecting data from almost every single street 6 days a week — not only from sensors installed on vehicles, but also from sensors on "blue" collection boxes, carrier devices, or mailboxes. Once installed on vehicles, the sensors could collect and send data either to a postal data repository or directly to cities. This would not require the carriers to do any extra work that could distract them from their driving and delivery duties.

Carriers as "Neighborhood Logistics Managers"

Mobile technology has already helped redefine the role of carriers in the neighborhood, expanding the variety of tasks they can perform. Recently, the Postal Service has equipped carriers with mobile delivery devices (MDD) to facilitate scanning packages at delivery and communicating with the post office. Carrier handheld devices could also become a platform for a variety of other activities, such as collecting sensor data and interacting with citizens in support of new services.

New applications may include, but are not limited to

- Government services. The Postal Service could start with services currently available at post offices, such as passport applications. The carrier's device could potentially be used to take passport pictures, or scan paper forms. Some additional examples would be identity verification for government and commercial services that require strong identity credentials, document notarization, payments, and disbursements. The carrier could use her terminal to verify credentials, apply a digital signature, and transmit the information to the involved agencies.[63]

- Monitoring services. One example of such a service is the "lost and found" service implemented in Denmark, where postal vehicles help identify stolen bicycles. A sensor embedded in the bicycle automatically registers its location through the closest postal connected device in the vicinity (up to 200 yards).[64] This approach could be extended to monitoring the status of components of the city infrastructure such as road conditions or street lights.

- Home care logistics support. Several posts have created passive and active "check on" services, whereby carriers regularly visit elderly or disabled people. As part of a new Japan Post/IBM/Apple partnership, these clients will receive iPads with apps "to connect them with services, health care, community, and their families."[65] The interconnection of sensor data from the elderly citizen's and the carrier's smart devices could be key to the effective provision of innovative check on services. For instance, the system schedules visits, alerts the client that the carrier is on his way, enables the timely delivery of medication, or reports back to family members or local health care authorities. The Postal Service could consider providing such wellness services in the United States.[66]

---

63 For a discussion of potential applications, see OIG, *e-Government and the Postal Service — A Conduit to Help Government Meet Citizens' Needs,* Report No. RARC-WP-13-003, January 7, 2013, https://www.uspsoig.gov/sites/default/files/document-library-files/2013/rarc-wp-13-003.pdf.

64 Richard Wishart, in discussion with the authors, September 15, 2014. The service, launched in 2012, is run by sensor systems company Commotive A/S in partnership with Post Denmark. "New Cheap Device to Track your Lost Bike," *Cambridgeshire Business,* February 13, 2013, https://cambsbusiness.wordpress.com/2013/02/13/new-cheap-device-to-track-your-lost-items/.

65 Darrell Etherington, "Apple And IBM Team With Japan Post To Address The Needs Of An Aging Population," *TechCrunch*, April 30, 2015, http://techcrunch.com/2015/04/30/apple-ibm-japan-post/#.appdc9:DFfD.

66 The OIG recently held a workshop to discuss wellness services. OIG, *The Postal Service's Role in Delivering Wellness Services: Event Recap*, Report No. RARC-IB-15-004, July 22, 2015, https://www.uspsoig.gov/sites/default/files/document-library-files/2015/rarc-ib-15-004_the_postal_services_role_in_delivering_wellness_services_and_supplies.pdf.

- Remote meter readings. Posts could assist utilities in reading meters, particularly in areas that are too remote or where there is no broadband or wireless connectivity for meters to automatically send data directly to the utility company. As carriers travel their regular routes, meters could communicate with sensors on postal vehicles or in the handheld devices through, for example a close proximity communication medium such as Bluetooth.

Providing these services would strengthen the Postal Service's social role of "binding the nation together." They could also generate revenue through new service-for-fee offerings."[67]

Summarizing the Dollar Value of IoPT Applications

Table 1 below summarizes estimates for the potential dollar value of key IoPT applications presented in this section. It indicates the cost savings or revenue IoPT could generate in the short term.

Table 1: The Potential Annual Dollar Value of Select Short-Term IoPT Applications

IoPT application	Financial impact	Dollar value
Predictive maintenance	Cost savings	$70 million
Fuel management	Cost savings	$120 million
Connected mailbox	Revenue	$126 million
Smarter postal buildings	Cost savings	$ 12 million
Total dollar value		$328 million

Source: OIG and IBM analysis.

The total estimated value is about $330 million per year after about three years. The value of IoPT would increase over time as more applications are implemented, and existing ones are scaled up.

Implementing the Internet of Postal Things

Implementing IoPT successfully requires not only a strategic vision but also careful consideration of a number of factors, such as how to prioritize the various applications. Below we describe several key findings that emerged from our research on successful implementation practices.

Starting with Proven Applications

First, the Postal Service will need to build the business case to justify the adoption of this new technology. IoPT development should be linked to clear and specific business objectives in order to solve concrete problems and support measurable outcomes. These measurable results can determine the success or failure of an application as well as justify investment and buy-in from all levels of employees throughout the business, from executives to operational staff. This buy-in is a prerequisite to any

67 39 U.S. Code § 101 (a).

implementation; employees must understand the potential and be committed to implementing IoT successfully. Additionally, setting well-defined business requirements is also critical to effectively determining the IoPT infrastructure, data, processes, and skills needed to support the expected outcomes.

This means an incremental approach; starting with low hanging fruit and taking into account existing goals, processes, and capabilities could lead to swifter adoption. Applications that are technologically proven, compatible with existing legacy systems, and able to generate measurable benefits in the short-term might be implemented first. We believe smart building and vehicle telematics applications fall into this category. In particular, the planned renewal of the Postal Service's delivery fleet provides a unique opportunity to test and implement cutting-edge fleet management applications.[68]

Exploring New Business Models that Leverage Unique Postal Assets

Over time, a deeper integration of the physical postal infrastructure and the digital world of information will take place, developing into one vast shared network over the Internet. We believe this could transform every aspect of the postal value chain in ways that cannot be predicted today. The combination of user and operational data, new consumer devices, and data analytics paves the way for the development of a new portfolio of smart, on-demand, and customer-centric products and services.

Preparing for this uncharted future requires a bit of controlled playfulness and experimentation and the acceptance of a certain level of business risk. In fact, some of the most promising use cases identified in our research — such as the connected mailbox and smart cities applications — might take longer to implement because the existing technology or business models are not yet ripe.

However, we suggest the Postal Service start experimenting with such services as soon as possible through pilots. Many of these services would leverage unique postal assets and could provide the Postal Service with a competitive advantage. The mailbox, for example, is a distinct postal asset. The best entity to experiment with the connected mailbox application and develop an appropriate business model would be the Postal Service itself. This would allow it to gain a practical knowledge of the operational, marketing, and technological issues involved. In addition, experimentation will help determine whether, for instance, a connected mailbox should be sold, rented, or use a freemium model where the basic mailbox would be given for free but perhaps charging customers according to the use of mobile apps and data associated to it.

Leverage Partnerships

An additional way to minimize risk, as well as acquire technology and skills more quickly, would be to utilize partnerships. For example, the Postal Service could partner with technology companies to acquire the core competencies needed to deliver on the promises of IoPT, such as personnel and software.

There might also be an opportunity for the Postal Service to participate in smart cities projects. The cities that have started developing those projects are seeking to gather a variety of data on a wide scale, some of which could be collected by postal vehicles. Ongoing federal initiatives, such as the Global Cities Teams Challenge, would provide a practical framework for the Postal Service to identify appropriate city partners, to understand their needs, and to pilot such solutions.[69] Linking up with local government initiatives would not only better position the Postal Service in the new urban logistics market, it would also help share some of the risks and costs of entering an emerging market segment.

---

68 As stressed by R. Miskanic, acting Chief Information Officer, U.S. Postal Service. J. Miller, "Advanced mobile devices pave USPS' way toward Internet of things," *Federal News Radio*, June 3, 2015, http://www.federalnewsradio.com/537/3869015/Advanced-mobile-devices-pave-USPS-way-toward-Internet-of-things.

69 The Global Cities Teams Challenge was created by a network of federal agencies to foster the creation of project teams. Teams, made up of agencies, suppliers, cities, software and hardware providers, and academia, develop and pilot innovative IoT-based smart cities projects.

Box 2. La Poste — Digital Hub: "A Control Center for All Your Connected Things"

This platform created by subsidiary Docapost securely stores in one single place all kinds of sensor-based data from different local sources — not only from the postal "things," but also city assets, smart phones, and consumers' connected things (for example, home appliances and wearables).

The objective is to allow cities or companies (in industries such as insurance, health, or energy) to develop new services based on different datasets they can access through Application Programming Interfaces (APIs).

The IoPT Platform: The Centerpiece of a Connected Postal Ecosystem

In order to fully take advantage of IoPT, and facilitate partnerships, the Postal Service will need to build and facilitate an open information platform.

The IoPT platform would enable the integration and analysis of data from a variety of different objects and systems — the postal infrastructure or third parties' systems such as cities — and host the various business and operational applications that the Postal Service would develop based on the data collected, all in one place.

IBM describes the platform as consisting of four key elements working in concert: a well-defined data model that clearly determines data flows, a data storage infrastructure, interfaces to make data accessible, and policies to regulate and authorize access to each data point.[70]

The main features of the platform would be

- Openness. Opening up IoPT data and applications to third parties — such as customers, governments, and private sector entities — through the platform allows the data to become more valuable to a wider range of players.[71] In practice, real-time data on the conditions, availability, and geo-location of the Postal Service's fixed and mobile assets such as facilities, vehicles, letter carrier handheld terminals, or post offices could be made available to third parties for them to develop their own uses and applications. Additionally, non-postal data collected by third parties could be integrated on the platform, allowing the Postal Service access to a wider field of potentially useful data. France's Groupe La Poste has already demonstrated the success of this open platform model for posts (Box 2).

- Scalability. This design of platform will grow and evolve. Since data are added as needed and applications are built in stages, if any particular stage is not successful it can be deleted without compromising the whole data architecture.

- Security and privacy. The platform model lets the Postal Service determine security standards and policies to authorize access to each data point.

Such an open, scalable, and secure information platform would be a key asset for the Postal Service, seamlessly linking the physical infrastructure to the digital data flows in a single, integrated network. The platform would also foster innovation similar to what Apple and Android have done by exploiting network effects between applications and users: more applications attract more users, and more users attract more applications. This platform could become the hub of an ecosystem of business partners that integrate their services and value chains with those of the Postal Service, and innovate to meet customer needs.

Additional Implementation Challenges and Considerations

The Postal Service will also need to consider the following external and internal challenges as it incorporates IoPT into its processes:

Privacy Challenges. Privacy is increasingly important to consumers. Businesses must incorporate privacy protection measures into the design of data collection, storage, and use. They should collect only needed data, aggregate and anonymize data that contain

70 The data model defines the relationship between different data collection points throughout the system. Application Programming Interfaces (APIs) make data more accessible by providing a layer of organization and insulation on top of the underlying architecture and enabling the quick development of apps. Policy-driven access acts as a layer of security and privacy protection, controlling who has authorized access to the data. See Accenture video available at http://www.accenture.com/us-en/Pages/insight-tech-vision-2015-platform-revolution-video.aspx.

71 On the platform, third parties could use postal-developed applications directly, or use raw data to develop their own useful applications.

personally identifiable information, destroy data that are no longer needed, and create transparent privacy policies that clearly state how data are collected and with whom it will be shared.[72] Businesses should also allow customers to opt-in to data collection, rather than opt-out.[73]

Security Challenges. Anything connected to the Internet is a potential entry point for an unauthorized individual to slip into the system.[74] This is of particular concern with IoPT due to the sheer number of endpoints that need to be protected. Businesses must implement new security frameworks that ensure access to any device or endpoint is authenticated and controlled and that system-wide detection mechanisms and appropriate response models are in place.

Interoperability Challenges. The value of IoPT increases as more data sources can be interconnected through seamless data sharing between systems. The lack of standards hinders this important interoperability and increases the risk that companies invest in technologies that become obsolete if they do not become the dominant standard.[75] On the other hand, the price of inaction is that companies risk lagging behind.[76]

Technology Challenges. Building an IoPT infrastructure can be a significant technical and capital investment and there are a number of technical challenges facing the Postal Service. The first consideration is the integration of IoPT with an existing IT infrastructure where data integration remains a challenge.[77] Second, it must choose and implement the right hardware and software. Finally, new internal policies must be put in place to manage the data, including determining who owns the data and who has access to the data.

Human Resources Challenges. The increased use of smart machines and advanced decision support systems transforms the roles employees play within a business. The Postal Service will need new personnel with expertise in systems management and integration, analytics, and security in order to maintain the IoPT infrastructure. Additionally, it will need to retrain existing employees to use the new IoPT enabled equipment or to perform new, value-added tasks.

Regulatory Considerations. The Postal Service is a regulated business and needs to take the regulator and postal regulations in consideration when pursuing IoPT. Non-core new products and services, as well as initiatives that involve opening up and monetizing data, would likely be subject to Postal Regulatory Commission (PRC) review and approval. Additionally, the Postal Service would need to negotiate with employee unions for the flexibility to adjust work hours based on real-time data and analytics, as a fully functional IoPT would require.[78]

---

72 Edith Ramirez, "IoT – Opportunities and Challenges," (presentation at The 2nd Annual Internet of Things Global Summit: Realizing the Potential of the IoT, Washington, DC, October 27, 2014).

73 Many of these requirements are already in the Postal Service's privacy policy. The challenge will be to balance protecting privacy and preserving the appeal or efficacy of IoT products and services

74 Hackers have already demonstrated that home appliances such as televisions and refrigerators can be used to access networks, compromise data, and take full control of appliances. Silvana Ordonez, "Hackers Can Get Into Your Refrigerator, Too," *CNBC*, January 17, 2014, http://www.cnbc.com/id/101345760.

75 The industry has recognized this risk and organizations, such as the U.S. National Institute of Standards and Technology and the Industrial Internet Consortium are working to promote interoperability and develop standards.

76 Sokwoo Rhee (Associate Director of Cyber-Physical Systems, National Institute of Standards and Technology), in discussion with the authors, October 20, 2014.

77 Cindy Waxer, "Digital SOS: How Technology Can Save the USPS," *Computerworld,* December 8 2014, http://www.computerworld.com/article/2855146/digital-sos-how-technology-can-save-the-usps.html.

78 For instance the National Association of Letter Carriers (NALC) has discussed with the Postal Service the best way to determine which handheld terminal was best suited for their jobs. Letter carriers were also involved in device tests. Similar approaches could be applied to other carrier-based IoPT innovations. NALC, *NALC Bulletin,* March 24, 2014, http://nalc.bytrilogy.com/news/bulletin/pdf2014/bulletin14-03.pdf.

Conclusion

Although we are only at the beginning of the development of the Internet of Things, the experience of early adopters shows that IoT can generate concrete benefits. By interconnecting and analyzing data from its vast and rich network infrastructure, the Postal Service could cut costs, generate efficiencies, optimize processes, and respond to customer demands for information and customization. It could also modernize the way it delivers its core business, generate new revenue, and ultimately create new business models.

In the short term, the Postal Service could reap the benefits of low risk, proven IoPT applications in fleet management and smart buildings. In parallel, it could explore the viability of IoPT applications, such as a connected mailbox, that leverage unique postal assets. Additionally, the Postal Service could partner with local governments and other agencies to join or initiate multi-stakeholder, platform-based projects in the smart cities and neighborhood and collaborative logistics spaces. Key to the implementation of an IoPT will be the development of an open and secure technology platform through which the data collected can be stored, managed, and shared. Although IoPT technologies are still in their early stages of development, the time is right to start experimenting with this technology as a way to create efficiencies, innovate, and improve business decision making. The Postal Service can start building today an IoPT infrastructure for tomorrow.

Appendices

Click on the appendix title to the right to navigate to the section content

Appendix A: The Technology of the Internet of Things

Sensors and Connectivity Explained

A sensor is a device that detects or measures a physical property and records, communicates, or otherwise responds to that data point. Sensors can be either passive or active. Essentially a passive sensor, like a thermometer, collects data that are naturally occurring in the surrounding area and does not need a power source. An active sensor, such as a barcode scanner, emits energy to collect data such as in the scanning of objects.[79]

Sensors can be designed to collect almost any type of data, such as:

- Acoustic. Collect sound and vibration data, including sounds inaudible to the human ear such as high frequency acoustic emissions.[80]
- Automotive and transportation. Collect acceleration rate, power expended, temperatures, and internal chemical compositions.
- Chemical. Transforms chemical information (ranging from the concentration of a specific sample component to total composition analysis) into an analytically useful signal; provides data and information about the chemical composition of a gas or liquid phase environment.
- Electric current, electric potential, magnetic, radio. Detects an electrical current (AC or DC) in a wire, and generates a signal proportional to it; the generated signal can be used to display the measured current in an ammeter (a measuring instrument used to measure the electric current in a circuit) or can be stored for future analysis.[81]
- Flow, fluid velocity. Used for air, gas, and water flow.[82]
- Navigation instruments. Gauge, speed, depth, location, altitude, and other similar characteristics. (For example, accelerometer).
- Pressure. Detects when pressure is applied to the diaphragm of an object to the point where it stretches or compresses the object.[83]
- Force. A transducer converts an input mechanical force into an electrical output signal.
- Thermal, heat, temperature. Detects heat and temperature within a given radius and sends an alarm if needed (e.g., smoke detectors).
- Proximity. Detects nearby objects without physical contact. This is commonly found on cars that alert the driver when they are within a certain radius of another object.

An actuator is the motor responsible for moving or controlling a mechanism or system — essentially it automates processes by taking action: it converts energy (mostly electric current) into motion like electric motors. In the case of the connected mailbox, a sensor would (for instance) recognize the Postal Service letter carrier standing in front of the box, while the actuator would be small motor opening the box. Sensors and actuators are often referred to as microelectromechanical systems (or MEMS).

---

79 National Aeronautics and Space Administration (NASA), *What are passive and active sensors?,* October 14, 2012, http://www.nasa.gov/directorates/heo/scan/communications/outreach/funfacts/txt_passive_active.html.

80 "Acoustic Sensors," *Siemens,* http://www.automation.siemens.com/mcms/sensor-systems/en/process-instrumentation/process-protection/acoustic-sensors/pages/acoustic-sensors.aspx.

81 Shaun Milano and Mike Doogue, *Hall Effect Current Sensing in Hybrid Electric Vehicle (HEV) Applications,* Allegro MicroSystems, LLC, http://www.allegromicro.com/en/Design-Center/Technical-Documents/Hall-Effect-Sensor-IC-Publications/Hall-Effect-Current-Sensing-In-Hybrid-Electric-Vehicle-HEV-Applications.aspx, and "ammeter," *Mirriam-Webster,* http://www.merriam-webster.com/dictionary/ammeter.

82 "What is a flow meter?" *max,* 2014, http://www.maxmachinery.com/what-is-a-flow-meter.

83 McLaren, *Pressure Sensors,* November 24, 2009, http://www.mclarenelectronics.com/Products/Document/Pressure%20Sensors%20Application%20Note.

Types of Sensors and Connective Devices

The following table lists some of the most common sensor and connective technologies, and a few key features for each:

Table 2: Sensor Technologies

Technology	Key Features
RFID	• A sensor technology that uses electromagnetic fields to transfer data • Allows unique identification of moving objects • RFID tags can be either passive or active • Is a widely accepted standard, used in a variety of industries • Has read distances of 1-60 feet (for passive tags) or up to 1600 feet (for active tags) • Fairly inexpensive, although active RFID tags cost more than passive ones ($20-80 vs. ten cents per tag, respectively)
Beacons	• A low-powered sensor that communicates with mobile devices, notifying a mobile app when it is within a specified radius • Beacons tend be larger than other technologies: current size and weight are similar to a computer mouse, but future beacons could be much smaller • Beacons can transmit signals as far as 200 feet away, but signal strength is reduced when traveling through objects (such as walls) • Beacons range in cost from $10-150, depending on the size and strength, but beacons are currently dropping in cost
Wi-Fi	• A standard for wireless connectivity through radio bands • Wi-Fi is perhaps the most pervasive type of connectivity, in use in many people's homes • Read distance is about 60 feet
Bluetooth	• A wireless connective technology for exchanging information over short distances • Read distance is about 150 feet • Can connect and synchronize multiple devices • Lower-power consumption
ZigBee	• A high-level communication protocol that uses low-power digital radios • Communications through ZigBee are able to pass through intermediary devices, but must be within the mesh network to be read • Connectivity ranges up to about 300 feet • Offers low power consumption because the device is not "on" all the time • A ZigBee chip costs about $30-70 per tag
Near Field Communication (NFC)	• NFC allows data to be communicated by touching together two NFC-enabled data collection devices, or bringing them into close proximity • As such, read distances are only a couple of inches • Utilizes electromagnetic radio fields • Similar to RFID, NFC tags can be active or passive

Factors Enabling Current IoT Development

As mentioned in the paper, IoT was developed over a decade ago. However, the technologies and market conditions to support its development were not yet mature.[84] The following four factors make IoT a current hotbed of development:

- Ubiquitous connectivity. Just like every citizen or business in the postal system or on the Internet, every device needs an address. With the development of Wi-Fi Internet and the proliferation of mobile devices, people (and things) can now be connected anywhere at any time.

- Decreasing cost of technology. The costs of general purpose computing, storage space, and analytics have all decreased. In addition, the price of the actual sensors has gone down dramatically. Ten years ago, passive RFID tags could cost up to $1.[85] Today, they can be as little as 7 cents — 14 times less expensive.[86] Most sensors are now cheap enough, and small enough, to be embedded in any device.[87] In addition to being ubiquitous, Internet connections are getting faster and cheaper.

- Increasing capacity for data storage and analytics. The cloud enables large amounts of data to be stored, accessed, analyzed, and transformed into actionable data in real time in ways that were not possible before.[88] This, combined with ubiquitous connectivity, makes computing resources available at a low price anywhere. In addition, the development of edge computing means that the sensors themselves can be programmed to take immediate action, if necessary.[89] This reduces the amount of data uploaded and stored in the cloud.

- Customer demand for data. Businesses can not only use this new data internally to improve operations and decision-making, but also to respond to increasing customer demand for more data-rich products — the value of the information associated with a product is nearly as important to the customer as the product itself.[90] This creates a better experience overall for the customer and has become a major competitive advantage.[91]

The Potential of IoT

IoT has the potential to disrupt companies' business models, strategies, value chains, workforces, and competitive environment. At the same time, IoT can provide unprecedented opportunities to generate new value, innovation, and efficiencies. It could be particularly transformative for the Postal Service given the sheer size of the network and complexity of its operations. The excitement around IoT resides in its possibility to

- Instrument and obtain real-time data from potentially any physical asset — giving a voice to 'things" that did not have voice before.

- Interconnect data across different objects and systems, breaking down silos, and facilitating data sharing.

---

84 eMarketer, *Key Digital Trends for Midyear 2014: The Internet of Things, Net Neutrality, and Why Marketers Need to Care*, July 2014, p. 3.
85 Passive RFID tags are very small electronic devices, often as thin as a piece of paper, capable of storing and transmitting data, such as an individual product number, at close range. RFID Journal, *Tag Cost and ROI*, February 16, 2004, http://www.rfidjournal.com/articles/view?, p. 796.
86 RFID Journal, *How Much Does an RFID Tag Cost Today?*, http://www.rfidjournal.com/faq/show?85.
87 IBM Institute of Business Value, p. 2.
88 McKinsey & Company.
89 DHL, "*Low-cost Sensor Technology – trends, potential, and field tests,*" December 2013, http://www.dhl.com/content/dam/downloads/g0/about_us/innovation/CSI_Studie_Low_Sensor.PDF, p. 10.
90 On the importance of big data analytics for postal operators, see OIG, *International Postal Big Data: Discussion Forum Recap*, Report No. RARC-IB-14-002, May 12, 2014, https://www.uspsoig.gov/sites/default/files/document-library-files/2014/rarc-ib-14-002.pdf.
91 Michael Porter and James Heppelmann.

- Provide intelligence through advanced analytics that make vast amounts of data actionable and enable real-time decision-making.
- Automate processes through direct machine-to-machine communication, increasing the overall efficiency of a system.

Many companies still lack a full understanding of the implications of IoT on their business models. Many experts think that big changes are coming, and they will force organizations to rethink the way they conduct business. Three major changes that will affect businesses, like the Postal Service, are described below.

Shifting from Unconnected to "Smart" Products and Services

The increasing availability of data on both product performance and consumer preferences is already enabling organizations to provide more customized and innovative products and services. In the long term, the ability to predict consumer behavior through data analytics, combined with the enhanced automation capabilities provided by IoT, could allow companies to offer products and services completely on-demand. It could also be done in a fully-automated way. For example, Amazon is automating the ordering process with Dash, which allows customers to order certain set items with the press of a button and has previously discussed plans for fully predictive ordering.[92]

Shifting from Competing on Price to Competing on Overall Value

As companies produce greater quantities of smart products and services, traditional competitive levers such as low price and high quality will no longer be sufficient to succeed in the market. In this new "outcome economy" products will evolve into services, as they will be only one component of comprehensive software-enabled solutions aimed at addressing customers' wider needs.[93] Companies that continue to compete only on price may be commoditized out of business.

Shifting from Industries to Ecosystems

The need to deliver outcomes rather than products or services often requires resources that go beyond the skills and capabilities of a single company. Therefore, meeting the needs of customers will require businesses to work with suppliers, partners, innovators, technology providers, and even competitors to create "ecosystems where each participating company can specialize on its core" while contributing to produce a common and collectively beneficial outcome.[94] Reshaping the relationships between businesses requires new intermediaries: software platforms able to collect and analyze data from all parties as well as interconnect and coordinate the systems and the supply chains of the various participants. Providers with nimble software-based business models and innovative value propositions are already developing interconnected platform solutions — traditional players will have to race against these new competitors.[95]

The Internet of Things in Action: Real Life Examples

IoT's potential is already becoming visible in a number of industries. Despite the current hype around popular consumer applications, such as fitness tracker wristbands, smart watches and smart homes, it is in the industrial sector that IoT can generate

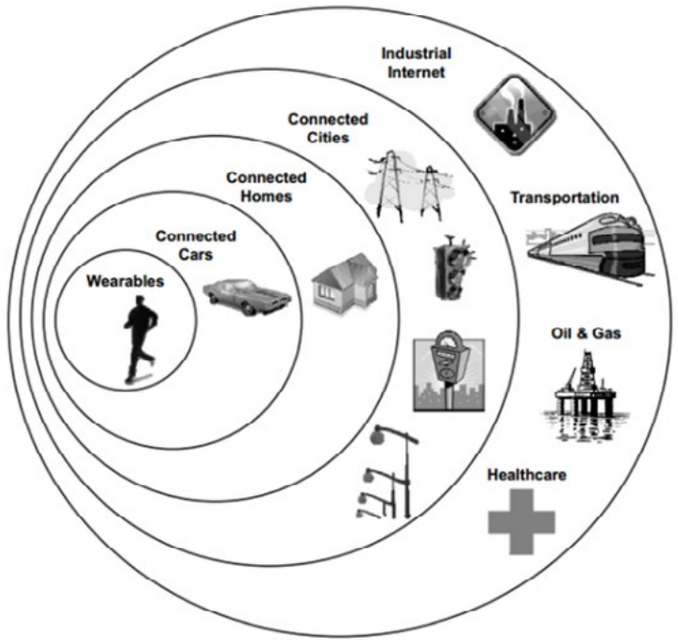
92 Sarah Halzack, "Amazon Dash: A way to order products with a touch of a button," *The Washington Post,* March 31, http://www.washingtonpost.com/blogs/the-switch/wp/2015/03/31/amazon-dash-a-way-to-order-products-with-the-touch-of-a-button/, and Lydia DePillis, "Amazon wants to send stuff before you order it. Are other retailers doomed?," *The Washington Post,* January 30, 2014, http://www.washingtonpost.com/blogs/wonkblog/wp/2014/01/30/amazon-wants-to-send-stuff-before-you-order-it-are-other-retailers-doomed/. Another example of a company that has successfully monetized sensor data to create value-added services that enhance the customer experience is OnStar, which offers roadside remote assistance for drivers.

93 "*Industrial Internet of Things: Unleashing the Potential of Connected Products and Services,*" January 2015, chapter 3, http://www3.weforum.org/docs/WEFUSA_IndustrialInternet_Report2015.pdf Ibid.

94 Ibid.

95 Ibid.

Figure 4: The IoT Landscape



Source: Goldman Sachs.

real business and socio-economic value.[96] IoT is taking hold in many industries, even those often considered low-tech, such as agriculture.[97] Asset tracking and remote monitoring are the most common applications in IoT-intensive industries, such as utilities, healthcare, manufacturing, and retail. Sector-specific applications, such as fleet management for transport and logistics, are also becoming widespread.

As Figure 4 shows, the current applications of IoT can be broken down into five main categories, all of them relevant to postal operators' fixed and mobile infrastructure and human capital.[98]

According to Business Intelligence, the manufacturing, transportation and warehousing, and information sectors will invest the most in IoT systems and devices in the next 5 years, followed by wholesale trade, healthcare, and retail (Figure 5).[99]

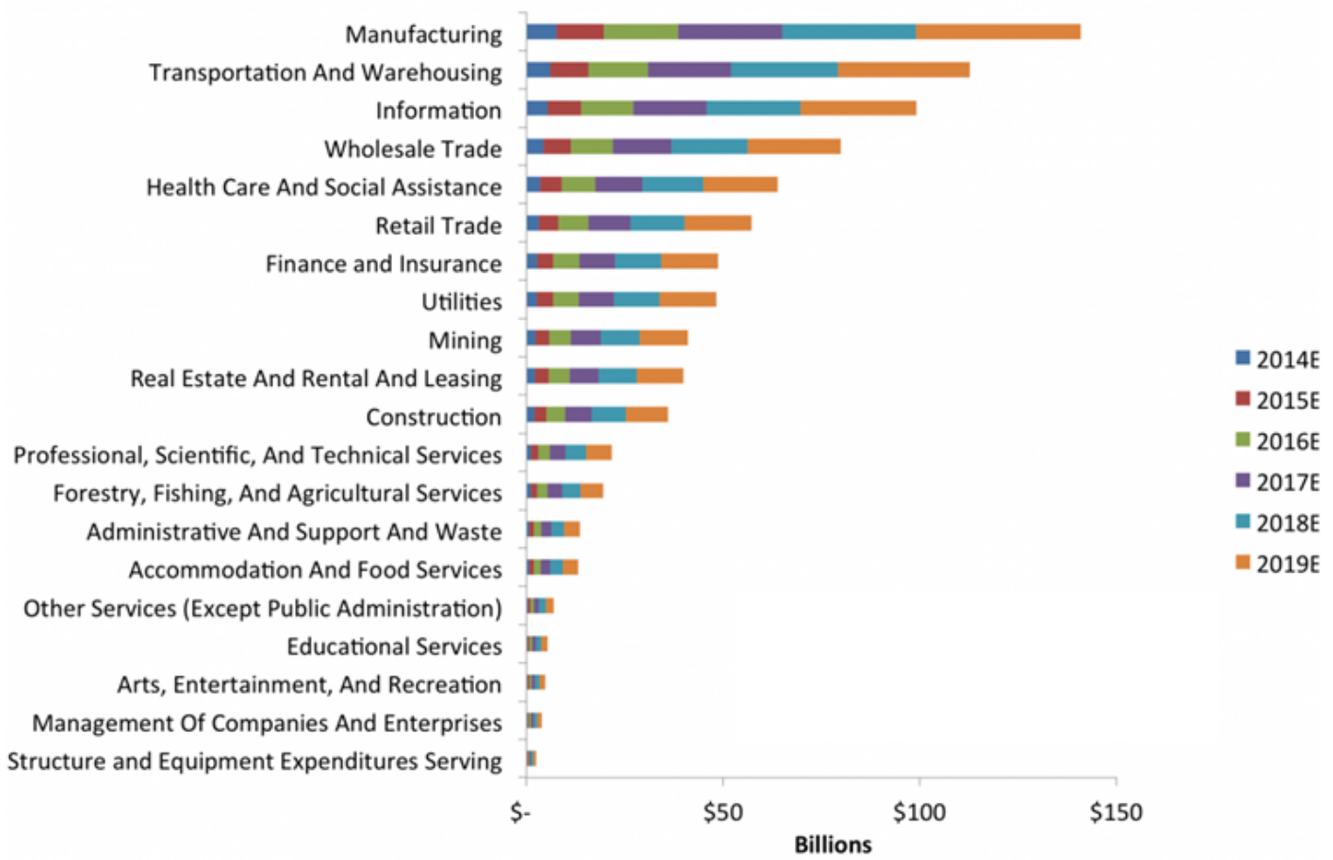
While industries (including some considered lower-tech such as agriculture) are expected to reap the benefits of IoT, the main triggers vary. In the transport and logistics sector, the main two factors are "opportunity for innovation" and "need for faster decision-making," followed by "need for competitive advantage."

While some consumer electronics applications are flashy or over-hyped (the proverbial "connected toaster"), others have achieved a very real return on investment.[100] As a major logistics player, retailer, fleet owner, and energy consumer, the Postal Service can benefit from the experiences of these industries. Below we briefly discuss some sample applications from three major industries.

Retail. Beacons, such as the iBeacon developed by Apple can detect when a mobile phone is in a certain radius, allowing retailers to market to customers outside the store, track customers in the store, show coupons, and provide contactless payment. Other retailers, such as Coca Cola, have experimented with interactive interfaces to draw customers in and engage with them. Users can use touch screens or their mobile phones to listen to music, take pictures, buy a Coke product, and share their experience through social media. All the while Coca Cola is collecting data from the customer's interactions and using cameras to collect demographic information. This data from these low-cost sensors and interactive interfaces helps retailers better target their advertising, improve the customer experience, and in the end maximize profits by generating new revenue.

96 Ibid.
97 For instance, farmers can use data from radio positioning tags to monitor cows for illness or herd behavior.
98 Goldman Sachs, "IoT primer, The Internet of Things: Making sense of the next mega-trend," September 3, 2014, http://www.goldmansachs.com/our-thinking/outlook/internet-of-things/iot-report.pdf.
99 J. Greenough, "The corporate 'Internet of Things' will encompass more devices than the smartphone and tablet markets combined," *Business Insider*, February 25, 2015, http://www.businessinsider.com/the-enterprise-internet-of-things-market-2014-12.
100 For an extreme but entertaining example of a "connected toaster" which "can sense when other toasters in the network are being used by their hosts" see http://www.gizmag.com/smart-toaster-networked/31236/.

Figure 5: Global Investment in IoT by Industry 2014-2019



Source: J. Greenough.

Healthcare. Personalized health monitors collect highly individualized, real-time information that can be shared with friends, family, and healthcare professionals. Wearables, such as the FitBit, can monitor a user's calories burned, activity levels, and sleep patterns. This information can be shared via social media in order to compete with friends and encourage fitness. Other wearables and ingestibles, such as a cancer-detecting nanotechnology pill currently under development by Google, have the potential to save lives by, for example, diagnosing illnesses earlier. IoT healthcare solutions encourage healthy living and ensure that doctors have access to a larger supply of better information, leading to fewer and more efficient doctor appointments, better diagnoses, and reduced overall healthcare spending.

Manufacturing and logistics. Thousands of sensors can collect data about each step in the manufacturing process and beyond, from warehousing to shipping to installation. GE has coined the term "brilliant factory," defined as "a dynamic system in which machine parts constantly relay information to operators, who can schedule maintenance before equipment fails, all the while improving the manufacturing process." Some large manufacturers are also moving to machine-to-machine (M2M)-based inventory and warehouse management systems that support real-time visualization of each product's exact location and status. This helps improve supply chain quality and drive down costs. Augmented reality devices, such as Google Glass, are being developed for use in fulfillment to guide packers to the right products. This decreases the time spent fulfilling each order.

Appendix B: Prominent U.S. Smart Cities Pilots (2015)

Table 3: Smart Cities Pilots

City	Solution	Description	Sensor Type	Benefits	Remarks
Chicago	Array of Things Initiative	Network of sensor boxes collecting real-time data on the city's environment, infrastructure, and activity for research and public use.	Sound sensors on waste units. Environmental sensors (air quality, temperature), and pedestrian traffic.	Create a "fitness tracker for Chicago." Data will be available to residents, software developers, scientists, and policymakers.	Publicly available data published to cloud-based system. Starting with 50 nodes (pilot in June 2015). No personally identifiable information will be collected.
New York	Lower Manhattan Smart Neighbor-hood Pilot	Provide real-time insights into urban challenges through a sensor network: air quality, weather, sunlight, noise pollution.	Sensors affixed to trash compactors, recycling bins, and street poles.	Help city planners, businesses, academia, and entrepreneurs; supports New York City's Smart Cities strategic plan.	Pilot. Open data platform.
Salt Lake City	Air Pollution Real-Time Mobile Monitoring	Real-time mobile air pollution monitoring.	Sensors affixed to train and subway cars, combined with city's fixed sensors.	Provide more granular monitoring of air pollution sources, for use by public interest groups, agencies, and individuals interested in public health.	18-month project initiated by Utah Valley University.
San Jose	Part of the Green Vision Initiative	Install a network of sensors to measure air quality, noise pollution, and traffic flows.	Air quality, sound, and microclimate sensors.	Generate insights that will lead to improvements in air quality, noise, transportation efficiency, environmental sustainability, health, and energy efficiency.	Six-month pilot announced in mid-2014.
Boston	Street Bump app	Volunteers use the Street Bump mobile app to collect road condition data (pot holes) while they drive.	Accelerometer embedded in smart phones.	Helps city identify then fix pot holes.	Pioneering app created in 2012.
Chattanooga	Geo-located Allergen Sensing Platform	Provide real-time information relevant to a major health concern of the city — allergies.	Sensors on building and residences monitor allergens.	Create a real-time visualization tool for use by residents and visitors, e.g., for planning outdoor activities.	Sensor data streamed live to a central platform, which will provide an open API for developers to experiment with. A mobile app will target individuals most affected by the fall allergies.

Source: OIG analysis and information packet given to participants of the Global City Teams Challenge (GCTC) Tech Jam organized by the National Institute of Standards and Technology (NIST), Gaithersburg, MD, February 12-13, 2015.

Appendix C: List of Interviews Conducted

Table 4: List of Interviews

Name	Affiliation	Date
Richard Wishart	Delivery Management Ltd	9/15/2014
Larry Buc	SLS Consulting	9/15/2014
Jody Berenblatt	GrayHair Advisors	9/16/2014
Michael Ravnitzky	Postal Regulatory Commission	9/18/2014
Maynard Benjamin	EMA (Envelope Manufacturers Association)	9/19/2014
Thomas Day	U.S. Postal Service	9/24/2014
Leon Pintsov	Consultant	9/25/2014
Andreas Addison	City of Richmond, VA	10/7/2014
Elmar Toime	E. Toime Consulting Ltd	10/14/2014
Dan Morgan	U.S. Department of Transportation	10/15/2014
Andy Stafford-Clark	IBM	10/20/2014
Sokwoo Rhee	NIST	10/20/2014
Mark Valcich	Intel	10/30/2015
Tiffany Sargent	Intel	10/30/2014
Ed Phelan	U.S. Postal Service	11/21/2014
Clayton Bonnell	U.S. Postal Inspection Service	12/1/2014
Chuck Chamberlain	Northrop Grumman	12/12/2014
Jon Baliles	Richmond, VA City Council	1/12/2015
Tim Kehrer	Quintiq	2/17/2015
Doug Caldwell	AFMS	2/18/2015
Gary Reblin	U.S. Postal Service	3/11/2015

Appendix D: Select Reports of the Internet of Things

Elgar Fleisch, Markus Weinberger, and Felix Wortmann, *Models and the Internet of Things*, Bosch Internet of Things & Services Lab, August 2014, http://www.iot-lab.ch/wp-content/uploads/2014/09/EN_Bosch-Lab-White-Paper-GM-im-IOT-1_1.pdf.

CB Insights, *Analyzing the Internet of Things Investment Landscape*, 2015, https://www.cbinsights.com/reports/internet-of-things-landscape.pdf.

Joseph Bradley, Joel Barbier, and Doug Handler, *Embracing the Internet of Everything To Capture Your Share of $14.4 Trillion*, Cisco, 2013, http://www.cisco.com/web/about/ac79/docs/innov/IoE_Economy.pdf.

Deloitte, *The Internet of Things Ecosystem: Unlocking the Business Value of Connected Devices,* 2014, http://www2.deloitte.com/content/dam/Deloitte/global/Documents/Technology-Media-Telecommunications/gx-tmt-Iotecosystem.pdf.

DHL Trend Research and Cisco Consulting Services, *Internet of Things in Logistics*, April 2015, http://www.dhl.com/content/dam/Local_Images/g0/New_aboutus/innovation/DHLTrendReport_Internet_of_things.pdf.

DHL Customer Solutions & Innovation, *Low-cost Sensor Technology – trends, potential, and field tests*, December 2013, http://www.dhl.com/content/dam/downloads/g0/about_us/innovation/CSI_Studie_Low_Sensor.PDF.

Eyefortransport (EFT), *Visibility, Speed and Agility: How M2M is Redefining the Supply Chain and Transportation*, 2014, http://events.eyefortransport.com/lp/content.php.

Hung LeHong and Alfonso Velosa, *Hype Cycle for the Internet of Things*, Gartner, July 21, 2014, http://www.gartner.com/technology/reprints.do?id=1-27LJLAK&ct=150119&st=sb#h-d2e1110.

GE and Accenture, *Industrial Internet Insights Report for 2015*, 2014, http://www.accenture.com/sitecollectiondocuments/pdf/accenture-industrial-internet-changing-competitive-landscape-industries.pdf.

Goldman Sachs, *The Internet of Things: Making sense of the next mega-trend*, September 3, 2014, http://www.goldmansachs.com/our-thinking/outlook/internet-of-things/iot-report.pdf.

GovLoop*, The Internet of Things: Preparing Yourself for a Connected Government,* July 2014, https://www.govloop.com/wp-content/uploads/2014/07/GL-Internet-of-Things-Guide-.pdf.

IBM Institute for Business Value, *Device democracy Saving the future of the Internet of Things*, September 2014, http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?subtype=XB&infotype=PM&appname=GBSE_GB_TI_USEN&htmlfid=GBE03620USEN&attachment=GBE03620USEN.PDF#loaded.

IBM Market Development & Insights, *Internet of Things: HorizonWatch 2015 Trend Report*, January 27, 2015, http://www.slideshare.net/HorizonWatching/internet-of-things-horizon-watch-2015-trend-report-client-version-28jan2015.

Intel, *Developing solutions for the Internet of Things*, 2014, http://www.intel.com/content/www/us/en/internet-of-things/white-papers/developing-solutions-for-iot.html.

Adam Thierer, "The Internet of Things and Wearable Technology: Addressing Privacy and Security Concerns without Derailing Innovation" (working paper, Mercatus Center, George Mason University, November 2014), http://mercatus.org/sites/default/files/Thierer-Wearable-Tech.pdf.

McKinsey Global Institute, *The Internet of Things: Mapping the Value beyond the Hype*, McKinsey & Company, June 2015, http://www.mckinsey.com/insights/business_technology/the_internet_of_things_the_value_of_digitizing_the_physical_world.

MIT Technology Review, *Business report: The Internet of Things-Billions of computers that can sense and communicate from anywhere are coming online. What will it mean for business?,* July-August 2014, http://dspace.mit.edu/bitstream/handle/1721.1/86935/MIT-Technology-Review-Business-Report-The-Internet-of-Things.pdf.

Pew Research Center, *Digital Life in 2025 – The Internet of Things will thrive by 2025*, May 14, 2014, http://www.pewinternet.org/files/2014/05/PIP_Internet-of-things_0514142.pdf.

Michael E. Porter and James E. Heppelmann, "How Smart, Connected Products Are Transforming Competition," *Harvard Business Review*, November 2014, https://hbr.org/2014/11/how-smart-connected-products-are-transforming-competition.

SAP, *Next-Generation Business and the Internet of Things Opportunities and Challenges Created by a Connected and Real-Time World*, 2014, http://www.sap.com/bin/sapcom/es_co/downloadasset.2013-10-oct-10-09.next-generation-business-and-the-internet-of-things-opportunities-and-challenges-created-by-a-connected-and-real-time-world-pdf.html.

Ovidiu Vermesan and Peter Friess eds., *Internet of Things— from research and innovation to market deployment*, (Rivers Publishers Series in Communication, 2014), http://www.internet-of-things-research.eu/pdf/IERC_Cluster_Book_2014_Ch.3_SRIA_WEB.pdf.

Vodafone, *The M2M Adoption Barometer 2014*, 2014, https://m2m.vodafone.com/cs/m2m/insight_news/2014-07-02-the-m2m-adoption-barometer-2014.

World Economic Forum (in collaboration with Accenture), *Industrial Internet of Things: Unleashing the Potential of Connected Products and Services*, January 2015, http://reports.weforum.org/industrial-internet-of-things/.

Appendix E: Management's Comments

RANDY S. MISKANIC
ACTING CHIEF INFORMATION OFFICER AND
EXECUTIVE VICE PRESIDENT

UNITED STATES POSTAL SERVICE

July 31, 2015

RENEE SHEEHY
DIRECTOR, RISK ANALYSIS RESEARCH CENTER
OFFICE OF THE INSPECTOR GENERAL

SUBJECT: Internet of Postal Things (White Paper)

The U.S. Postal Service has reviewed and acknowledges the Internet of Postal Things Report. We will consider and review further the available opportunities.

This report and management's response does not contain information that should be exempt from disclosure under the Freedom of Information Act.

Randy S. Miskanic

cc: Paola Piscioneri, Director, Digital and Global, RARC, USPS OIG
Sally Haring, Manager of Corporate Audit and Response Management
Allison Glass, RARC, USPS OIG

475 L'ENFANT PLAZA SW
WASHINGTON DC 20260-1500
WWW.USPS.COM

OFFICE OF
INSPECTOR
GENERAL
UNITED STATES POSTAL SERVICE

U.S. Postal Service Office of Inspector General
1735 N. Lynn Street
Arlington, VA 22209

Telephone: 703-248-2100
www.uspsoig.gov

For media inquiries, contact Agapi Doulaveris
Telephone: 703-248-2286
adoulaveris@uspsoig.gov