EMERGING TECHNOLOGY IN TRAVEL

2017 REPORT

Sabre

NOTE FROM SABRE LABS

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Sabre Labs is the travel and technology innovation lab within Sabre that explores capabilities that will impact travel over the next decade. The Emerging Tech in Travel Report represents our most comprehensive overview of this space to date.

For agencies, airlines, hoteliers and travelers, this report recommends specific actions you should consider to help navigate the rapidly changing technology landscape.

These recommendations stem from three megatrends poised to impact travel in 2017: connected intelligence, conversational interfaces and digital realities. This report also provides context to understand these important areas. Each megatrend is anchored by multiple technologies and each technology is explained in detail within the report.

Whether you read the whole report or just focus on recommendations for your specific industry, we hope you'll find this a valuable resource for your work in travel.

If you have feedback or want to discuss the future of travel and technology, please reach out via SabreLabs@Sabre.com.

Thank you,
The Sabre Labs Team

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FOR AGENCIES & OTAS

As traditional agencies and online travel agencies (OTAs) look for ways to improve service and support for existing customers, as well as broaden their client base, new technologies are providing tools to help increase efficiency, build deeper connections with customers, and inspire new travelers.

Connected intelligence is playing a significant role for agencies, primarily through advances in automation. Automated search algorithms are making it possible for agents to have more information at their fingertips with less work, improving the services they are able to provide to customers. Automation is also able to handle some of the routine work of itinerary management, freeing up time for agents to build relationships and respond to customer requests.

Conversational interfaces are changing how agencies are able to connect with customers. Message based interfaces allow agents to chat with customers during trip planning as well as while traveling. The casual, trusted medium of messaging allows increased context and connection. It also offers the opportunity to integrate elements of automation to easily provide reminders and travel updates to travelers on the go. Improvements in voice interfaces can help agents be more attentive to customers and quicker at providing advice by passively listening to call audio,

logging important data and triggering flight and hotel searches in real time.

Digital realities offer tremendous opportunities for brick and mortar agencies to inspire travelers in new ways and encourage a broader scope of potential destinations and excursions. VR can make all manner of locations and experiences immediate, both for potential travelers as well as for all agents who want to learn about new travel products and destinations they may want to share with customers.

Take a deep dive into the technologies with the greatest impact on agencies and OTAs, and read through specific recommendations for how to act on these technologies today to prepare for the future.

FOR AIRLINES

As airlines look for opportunities to improve operational efficiency and the traveler experience, new technologies are enabling improved training, service and maintenance, and a better understanding of the needs of travelers before, during, and after their flights.

Connected intelligence is playing a significant role for airlines, primarily through advances in indoor location data gathering and analysis. Understanding where travelers and staff are and how and where they travel through an airport can help improve flow, prevent bottlenecks, and allow airlines to more efficiently deploy staff to meet guest needs. It also allows targeted messaging to reduce missed connections and provide offers to increase customer satisfaction.

Conversational interfaces are making their mark through message based interfaces, allowing travelers to interact in a casual, trusted manner directly with airlines before booking and during travel. Messaging with passengers via their preferred platforms should allow more customized communication with passengers and the opportunity to resolve issues and concerns quickly in a private space.

Digital realities offer significant operational efficiencies for airlines in maintenance and repair and are changing how airlines position their premium travel experiences. Augmented reality through head-up displays allows maintenance expertise to be applied remotely to make repairs more efficient, reducing downtime and delays. Head-up displays also offer long term benefits to flight operations by being able to make significantly more information available at a glance. Virtual reality gives airlines a chance to create content to showcase premium experiences in a visceral way that may help improve conversion. Air travel is also an ideal space in which to offer curated VR experiences as an upsell or amenity for passengers.

Take a deep dive into the technologies with the greatest impact on airlines and read through specific recommendations for how to act on these technologies today to prepare for the future.

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FOR HOTELIERS

As hotels continue to focus on the guest experience, the application of new technologies can to improve communication with guests, inspire new experiences and increase operational efficiencies.

Connected intelligence is playing a significant role for hotels, primarily through advances in indoor location data gathering and analysis. Understanding where guests and staff are and how and when they travel through a hotel property can help improve flow, increase conversion for events and on-site amenities, and optimize staffing to efficiently meet guest needs.

Conversational interfaces are making their mark through message based interfaces, allowing guests to interact in a casual, trusted manner directly with properties before booking, during their stay, and after checkout. Message based interfaces also show promise to streamline communications among staff members, helping improve day-to-day operations and accelerate response to guest needs.

Digital realities are offering a wealth of opportunities for hotels to engage guests. Augmented reality through smartphones is affecting real world behavior with applications like Pokemon Go, changing how people engage while they travel.

Hotels have an opportunity to start creating additional value for guests through location-specific guides to desirable digital content. Virtual reality is being used as a way for hotel properties to richly showcase properties and amenities. This can include broadening visibility for high-desire exclusives like a behind the scenes tour of an on-property restaurant or a concierge-led virtual tour of the presidential suite.

Take a deep dive into the technologies with the greatest impact on hotels and read through specific recommendations for how to act on these technologies today to prepare for the future.

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FOR TRAVELERS

It's an exciting time to be a traveler. Whether on business or leisure or some combination of both, new technologies are providing tools to help streamline travel, from inspiration to logistics to the actual experience, along with all the ancillary opportunities along the way.

Connected intelligence allows bots and robots to play an increasing role in every part of travel. Bots are serving as digital personal agents, helping simplify travel through more streamlined search, basic itinerary management and travel reminders throughout each trip. Robots are starting to fill niches on the service side of travel, taking on roles like carrying bags and providing room service.

Conversational interfaces allow travelers to interact with every business they need to connect with during a trip, from agents to airlines to hotels to financial services and beyond. The ability to use preferred communication platforms to connect with businesses is easy and saves time vs. having to navigate a host of proprietary smartphone apps. Messaging also tends to provide quick responses in a frictionless way. Voice interfaces are making it possible for travelers to have hands free access to travel details and destination information, and the possibility of near real time language translation is on the horizon.

Digital realities, primarily through smartphone applications, are effectively providing travelers with superpowers like real time translation of written words and access to layers of digital information about city environments, landmarks and transportation. Navigation of new places is also being simplified by the added context provided in augmented reality.

Take a deep dive into the technologies with the greatest impact on travelers and read through specific recommendations for how to act on these technologies today to prepare for the future.

MEGATRENDS

Technology trends impacting travel in 2017

Megatrend

CONNECTED INTELLIGENCE

The world is increasingly connected at every level. Roads, planes, trains, boats and on-demand transportation have brought the physical world together; the Internet makes global communication instantaneous; and media streaming and travel cross-pollinate cultural values. In the background, a growing tsunami of connected sensors and devices invisibly gathers data from every sphere of life, fueling the development of "connected intelligence." These intelligent algorithms are capable of taking the wealth of data being generated by sensors connected to the Internet, analyzing the data, acting on analysis to enact change, and gathering outcome data to iterate continued improvement.

WHY BIG DATA MATTERS

The ability to sense, analyze and act on a wealth of data changes what kinds of technologies are viable. Voice recognition started in 1952 when Bell Labs developed a system that could understand 10 spoken digits. For more than 50 years, voice recognition systems were hampered by the need to be extensively trained for each individual user to provide enough data for working recognition. But in the 2000s, when Google and Apple brought voice search to smartphones, they built their voice recognition systems on analysis of huge data sets of natural speech rather than individual voice training. Application of this analysis caused a huge leap in efficiency and accuracy, and for the first time voice recognition gained mass acceptance. Now talking to Siri, Android or Alexa seems commonplace, but voice owes its acceptance and utility to big data.

One of the most immediate ways to picture how big data evolves and is utilized is in weather forecasting. We've had weather forecasts for thousands of years, from joints that ache when the pressure changes to the Farmers' Almanac to The Weather Channel, but forecast accuracy has increased dramatically in the last few years. Predicting weather accurately requires an amazing amount of data—sensors showing live data about temperature, humidity, wind speed, moisture, pressure, etc., as well as historical data about the same factors over the past hours, days, months and years. With the exponential increase in data, it's no longer possible for humans to parse the data ourselves; we rely on sophisticated programmed algorithms to compare historical trends to current data to make predictions. All global weather is connected, so the broader the data set, the better the chances of having the information necessary to accurately predict the weather in a particular place and time.

Of course, having data and understanding it isn't an end unto itself—the goal of data analysis is to be able to act on the information to positively affect a domain. In agriculture, the weather forecast can be combined with a system of connected sensors to optimize growth, assessing soil moisture for each plant in a field, and then irrigating each individual plant based on the forecast. Sensors can track the efficacy of the action over time to continue to improve resource efficiency and maximize future yields.

At home, a connected thermostat like the Nest can monitor forecast, humidity and sunlight along with temperature to optimize comfort instead of basing HVAC activation on a single variable. The system also adapts to an owner's preferences over time by integrating user input into its algorithm. Connected intelligence becomes more powerful the more different parts of a system can be brought together.

IOT: THE CONNECTEDNESS PIECE

Internet of Things (IoT) is one of the key buzzwords in the orbit of connected intelligence. IoT is a broad term for connecting physical objects to the Internet to collect and share data, creating an interconnected infrastructure embedded in everyday life. The IoT can encompass virtually anything with a sensor and a wireless

Nest uses sensors and other data to optimize a home's comfort. It can integrate with other connected devices as part of a smart home ecosystem. *Image: Nest.com*

most bullish on expansion, expecting 200 billion connected "smart devices" in 2020. [3]

Of particular interest this year, proximity beacons are becoming more widespread and have many immediate uses in the travel space to enact capabilities like **indoor location** and to improve our understanding of how people and objects move within and engage physical spaces like airports and hotels.

As more things come online, we increase exponentially the ability to **automate** certain kinds of tasks. We also have exponentially more data to analyze, and we add exponential complexity behind the scenes to the systems we use every day.

SENSING AND STORING DATA

The ability to sense and gather data has been made possible by the same primary drivers as many other recent technological advances: faster, smaller circuits and increased battery capacities. Smaller, more power-efficient sensors for things like audio, video, motion, vibration, etc., powered by longer-lasting batteries have made it possible for sensors like indoor location beacons to function anywhere, apart from traditional wired power. As the same "smaller, faster, more efficient" trends continue, we'll see new types of sensors cut the cord and become wireless.

Once sensors collect data, it has to be transmitted and stored. For indoor location beacons, Bluetooth or wi-fi to a hub are effective because the beacons are primarily stationary. For data like biometrics sensed by a smartwatch, cellular connectivity through a smartphone

transmitter: a car, a thermostat, a refrigerator, an iBeacon, a dog collar, a shelf price tag, and even so called "smart dust."

There are a relatively small number of devices and sensors currently connected to the IoT, but every day, millions of new sensors are coming online. Estimates vary for the number of IoT sensors connected right now, and what growth will look like over the next few years. Research firm Gartner is at the low end of estimates, with 6.4 billion connected things in 2016 (not counting smartphones, tablets or computers), growing to 20.8 billion in 2020.[1] A variety of industry experts project approximately 30 billion connected things in 2020 (with all devices included).[2] Chip maker Intel is the

[1] http://www.gartner.com/newsroom/id/3165317
[2] http://spectrum.ieee.org/tech-talk/telecom/internet/
      popular-internet-of-things-forecast-of-50-billion-devices-by-2020-is-outdated

[3] http://intel.com/content/www/us/en/internet-of-things/infographics/guide-to-iot.html

or the smartwatch itself offers immediate transfer to the "cloud." The networked cloud can hold the infrastructure necessary to put all the data in a central place, accessible from anywhere. The IoT wouldn't make sense—and couldn't exist—without cloud storage for data.

In business—particularly when considering large machinery—the number of sensors and quantity of data available is staggering. GE has noted that each one of its current jet engines generates approximately 1 terabyte of sensor data per flight. Multiply that times the number of engines on a plane, number of flights in a day, and thousands of planes, and that's an almost unfathomable amount of sensor data… every day![4] Before long, this volume of sensor data and the ability to drill down for incremental insights will be the new normal for industries.

HUMANITY IN DATA SCIENCE

A data set's utility arises from the insights that can be derived from it.

Data analysis was once a human-first endeavor. When Isaac Newton codified his three physical laws of motion, he based his insights on analysis of his own observed and measured data. Human-first analysis works for a limited amount of data, however, as data sets become increasingly complex, comprehensive human analysis becomes impossible and we need a computer's help. For instance, at any moment, there are approximately 2 trillion airplane fares

[4] http://computing.co.uk/ctg/feature/2399216/the-future-is-here-today-how-ge-is-using-the-internet-of-things-big-data-and-robotics-to-power-its-business

MACHINE LEARNING

Machine learning gives a computer the ability to program itself by using algorithms to analyze data. From the data, it learns to make predictions about future data. Comparing data outcomes with predictions allows it to refine and rapidly improve performance.

This variation on trial and error learning—with continual feedback—has similarities to the way children learn about the world. Machine learning…

- Allowed IBM's Watson to defeat the best Jeopardy players in 2011
- Allowed Google's Deep Mind to win a Go match against Lee Sedol in 2016 and then learn to master 1980's arcade games
- Allowed Baidu and Microsoft to develop human-level voice recognition capabilities
- Allows Facebook to suggest people you might know
- Allows Airbnb to rank its search results

in the Sabre reservation system—it would take a person ~60,000 years just to count that high, much more to actually read the data. Complex data sets necessitate automated analytics.

Computers can provide easily digestible graphs and charts or query results from massive data sets, but that doesn't mean they're actually producing insights from the data. In most cases, it's still people asking the questions and then interpreting the graphs and information to glean new insights. For the foreseeable future, data scientists—people trained to know how to ask computers the right questions and then put the computers' answers in context—possess an incredibly valuable skillset.

AUTOMATED INSIGHTS

It's become possible for computer algorithms to generate increasingly complex insights, with their training derived from sufficiently large data sets. This is usually termed machine learning or artificial intelligence. At this point, automated insights are still most effective within certain kinds of constrained domains, but the ability of algorithms to adapt to relevance in new domains is increasing daily.

The kinds of automated insights that artificial intelligences are currently optimized to provide can be far more effective than humans at certain kinds of tasks. For instance:

- Weather forecasting remains the most straightforward example, and computer algorithms are forecasting further out in time and with greater accuracy than human systems.

- Automated analysis of real time traffic patterns can tell you when you need to leave your house to arrive on time to a given destination based on congestion, wrecks, weather delays, etc.

- AI could analyze when and how to staff airport security to shorten TSA lines and speed up screening.

However, insight into weather, travel recommendations, and traffic analysis doesn't automatically translate to insight across all other domains, in large part because at some point, most insights must cross the threshold from digital ones and zeroes into human context.

It's at the point of requiring context that automated intelligences have the greatest challenge. Knowing what to say is important, but it's equally important to know when to say something, who to say it to, and how to frame the insight. The subtleties of communication required to make insight actionable for humans are particularly challenging for AI.

FULL AUTOMATION

For the domains in which automated insights are proving effective, people are working through issues of trust to determine where best to move to full automation, allowing the automated intelligence to take action on its insights. This requires automated intelligences to have the authority and ability to act in order to actually book a hotel, order a product, adjust a thermostat, etc.

The stakes in play for automation vary significantly based on the task undertaken.

> ## "THE BEST HUMAN ASSISTANT KNOWS WHAT INFORMATION TO COMMUNICATE, WHEN AND WITH WHOM. THIS LEVEL OF CONTEXTUAL UNDERSTANDING IS THE HIGH BAR A.I. ASPIRES TO REACH.
>
> *– Mark McSpadden, Sabre Labs*

- *Connected devices* (like a Nest thermostat) – When allowed to make small changes, like automatically adjusting temperature, stakes are relatively low—comfort and energy usage are at stake, but adjustments can be easily altered, change is gradual, and incremental improvements are frequent.
- *Assistive / warehouse robotics* (Amazon) – The safety of physical products is at stake if a robot malfunctions. Productivity is at stake if the robots pack or send the wrong product or are inefficient in their tasks. However, safety is not a huge concern and individual malfunctions have low costs relative to the size of the enterprise.
- *Automated stock trading* – Vast amounts of currency and stock valuation are at stake; poor algorithms could trigger a flash crash if something malfunctions. Livelihoods and money are high stakes, but potential gains are also high.

Widespread automation—increasing safety, productivity and efficiency—is one of the chief goals for connected intelligence, taking the burden of an increasing array of discrete tasks off of humans and moving it to computers.

CARS IN THE CONNECTED WORLD

Changes in automotive design and technology are an easy place to see the advancement of connected devices. A decade ago, the average car had a handful of internal sensors for things like speed, fuel level, tire pressure, and engine temperature, but those sensors weren't connected to anything. Now, cars are loaded with both internal and

external sensors and can connect to other devices via wi-fi, cellular signals and other wireless protocols. Internal sensors allow much more extensive monitoring, allowing programs like BMW Teleservice to proactively send data about your driving habits and car condition to the dealer and automatically schedule service appointments based on upcoming needs. External sensors are allowing cars to park automatically, cruise a set distance behind another car, or sound a warning when drifting out of a lane. Additionally, most smartphones of both driver and passengers effectively become car sensors, sending data about speed and location to services like Wayz to help feed traffic analysis.

Outside your car, the number of sensors monitoring your journey have radically increased. Toll sensors, stoplight cameras and speed traps are the most obvious, but new sensors are starting to come online like those used to track parking. At places like DFW Airport, parking lots are starting to track individual spaces, indicating which spaces are occupied and displaying that information on digital signs to make it easier to find open parking. The data is then used to show parking availability via a DFW Airport app or website. A future version could feed parking availability directly into GPS navigation systems so your car is routed directly to the most convenient open parking space. The same connected app should also remind you where your car is when you get back from a trip. Unlike in-car sensors, all of these external monitoring systems are effective regardless of the age or connectedness of a car.

Connected systems and sensors—both internal and external to a vehicle—are essential as autonomous cars begin to take to the roads. The success and safety of autonomous cars is one of the "killer features" for applying connected intelligence to travel. Lives are at stake—those of passengers, pedestrians, and riders in surrounding vehicles. But a large part of the push towards autonomous vehicles is the potential to save thousands of lives that are lost every year to human error. There is an existing human cost and the hope is autonomous cars will prove to be safer and more efficient. The possible rewards of automation are astounding, but so are the risks if the technology is rushed.

RE-SENSING, REFINEMENT AND CONTEXT

The chief end of connected intelligence isn't simply automation, but a feedback loop of re-sensing and refinement, using connected sensors to evaluate the success of actions to continually improve the system. This is crucial if machines are to "learn" in the same way humans learn—through trial and error. We assess all available data, move forward based on analysis of the data, and reevaluate based on real world outcomes.

For instance, if the Nest thermostat adjusts the temperature down, then you adjust it back up, it should eventually have enough data to predict when—and to what degree—to adjust the temperature. However, a connected thermostat's predictions will always be limited by the amount of context—the breadth of data—provided to it.

For systems to continue to improve, they need to connect to one another to provide integrated context—subject to personal approval and privacy concerns. For instance, if the thermostat has

a live feed from your smartwatch to know you just went for a six mile run in 100 degree weather, it could learn to preemptively lower the thermostat every time you go for a run on a hot day. Similarly, if it connected to your car's GPS, it could sense when you were nearing home and automatically turn off "away" functionality to make sure the temperature was optimized for your arrival.

Beyond just home, your thermostat (or the broader system of software your thermostat is a part of) could distribute your preferences and behaviors to places you visit on the road. The connected thermostat in your hotel room should know how best to prepare for your comfort. Similarly, the lighting preferences in your smart home could also be shared with the hotel, along with music, film, coffee and meal preferences. There is tremendous room for systems to share information to make comfort and personalization seamless across travel spaces.

Re-sensing and refinement are a part of all connected intelligence, and the more data points—and the broader the data points—the more sophisticated the intelligence can be and the more refined the predictions will become over time.

2017 & BEYOND

Barriers are dissolving in a virtual tsunami of sensor data as we move towards having every electric object connected to the Internet. Though we're still several years away from having a robust understanding of how this degree of information will change how we conduct business.

Companies run the risk of drowning in data if they are unable to turn data into insights to drive process change. This is where connected intelligence comes in—the automation necessary to help turn data into action.

For 2017, businesses need to be assessing what they can know and what they might like to know—almost anything can be measured. And then start looking for ways to understand how proprietary data interacts with and transforms other domains, creating efficiencies for the business, for the industry and for consumers. And because connected intelligence is inherently designed to drive continual process improvement, businesses who get an early start have the potential to quickly outstrip their peers.

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Megatrend

CONVERSATIONAL INTERFACES

From punch cards to touchscreens, interacting with digital devices has always required a learning curve to accomplish a goal — whether trying to record a TV show, set the time on a microwave, or book a flight on a smartphone. Conversational interfaces aspire to flatten the learning curve by mimicking conversation with a human being, using voice and text to interact with digital devices, from your smartphone to your car to your coffeemaker.

All conversational interfaces are inherently relational interfaces. Done well, conversational interfaces can build trust, increase connectedness, and lower barriers to accessing new systems and technologies, all while increasing operational efficiencies. Done poorly, conversational interfaces can frustrate people, fragment systems and impede adoption. For businesses, it's vital to understand conversational interfaces, know where they will be most effective, and plan how to implement them well for your specific audiences, in travel and beyond.

TECH DRIVING CONVERSATIONAL INTERFACES

At the heart of conversational interfaces are radical advances in natural language processing (NLP)—the ability of a computer to recognize both the words and the intention of a conversation—and in artificial intelligence (AI)—the ability of a computer to simulate intelligent behavior. When integrated, the two technologies make it possible for a computer to understand casual, conversational language and to respond with contextually relevant information.

Of course, NLP and AI aren't the only factors, they are just the most notable, and each capability is based on a host of other related technologies. NLP has been accelerated by big data sets with virtually infinite samples of natural language that serve to train voice recognition systems to be increasingly seamless in their ability to understand the literal words being spoken. As a result of having everything connected, these huge sample sets also help train AIs to understand the context and intention of words. "It's not what you say, it's what you mean;" a truism particularly relevant for conversational interfaces, and an area of continuing exploration as companies seek to understand tone, inflection, slang, sarcasm, emoji usage, etc.—the nuances of language beyond just the words.

There is an arms race among the world's leading technology companies to improve proprietary NLP and AI engines faster than their competitors, and the fierce competition is driving advancement. Amazon Alexa, Apple Siri, Baidu Deep Speech 2, IBM Watson, Google Assistant, and Microsoft Cortana are among the dozens of players competing in this space.

The other primary technological driver of conversational interface adoption has been the spread of smartphones, which provide the processing power and internet connectivity for conversational interfaces to be accessed everywhere. In 2016, there are over 3 billion smartphone users worldwide, and adoption keeps increasing.[1] Every additional smartphone is another access point for a host of conversational interfaces.

RELATIONSHIPS AND TRUST

Through conversation, we establish, build and strengthen relationships. This is why a true conversational interface is different than just an answer engine or a natural language FAQ; it's an opportunity to establish and deepen trust.

Building trust involves more than just putting chatbots in a trusted space like a messaging app, it requires a seamless experience for the user. Chatbots must function as expected by the user. The goal is for the technology to disappear and for the user to forget about the interface. For this to happen, understanding intent is essential.

Knowing a user's intent is different than capturing intent in travel. In travel, "intent" = what is the purpose of a trip? (e.g. is this business or leisure, is this a honeymoon or a camping trip…) For technologists, "intent" = what is the user trying to accomplish? One of the goals of NLP is to understand not only words, but "intent" in the technologist sense of the word. If you understand intent, you

[1] https://ericsson.com/res/docs/2016/ericsson-mobility-report-2016.pdf

can provide contextually relevant responses that increase trust with the user.

And, with the trust that builds from a seamless, personalized conversational interface, we're seeing that people are more willing to share travel intent in a conversational context. When you're chatting with someone else—even a digital someone—you tend

Amazon Echo is an example of a voice interface in your home or office. You can ask questions to get information or issue commands to carry out simple tasks. The Echo can also be used as a central hub to control other connected devices. *Image: Amazon*

to include details you would never tell a search engine. The more context a conversational interface has, the more effective it can be; and the more effective it is, the most it will be trusted with voluntary context.

The line is blurring between conversations with people and with digital personalities. We naturally build relationships with things in much the same way as we do with people; this is especially true when those things have personalities, even contrived ones. It matters very little anymore if a conversation is with a person or a chatbot; what matters is that the conversation be as frictionless as possible, maximizing the opportunity to build a relationship and strengthen trust.

TYPES OF CONVERSATIONAL INTERFACES

Conversational interfaces fall into two categories based on the kind of input used: you talk to **voice based interfaces** and you type in **message based interfaces**. Most voice interfaces today are built into devices at the operating-system level, such as Amazon's Alexa, Apple's Siri, Microsoft's Cortana, etc. These voice-enabled assistants rely on natural language processing to understand a person's words and intention in order to provide an answer or craft a response.

Voice interfaces typically rely on natural language processing through one of the few big company engines, Alexa, Cortana, Watson, etc. Most message based interfaces exist as applications and function across a wide variety of platforms and operating systems. The personalities on the other end of an MBI conversation—typically

called chatbots—often utilize some of the same NLP technology as voice assistants in order to understand user input. However, MBI platforms and chatbots are far more widespread and varied than current voice interfaces.

Increasingly, people are using both voice and text as input methods based on situational convenience. For instance, it's easier to talk to while driving a car and less intrusive to text while in a meeting.

For output, conversational interfaces vary the way they respond based on the type of information being conveyed and the type of device being used. If you ask for directions to a restaurant through a strictly voice-based device like an Amazon Echo, the response has to be audible. If you ask your smart TV for directions, a visual map may make more sense. If you ask for directions through a smartphone, the response might vary—if in a car, it might default to audible directions; if walking, it might send turn-by-turn directions to your smartwatch; if stationary, it might bring up a map on your smartphone display.

Conversational interfaces will rapidly evolve in their usefulness as the underlying technologies improve, and also as they know more about each user. Personalization can be enriched by knowing a person's location, schedule, habits and preferences; their preferred social networks and digital footprint; their ecosystem of connected devices; their commuting and travel patterns; their corporate and personal travel preferences; etc. The more context a conversational interface is given, the more potential it has to offer relevant information, and to do so on the first try.

EASING ACCESS TO THE DIGITAL WORLD

Sharing ideas in natural language—signing, talking, writing—is the most intuitive way humans have of interacting with one another. It's a skill learned

CHATBOTS

Historically, if two people had a quick conversation, it was a "chat;" the term "chat" moved into the digital world when messaging platforms allowed people to trade short messages with one another in real time. With the advent of conversational interfaces, the term "chatbot" takes on the meaning of a digital personality programmed to communicate in natural language—a hybrid of "chat" and "robot" designed to use voice or text to answer questions or otherwise engage a user.

As another helpful bit of jargon, a subset of chatbots called "digital personal assistants" (DPAs), are designed to handle a growing number of functions that have typically been the purview of human assistants—tasks such as scheduling a meeting, ordering lunch, or booking a hotel room. DPAs can monitor calendars and email to initiate next steps and help simplify repetitive logistics, leaving humans free for more interesting, complex and demanding tasks.

as we grow, an integral part of culture. Part of the inherent fabric of what it means to be human.

By making language the minimum requirement for access, conversational interfaces will radically transform global utilization of digital devices. Through voice, they can not only eliminate technical know-how as a barrier to entry, they can eliminate literacy as a barrier, age as a barrier, physical handicap as a barrier, etc. The implications for adoption and utilization are staggering.[2]

[2] https://technologyreview.com/s/600766/10-breakthrough-technologies-2016-conversational-interfaces/

Google's personal assistant inside the Allo messaging app is available in a small number of languages now with more languages sure to follow.

One of the biggest challenges to travel has always been language barriers—how do we communicate across cultures. The same challenge has long been true in the digital world—it's prohibitively expensive to design content across dozens of languages. But with global business and travel increasing, it's vital to find ways to work across language barriers, and conversational interfaces may play a significant role in easing those barriers.

As NLP improves, and chatbots are connected to NLP, so too improves their ability to translate well across languages and to do so cheaply and quickly. Most of the leading AIs support multiple languages; Google has support for more than 80 languages via voice and more than 100 via text.[3] Multilingual AI makes it possible to build out conversational interfaces that can communicate with virtually any user without traditional language barriers, accelerating use, utility and adoption. Imagine being able to develop one app, one website, one chatbot, and having the same content instantly available in a native language on every smartphone in the world—it's not there yet, but we can see that future from here.

INCREASING CONNECTEDNESS

Conversational interfaces are about convenience—both for users and for companies. For companies, conversational interfaces allow creation of a single digital personality that is app agnostic, built to allow users to access the same information through any interface. This can streamline development and ease upkeep since it eliminates

[3] http://translate.google.com/about/intl/en_ALL/languages.html

the need to maintain separate applications for various mobile and desktop operating systems and platforms.

Chatbots primarily exist in messaging platforms, right alongside contacts and conversations with a user's friends and family. By existing in a trusted space, where users already are, conversational interfaces can increase utilization, trust and loyalty, strengthening a company's connections to its customers.

Increasingly, companies are building chatbots to provide merchandising, service and support to customers. This can be as simple as booking a flight, changing a fare, or upgrading a hotel room to a suite. On the more complex side, chatbots can be an extension of brand and digital marketing presences that have complicated personalities, back stories and virtual motivations that work to engage customers and potential customers, creating curiosity and goodwill towards a brand.

2017 & BEYOND

Conversational interfaces are increasingly a part of daily life, both through voice and through message based interfaces. In 2017, we'll see conversational interfaces become more refined, more capable, and more integrated into all aspects of interacting with digital devices and personalities.

As conversational interfaces continue to grow as a share of how users interact with devices, it will become increasingly important for businesses to be accessible through conversational interfaces, which will require evaluating what services make the most sense to increase customer interaction on different platforms.

When done well, conversational interfaces are a rich opportunity to build relationships, deepen trust, and streamline interactions between businesses and consumers.

FOUNDATIONAL TECHNOLOGIES

Megatrend

DIGITAL REALITIES

For decades, Hollywood has been saturating popular culture with conceptions of digital realities: entering the computer in Tron; the Holodeck in Star Trek; the fully virtual world of The Matrix; the floating digital interfaces of Minority Report and Iron Man; among countless other examples in both television and film. The groundwork laid by cinema has primed expectations for digital realities to be miraculous, mysterious and/or nefarious, depending on the portrayal.

The actual expression is more complex. Digital realities—virtual, mixed and augmented—represent a spectrum of usefulness and outcomes, and the landscape is constantly evolving, and is evolving differently in each culture, so there is no one, dominant future. The unifying themes for digital realities are excitement and curiosity—the possibilities appear limitless and close at hand—close enough we at Labs can pull out our virtual crystal ball to see a few years into the future.

SPECTRUM OF DIGITAL REALITY

Digital realities range from a thin overlay of digital content on the physical world to attempts at full immersion in a digital world. As we think about immersion, it's important to think in terms of the input we receive from our five senses: sight, hearing, touch, taste and smell. Digital realities provide computer-generated information to one or more of those sensory inputs, feeding us information that is otherwise not present in the physical world.

Virtual reality (VR) is the best known buzzword in digital reality, and is the example most often portrayed in cinema. VR attempts to fully replace the physical world with a digital world—a virtual world. Today, sensory immersion in VR is almost exclusively focused on sight and hearing; touch is a distant third. In terms of cinematic worlds, the endpoint of virtual reality would be nearest to the The Matrix, the ability to feed input from all five senses directly into the brain, with digital reality indistinguishable from physical reality. We can reassure anyone who is worried: technology today is nowhere close to emulating The Matrix. Though we know a few billionaires who believe we are living in a simulation.[1]

Augmented reality (AR) adds a layer of digital content to the physical world while still keeping the senses engaged in the physical world. AR attempts to add to—to augment—the physical world to provide a richer, more informed, more seamless experience. In cinematic terms, AR is most visible in the head-up display of The Terminator, where the visual system analyzes and displays information about the people and objects around him.

Mixed reality, a.k.a. merged reality (MR) is closely linked to AR, and the terms are often used interchangeably, but there are nuances; MR is augmented reality plus interaction—the ability to manipulate digital objects in the physical world and/or physical objects in the digital world. The digital interfaces in Minority Report and Iron Man are excellent examples of MR.

For the purposes of this report, Labs has opted to use the term AR to be inclusive of MR, since AR is a much more widely recognized term, and most of the near-term utility we see in travel is AR-based. By this time next year, we expect the growth of the MR device segment will help provide greater awareness of and clarity around these two terms.

EXPLORATION & INSPIRATION

Digital realities—virtually reality in particular—are offering visceral opportunities for travelers to explore new destinations and experiences.

Inspiration is one of the first and most robust use cases for virtual reality. Fully immersive 360-degree photos and videos are giving potential travelers a chance to see destinations in a new way, and with a higher appearance of authenticity. VR captured from

[1] http://www.bbc.com/earth/story/20160901-we-might-live-in-a-computer-program-but-it-may-not-matter

real life is quick to produce and increasingly abundant, offering a chance to see places at all scales: cities, parks, hotels, cruise ships, roller coasters, restaurants, etc. In VR, you can experience drone shots of Taj Mahal from the air, ride along on a helicopter flight through the Grand Canyon, tour the presidential suite at a five-star hotel, and peek behind-the-scenes at dinner being prepared at a Michelin-starred restaurant. These types of experiences impact travelers in the planning stages in three primary ways:

1. Inspire travelers to consider destinations they might not otherwise engage

2. Create opportunities to explore ancillary experiences both before departure and during the trip (with portable VR)

3. Provide access to experiences most people will be unable to visit physically (which offers revenue opportunities for creators and distributors of unique VR content)

A benefit of VR over other forms of inspiration is the additional feeling of authenticity. Most travelers have had the frustrating experience of arriving to a destination, perhaps a hotel or resort, and realizing the actual location bears little resemblance to the promotional photos. In VR, it's far more challenging to oversell

Many Millennials and members of Generation X will remember using the original ViewMaster as a child to look at 3-D images of their favorite cartoons and exotic locations. Reimagined in 2015, the new ViewMaster is a virtual reality headset device, featuring 360-degree views of travel destinations around the world.
Image: View-master.com

the appearance of a place because the viewer has so much additional context. In addition, travelers in a VR experience can "look around" of their own volition; this measure of control provides greater investment and confidence in the authenticity of the experience.

The Microsoft Hololens allows for digital information to be overlayed onto physical reality, as seen in this manufacturing application for Volvo Cars.
Image: Microsoft.com

We haven't yet seen data around the measurable impact of personal investment and validation in VR experiences, but based on our first-hand observations, we expect the effects to be significant.

ASSISTIVE TECHNOLOGIES

While virtual reality is helping transform inspiration and exploration ahead of travel, augmented reality is helping transform travelers' experiences as they move around in the physical world. AR can assist in their trip by providing contextually-aware information to streamline and enrich their experiences.

Augmented reality includes a range of products. Many people associate AR with head-up displays like Google Glass or Microsoft Hololens—these devices are precursors to radical future travel use-cases, but are currently only being used in niche areas. Almost all widespread use cases for augmented reality in 2017 will be on smartphones and tablets.

Augmenting reality requires the ability to sense the real world in order to add relevant information. Smartphones and tablets are already being built with an array of sensor technologies that make it increasingly easy to tie those sensor inputs into a connected web of digital content to provide relevant information as people move from place to place. The inclusion of cameras, GPS, a gyroscope and an accelerometer make it possible for developers to build applications which overlay rich visual and aural information about public transportation, landmarks, restaurant reviews, etc.

One of the most basic—and most powerful—augmented reality applications is Google Translate, which allows users to point their smartphone camera at text in over 80 languages, and have that text translated in real time. When traveling, this eases language and navigation barriers across much of the world. The outcome is close to magic.

COLLABORATIVE REALITIES

Both virtual and augmented reality are making possible new forms of collaboration—both in person and across the world. There is speculation the "killer apps" for digital realities will be social—apps that use VR and AR to increase human connectedness and interaction. One of the most outspoken champions of social VR is Facebook CEO Mark Zuckerberg, who has an enormous vested interest in seeing that future come about.[2]

In virtual reality, video platforms are streamlining synchronized viewing so people anywhere can watch the same VR content at the same time, while being able to communicate in real time as part of a shared experience. The ability to synchronize content is essential for VR to succeed because in every near-term iteration of VR, the technology itself is immediately isolating. By entering VR you block out the physical world, and you do so alone—one headset per person means that there is no simple physical way to share a VR experience. Social interaction in VR has to be virtual.

There is a growing trend towards live-streaming sports and cultural performances in VR. In some cases, like the streaming from the Rio Olympics or the presidential primary debates, it's a one-way feed. Online platforms like High Fidelity offer a shared two-way experience where, as you attend real world events in VR, you can interact with performers and other attendees. VR is also making possible virtual meeting spaces with individual participants arriving as "avatars"—digital representatives of themselves. Within virtual spaces, you can draw on virtual white boards (by moving a real world controller with your physical hands), interact with 3-D models, and even sketch in three-dimensions, engaging in creative spaces with other people. Multiplayer video games are also a powerful and exciting use of social VR, but what that community will look like and the degree of adoption has yet to be seen.

Using collaboration in a travel context, you could imagine touring a hotel before booking and engaging in real time with a VR concierge in to show you around and answer any questions. Or joining with friends and family from across the country to quickly tour virtual museums or landmarks together as a way of expediting consensus around trip planning. School groups are starting to go on virtual field trips together, often as a way of augmenting real world travel: for instance, they could enter VR to watch a reenactment of the battle of Gettysburg before visiting the real world battlefield.

Virtual reality still has a long way to go as it works to increase collaboration. There is virtually no risk of VR replacing physical experiences anytime soon, but there is a lot of interesting space to explore around collaboration in a shared virtual environment.

[2] http://www.webpronews.com/zuckerberg-virtual-reality-will-social-platform-ever-2016-08/

With augmented reality, collaboration can be both in person and across distance because AR doesn't isolate us from the real world—if anything, it enhances the real world.

- Augmented reality audio tours are a great example of collaboration—instead of a group trying to synchronize rented headsets or hit "play" on a podcast tour at the same time, audio AR can do the work of synchronization for you, ensuring everyone is on the same word at the same time, increasing the sense of shared tour experiences.

- With head-up displays like the Microsoft Hololens, several people can see and engage with the same 3-D map, building rendering, or other renderings as they discuss strategy or design. And they can do so from the same room or from around the world.

- Head-up displays also provide the opportunity for managers and subject experts to collaborate with colleagues in the field. There are use cases popping up throughout the transportation space, usually involving maintenance and repair of everything from plane engines to subway rails. With head-up AR displays, workers can see repair schematics and videos while keeping their hands free, and can talk or text in real-time with other workers, and the AR devices can broadcast real-time video back to other people to allow experts to collaborate and advise on repair. This allows one particularly knowledgeable technician to oversee and assist a whole team in real time, without regard to geography.

Real time collaboration for repair and maintenance is poised to allow greater expertise to be deployed more broadly with existing resources, increasing efficiency and safety across the board.

2017 & BEYOND

After years as a mix of science fiction, vaporware and product failures, 2016 was the year the technologies underlying digital realities finally became physical realities. And now that the technology is finding its feet, it's showing no signs of slowing down.

Technological advances expected to both AR and VR platforms in 2017 will continue to drive consumer adoption, while giving those companies willing to take a chance on these new technologies the potential for increased operational efficiencies.

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TECHNOLOGIES

*Six techs you need
to know for 2017*

Technology

AUGMENTED REALITY

In concept, augmented reality is not new; it's the same service tour guides have been providing for years. A tour guide adds a layer of real-time information to the physical world you're experiencing. The guide doesn't block out or replace the physical world, it simply adds to it.

In execution, this new breed of augmented reality technology has a far broader range of implementations and capabilities than any tour guide. It adds a sensory layer in real time to the physical world and can be built in many different forms, depending on what senses it is augmenting. In practice, AR can be omniscient (to the limits of knowledge connected to the Web) and omnipresent (anywhere within range of a GPS or wireless data signal).

Image: Microsoft.com

> ## "WE BELIEVE AUGMENTED REALITY IS GOING TO BE A BIG PART OF THE IN-GAME EXPERIENCE.
>
> *– Robert Kraft, New England Patriots*

UBIQUITOUS AR

Augmented reality, especially in its simplest forms, has become so commonplace we hardly recognize it. In weather forecasts, when digital maps and animations appear to respond to the weatherman's gestures and proclamations, that's AR. In sports, the 1st–and-10 line shown on the field during U.S. football broadcasts has become an iconic example of AR. In both cases, digital content is overlaid in near real-time onto live video, adding information and context to the experience.

The cameras, 3-D models and computer systems that make the weather and football AR examples possible were commercialized far before similar technologies were available to consumers. But the rise of smartphones has put the processing power, cameras and sensors necessary for sophisticated AR in the palm of your hand. The ubiquity and capabilities of smartphones makes them the center of most of the consumer-focused AR under way or on the immediate horizon.

Also in football, the New England Patriots are rolling out in-person AR in stadiums by creating apps for smartphones and for head-up displays.[1] The apps overlay first down information and details about each player on the field in real time for fans. This helps enrich the in-person fan experience with some of the same information previously provided only through televised viewing. The in-person AR experience has a significant advantage over a broadcast for more reasons than just beer and brats. The AR user has control

[1] http://searchcio.techtarget.com/feature/Patriots-digital-transformation-strategy-taps-mobile-social-AR

over what, when and how much information they take in through AR, instead of being at the mercy of whatever a broadcaster decides to show. The ability of the user to drive the experience is key to many advantages of smartphone-based augmented reality.

SMARTPHONE AR

The Sky Map app, launched in 2009, uses a smartphone's GPS, accelerometer and compass to turn the screen into a "window" showing constellations in the night sky. You can use the app to see constellations in any direction, even seeing "through" the earth by pointing the phone at the ground. Augmented stargazing was a first taste of smartphone AR for many people—a neat demonstration, but it didn't change the world.

In 2015, Google's Translate app was upgraded to include image translation. Using a smartphone's camera as a live video feed to the screen, the app translates text between dozens of languages in near real time—a transformative application for international travel. Point your phone at any text and in seconds, the foreign text vanishes and the words appear in your native language. Magic. And still one of the most powerful examples of AR's ability to change the way we interact with the world.

Synchronizing live video with a smartphones' other sensors and GPS location is being used for a wide range of AR applications. In July of 2016, Pokemon Go burst onto the scene with all the grace and subtlety of a rampaging tyranitar (Pokemon's equivalent to Godzilla). It claimed to be a breakout "augmented reality game" by virtue of its live camera feature. Ultimately, calling Pokemon Go's camera feature "augmented reality" causes more confusion than clarity. The game's attempt at AR is simplistic, overlaying digital monsters onto live feeds of surrounding terrain, but lacking any way for the real world context to influence the digital content. The live video in Pokemon Go is a veneer of augmented reality, but not the real thing.

The live camera feature of Pokemon Go isn't groundbreaking AR, but the idea of virtual goods mapping to real world spaces is shifting consumer and traveler behavior.

More sophisticated AR apps use a smartphone's sensors to add context directly influenced by the real world. For instance, Departures Switzerland allows you to aim a smartphone at a nearby public transportation station to see all arrival and departure information in real time, including delays and platform changes. Yelp's Monocle feature allows users to pan across the physical world to see nearby attractions and dining options, along with reviews and contact information. Star Walk is a stargazing app with a time machine feature allowing you to see what a particular part of the sky would look like in the past or in the future. Other apps have been built out to allow users to overlay time-based content onto real world objects, for instance, seeing what a building or a city skyline looked like in the past, or will look like based on approved architectural plans. Another app puts flesh onto fossilized bones in a museum exhibit.

Not limited strictly to visual systems, smartphone apps can overlay location-aware audio content through utilizing a combination of GPS and/or location beacons. Companies like Detour and Geotourist are creating indoor and outdoor content for city tours and museum visits. The benefit is you can get information about the place you are standing when and how it is most convenient to you—you set your own pace and your own tour rather than following an existing script. Additionally, this technology should make it easier to navigate cities without having to keep looking at a phone screen; if all the content you need is in your ear, you are able to keep more of your senses trained on and engaged in your immediate environment.

AR AFFECTING PHYSICAL BEHAVIOR

It's easy to pick on Pokemon Go for its weak use of live video to simulate situational AR, but the game does one thing really well: it drives physical behavior.

DIGITAL FIRST GENERATIONS

Pokemon Go and Foursquare are early glimpses of how location-based virtual content will drive future behavior in the physical world. As people's priorities have become increasingly digital—particularly for members of the Millennial and Z generations—the convenience of digital objects is starting to shift the value equation against the desire to own certain kinds of physical objects. Books are icons on an e-reader or smartphone; music and videos are streaming playlists; photos and artwork are files in the cloud. Travel souvenirs may go much the same way—why bring back a clock or a rug from overseas you may tire of or break when instead you can bring back a rare Pokemon that will live in the cloud forever… and won't take up space in your carry-on.

The game maps a player's presence on a digital map corresponding to the physical world. Key in-game locations correlate to places and objects in the physical world. And with the popularity of the game, objects that exist solely in the virtual world are affecting commerce in the real world, including in travel and hospitality.

Through the use of in-game "lures" to draw Pokemon to a particular location, shops and restaurants are drawing patrons through

Vuzix has a line of headsets that enable AR applications for industrial and medical contexts. Having hands free schematics and repair information can help streamline jobs like maintenance and repair of aircraft.
Image: Vuzix.com

their doors. Areas where Pokemon congregate in the virtual world draw people in the physical world to catch those digital creatures. Currently, high density areas for Pokemon tend to correspond with tourist attractions because of how the game's algorithms were established. But there is no reason this has to be the case—the power of location-based virtual commerce could theoretically be used to help drive people anywhere if the location based digital tchotchkes are desirable enough.

In terms of potential to create value, digital tchotchkes are virtually free to produce in infinite quantities. This was social network Foursquare's reason to exist—to gamify diversity and devotion in the places a user visited in the physical world. Foursquare added perceived value to visiting and patronizing particular locations through the bestowal of digital badges and honors and created end user competition, driving demand to visit particular locations.

There is every reason for travel providers to look for opportunities to create similar kinds of experiences—awards for visiting a breadth of hotels within a single chain; digital scavenger hunts for kids at resorts, in airports or on cruise ships; potential partnerships with a brand like Pokemon to create a creature or tchotchke exclusive to a particular branded location(s).

OPERATIONAL AR

We're seeing slow movement in operational AR compared to the broader consumer-focused uses for AR, particularly in smartphone

applications. Overall, head-up displays (HUDs) are making the most progress, followed closely by auditory AR.

Auditory AR isn't widely implemented operationally, but it can be used for one-way alerts, hands free task lists, audio walking directions for maps (or for indoor locations), or—someday soon—even real-time audio translation. All of these auditory tasks can be driven by a smartphone, but there is the potential for some to be independent of smartphones, depending on the applications and environment.

As a head-up display, Google Glass received a lot of media interest when it was released but struggled to find an audience and was eventually discontinued. However, despite early challenges, HUDs are beginning to find operational use cases, and are starting to succeed within specific market niches, notably in construction, maintenance, repair and training.

- The Daqri smart helmet is a hardhat with a HUD and additional sensors, including a thermal imaging sensor. This gives wearers the superpower of being able to "see" heat in a real-time overlay on their HUDs, along with other sensory data about the world around them, improving safety and efficiency on the job.[2]
- Japan Airlines is using the Microsoft Hololens to project a virtual cockpit to help more efficiently train new pilots.[3]
- Various Vuzix headsets, are being used by maintenance workers in places like the Boston subway system, where real-time camera feeds back to dispatchers and senior technicians, along with

head-up schematics and repair diagrams. This allows workers to be better informed and in closer contact with colleagues while working to complete repair tasks.[4]

- Similar use cases exist for distributed expertise in repair of all manner of transportation devices, from cars to jet engines. And the more complex the system, the greater the advantages of AR HUDs as tools to create efficiency and improve outcomes.
- Health care is working towards a similar model for complex cases and surgeries, allowing medical experts and top surgeons to consult, oversee, or even take remote control of surgical devices during complex procedures. This is particularly useful in life-or-death cases in distant geographies where it's not safe to move a patient to a center of expertise.
- AR has the potential to flatten access to world-class expertise and experience, regardless of industry or geography.

The state-of-the-art current technology for HUD AR is led by two devices, the Meta 2 and the Microsoft Hololens, each taking a slightly different approach to the same goal: the promise of all the screens (and things), all the time, anywhere... all without losing touch with the physical world.

The operational efficiencies start to seem obvious when you experience either device—screens and 3-D objects float in front of you and can be moved around and arranged within a merged reality space. The device scans and recognizes your physical environment,

[2] http://www.businessinsider.com/what-is-the-daqri-smart-helmet-2016-4
[3] https://enterprise.microsoft.com/en-us/industries/hospitality-and-transportation/japan-airlines-hololens/
[4] https://technologyreview.com/s/602188/commuter-rail-workers-in-boston-are-about-to-get-bionic-eyes/

and it forces virtual objects to obey the physical limitations of the space you are in. The opportunity to arrange a dozen monitors or TVs, and leave them hanging wherever they are most convenient in physical space, and to seamlessly weave in 3-D models (either for functionality or aesthetics) is pretty compelling. In theory, it's the foreshadowing of a future were we've relinquished our smartphones in favor of inconspicuous, wearable HUDs.

The promise of all the displays—all the data—all the time is particularly meaningful for applications like flight operation centers, where having a wealth of maps and supporting data all visible with a shift of your eyes would increase operational efficiencies. Or it might be just as useful during the Olympics to ensure you can simultaneously watch all concurrent events.

Right now, the more ambitious HUDs are limited in their potential for broad adoption by their interfaces. You can use a keyboard or a mouse, but those seem to defeat the point of a futuristic interface, and trying to keep track of a mouse pointer within a 360-degree environment can be challenging. Gestural interfaces are relatively frustrating at this point—hand tracking cameras are not detailed enough to make gestural interaction quick or intuitive, and—from an outside perspective—AR HUD wearers look pretty strange waving their arms around in midair. Voice commands are a secondary control mechanism, but suffer from the same limitations of all current voice interfaces (they don't always understand what you want them to do; they aren't ideal for public spaces). It's also really challenging to manipulate objects in 3-D via voice commands.

Voice in AR HUDs at this point is primarily useful for things like opening and closing menus, calling up applications or switching tasks—it's not capable of being a primary user interface. Improved hand tracking and more advanced gestural interfaces will be needed to accelerate AR HUD adoption.

2017 & BEYOND

With next-generation augmented reality HUDs coming in 2017, marketing will extend beyond just developers to businesses and end users. Unless something significant and unexpected changes, the displays will need to be lighter, cheaper and have longer battery life than current offerings in order to be seriously considered by consumers. Even then, HUDs will primarily be useful as compact, extended desktops or in place of multiple-monitors, connected wirelessly to a traditional keyboard (and possibly mouse) for operational work. Not ideal, but there still may be some worthwhile efficiencies, depending on the software built out for HUDs. Right now, a limited software ecosystem reinforces the view of AR HUDs being used primarily as compact displays for existing 2D software offerings, at least until content offerings mature.

Microsoft is working to amplify content offerings for AR with the launch of Windows 10 "Creators Edition" expected in spring of 2017. The platform is being targeted towards AR and VR gaming and productivity applications. It will allow users to scan real-world objects as 3-D models using smartphones, then edit and engage with those objects as AR holograms or VR models. Social functions are

expected to include integration with messaging to make it possible to carry out many common communications tasks without having to leave AR or VR.[5]

The most mysterious player in the HUD AR space is a company called Magic Leap, headquartered in Florida. It has raised over $1.4 billion in capital and at the time of this writing has not yet shown a physical product to the public. Occasional videos showing the view through its purported AR headset are impressive, and the entire industry is anxious to see what the first actual product coming out of Magic Leap will look like.

The other key player likely to emerge from the shadows in 2017 is Apple. In CEO Tim Cook's few public comments on the subject, he's indicated his bullishness on AR as being far more exciting than VR, and it's where Labs expects Apple to devote the bulk of its' digital reality efforts in the year(s) ahead.[6]

The other relevant action in 2016 that will affect the long term horizon for AR was a "land rush" for patents around digital contact lenses. Major players like Google, Samsung and Sony filed patents to protect any and every idea their internal think tanks have been able to generate around in-eye displays. We're still many years away from being able to miniaturize full AR HUDs into a set of contact lenses (power appears likely to be the biggest challenge). However, seeing the direction major companies believe we're going adds tremendous excitement about the long-term prospects for augmented reality to become part of the fabric of everyday life.

[5] http://theverge.com/2016/10/26/13379988/microsoft-windows-10-update-new-features-announced
[6] http://mashable.com/2016/10/03/tim-cook-augmented-reality/

AUGMENTED REALITY
TAKEAWAYS FOR 2017

Sabre Labs identifies the travel industry segments that will see the greatest impact from Augmented Reality. Here are specific ideas to keep in mind as you strategize for the year ahead.

FOR AIRLINES

- Most of the airline use cases for augmented reality require head-up displays (HUDs). HUDs are beginning to be used for pilot training. AR allows a pilot to practice in a simulated cockpit while still being able to see their hands, helping to learn placement of controls and reinforce muscle memory.

- HUDs are being used in maintenance and repair. Technicians can have hands-free access to schematics, repair instructions and videos. The HUD can also send photos or stream real time video. This allows your most experienced staff members to remotely oversee work in progress and offer advice via voice or messaging.

- As HUDs become more advanced, they will offer flight operations' staff the chance to simultaneously display a virtually unlimited amount of information, with a mix of 2D windows and 3-D models. It's important to start thinking about what information they will want accessible once traditional screen limitations aren't a barrier. Planning now will help make effective, optimized HUD operations software a reality.

FOR HOTELIERS

- Smartphone-based augmented reality has already started changing the hotel landscape with location-specific digital content, like Pokemon Go. We expect more platforms encouraging the creation of digital content with real world locations—everything from digital sculptures and art events to scavenger hunts. There are a wealth of opportunities for hotel chains to create branded content to drive traffic to specific properties or places within a property. It's also a way to build something new for relatively low cost, which may be particularly attractive in areas with high real estate values.

- A combination of auditory AR and/or head-up displays may offer efficiencies for hotel staff. The ability to receive hands free alerts and reminders, along with real time language translation are key opportunities. AR technologies could also expedite training of new staff for roles like room cleaning—having a hands free checklist of tasks can help ensure consistent, comprehensive results.

AUGMENTED REALITY
TAKEAWAYS FOR 2017 – CONTINUED

FOR TRAVELERS

- Smartphones have helped advance AR more quickly for travelers than for other segments of the travel industry. Real time translation of signage and other text based content has been one of the most powerful tools for international travelers, and real time translation of voice is not far behind.

- AR navigation apps are making it easier to find locations and attractions in cities. We expect an increase in apps and games featuring location-specific digital content that can only be accessed through AR. This new digital content will provide travelers another layer of engagement and information throughout their journeys. This will include digital art installations, scavenger hunts, archived collections of media to add context to historic locations, and countless other possibilities.

Technology

❙ AUTOMATION

As individuals and as businesses, we always look for ways to get more from less—more time, more energy; less attention, less resources. Automation uses control systems to carry out actions with little to no need of human intervention, creating the efficiencies necessary to do more with less and—in many cases—to do jobs beyond humans' physical or intellectual capacity.

Manufacturing is an easy place to see automation in action: an intricate choreography of custom machinery moving at breakneck speeds, producing anything—everything—from cars to clothing to crayons. But manufacturing is by no means the only domain for automation. Increasingly, the most significant advances in automation are invisible, comprised of digital software running behind the scenes. Sophisticated software bots are automating digital tasks in ways analogous to how robots have been used to automate manufacturing.

Image: Savioke.com

REQUIREMENTS FOR AUTOMATION

Most automation is orders of magnitude more complex than a coffee maker, but the basic principles and processes are similar, so it serves as a good example of an automated system. In a simple consumer device like a Keurig or Nespresso automatic, single-cup coffee maker:

1. The coffee maker has limited sensors, but can usually detect the presence of a coffee pod, a coffee cup, and water in a reservoir, and can sense when the machine is hot enough to heat water to brewing temperature
2. Internal software gathers data from the sensors
3. The software confirms when the sensors indicate all the conditions are in place to brew coffee
4. The system takes action, physically brewing a cup of coffee
5. Some brewing systems require user authorization before taking action, asking for a decision about cup-size or brew-strength, though this is not a requirement; other systems assume authorization at initiation and are then limited to making a preset cup of coffee

No automation—coffee or otherwise—can happen in isolation. All digital automation needs the same five basic elements, as evidenced in our coffee example:

1. Sensors to measure the world
2. Data harvesting to gather sensor measurements
3. Artificial intelligence or some other kind of decision-making algorithm to sift the data
4. The ability to act—often to physically change the world in some way
5. The authorization to act on someone's behalf

If an automated system is lacking any of these pieces it is constrained in some way, and is not as efficient or as autonomous as it could be. In many cases, automated systems are intentionally limited, requiring human intervention at key branching points, such as the serving-size decision for coffee.

Automation in manufacturing is far ahead of automation for consumers, though the consumer landscape is gaining ground. Our homes are full of small-scale, mostly disconnected examples of automation, from thermostats to lawn sprinklers to cleaning robots like the Roomba. Increasingly, new versions of these devices are being connected to the Internet and to one another. As these devices connect, their potential for automation and efficiency increases, essentially inciting chain-reactions where one automated process kicks off another automated process, increasing the total amount of work accomplished without the need for human intervention.

For instance, in a connected system, the biometric sensors in your smartwatch can monitor you in your sleep, sending signals to a connected thermostat to adjust the temperature to help you sleep better, and then sending a signal to your connected coffeemaker when you start waking up so your first cup will be ready when your feet hit the floor. Similarly, your GPS-enabled smartphone can know where you are and communicate with your cleaning robot so it only vacuums while you're away, or can let your hotel know when you're out of the room so housekeeping never interrupts your routine. *For more on this concept, read about the Connected Intelligence megatrend on page 10.*

THE RISE OF ROBOTS

Hollywood and science fiction writers have fed our imaginations for years about what robots will look like and the risks and benefits they pose to humanity. But how do you define "robot?" Two key traits: 1) robots have the ability to complete a task or scope of tasks with a high degree of autonomy and 2) robots have a physical presence. Physical presence is important—it's what distinguishes "robots" from "bots." Bots lack physical presence, existing only as pieces of software which automate tasks in a digital context. But once set in motion, both robots and bots can complete a task without further human intervention.

A common misconception about robots is the idea they will look like humans (or even like animals); robots are being designed with function over form, so function dictates form. The Savioke Relay delivering coffee to your hotel room, the Roomba cleaning your floor, and the mechanical arm packing boxes in a warehouse are all robots, though none of them look human.

iRobot's Roomba 980 vacuuming robot uses an array of sensors to navigate an area, ensuring it cleans every part of the space it is able to reach.
Image: iRobot.com

Humans are highly adaptable and able to perform a virtually infinite range of tasks, but the form that make humans adaptable also make us hard to mimic with machinery. We are still many years away from robots with the adaptability of human musculature and sensation.

ANTHROPOMORPHIC ROBOTS

Most robots designed to look like humans or animals are designed to interact with humans, and their form helps strengthen a user's emotional connection with the machine. We see this in robot pets like Sony's Aibo or humanoid helper robots like Honda's Asimo.

In the hospitality space, we're seeing anthropomorphic robots most often in places like hotel check-in or information services. The five-star Henn-na Hotel in Japan made global headlines when it opened in 2015 with a robot dinosaur and robot humanoids staffing the reception desk; the hotel is part of an amusement park in Nagasaki. In North America, the Hilton hotel group recently introduced Connie, a humanoid robot receptionist, in collaboration with IBM's Watson artificial intelligence technology.

Current hotel reception robots do little more than check guests in and offer information about local attractions—functions equally possible through an app or a message bot on an iPad. However, limitations aside, check-in bots are still useful—they can produce efficiencies by freeing hotel staff to be away from the check-in desk; most check-in bots can communicate in a variety of languages; and perhaps most importantly for now, they provide novelty, driving visibility and traveler engagement.

A trade-off of humans being optimized for adaptability is that they are not optimized for any one physical task. Almost any creature in the animal kingdom is "better" than humans in some respect: cheetahs are incredible short-distance sprinters; owls have amazing night vision; ants can lift many times their body weight, etc.

For the time being, robots are being designed to fill narrow niches, but can be exceptional in their specific tasks. Robots tend to be highly specialized, and they don't have to complete tasks in the same way that a human being might. Technically, your washing machine is a robot: it's a physical object full of sensors running software to achieve a tangible outcome without requiring additional input, and in the end, it cleans your clothes. A washing machine could look human if we wanted to design it that way. It could have a humanoid body and could scrub clothes on a washboard in a mop sink, but as a humanoid it would be highly inefficient. A non-human form is often more efficient for most tasks.

A limitation of most robots is their lack of adaptability—they often can't function unless they are in spaces designed around their specific needs. Robots and their environments are often designed to complement one another. Most factories are robot-first in their design, and have been for years. Laundry rooms are the first "robot-first" rooms in most homes—the rooms would look a lot different if they were designed for humans and robots to wash clothes side-by-side. Over time, a growing number of spaces will adapt to become more robot-first in their design and layout, to optimize specialization for certain tasks.

For the foreseeable future, robots will continue to be designed to be efficient for their intended functions, even if that limits their adaptability, resulting in them taking countless forms. And many everyday robots will be virtually invisible (like your washing machine), but their invisibility doesn't mean they aren't robots, and a key part of automated everyday life.

ROBOTS ON THE MOVE

Moving objects from one place to another—whether packages, parts or people—is a set of tasks where robots are particularly effective. Amazon kicked-off what amounted to a robotic arms race in 2012 when it bought Kiva, the leading company building robots to help move objects around a warehouse. After the purchase, Amazon monopolized Kiva robots to ensure a competitive advantage. It took several years for other companies to bring products to market to fill the gap left by Kiva, but we're now seeing robot automation and competition across warehouse spaces. Some of these robots are ground based and some are quadcopters (often referred to as "drones"), the quadcopters tasked with moving smaller objects without regard to terrain. Robots are also being tested for tasks like mail delivery, home grocery delivery and pizza delivery.

The travel industry is exploring use of robots to transport traveler luggage at airports and hotels; the robots read QR codes or baggage tags and deliver bags to their destination. Robots are also delivering drinks and food to hotel rooms.[1] A robot at the Dusseldorf airport serves as an automated valet, treating your entire

[1] http://www.latimes.com/business/la-fi-hotel-robots-20160207-story.html

car as a package by parking it for you, then bringing it to you when you return.[2]

Of course, in the near future, you won't need a robot to park your car—your car will park itself. The same sensor technologies helping deliver luggage and move packages around warehouses are giving rise to fully autonomous vehicles, and will transform most areas
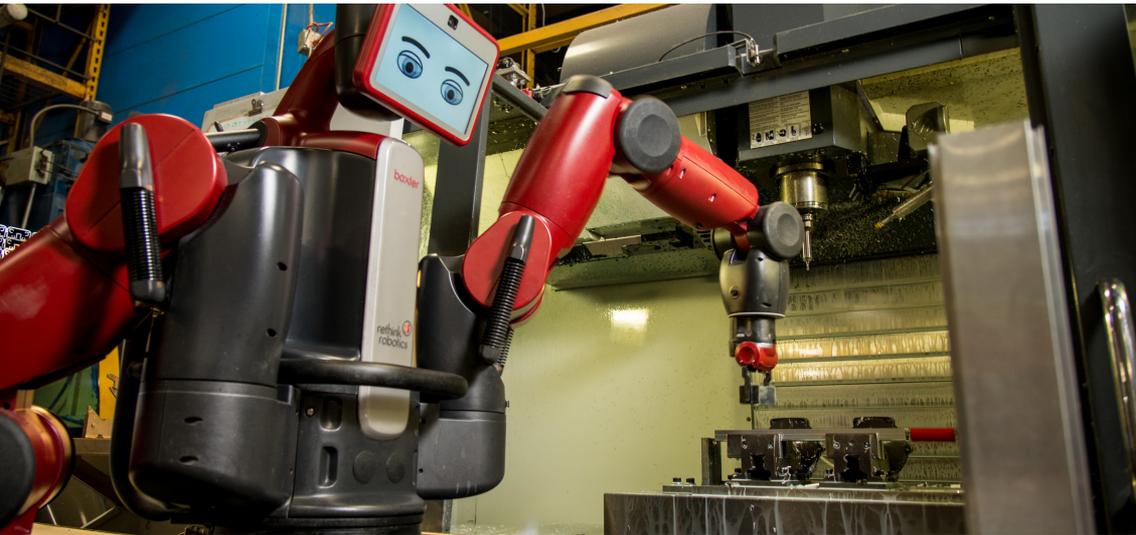
[2] http://edition.cnn.com/2015/01/30/tech/mci-robot-parking-valet/

Rethink Robotics' Baxter cobot is designed explicitly to work alongside humans in a manufacturing environment.
Image: RethinkRobotics.com

of transportation ("driverless cars" being one of the most visible use cases). Autonomous vehicles fit neatly inside our definition for robots—complex machines full of sensors designed to achieve a task without need for user engagement. Once a destination is set, it's up to the vehicle to communicate with a network of sensors to find the quickest route, navigate traffic and obey relevant driving laws all to get its passenger(s) to their destination(s). The entirety of the task is automated and, if the vehicle is appropriately connected to your calendar, email, etc., you may not need to provide a destination—the vehicle should know where you plan to go before you ask.

More and more we are seeing that if something needs to be moved from one place to another—in travel or any other industry—robots are being designed to assist with those tasks.

COLLABORATIVE ROBOTS

An interesting development in the past few years has been the rise of "collaborative robots" or "cobots," designed to be roughly human in scale and mimicking as closely as possible the functionality of human arms and hands. Cobots are most widely in use in assembly line and manufacturing settings where they work side-by-side, collaboratively with humans.

Cobots have been made possible largely through advances in sensor technology which allow them to "see" and respond to the environment, making sure they are safe to interact with humans without causing potential harm. Sensor advancement also improves the cobots' ability to adapt to different settings and tasks.

Cobots are designed to be easy to move around, adaptable to a wide variety of tasks, and intuitive to train, learning new tasks by example rather than by coding. This makes it possible for virtually anyone to train a cobot and automate repetitive tasks, freeing humans up for more mentally engaging work.

Common cobots include Rethink Robotics' Sawyer and Baxter cobots and ABB Robotics' YuMi. In terms of sophistication they can do anything from counting and bagging products, to loading and unloading inventory, to folding paper airplanes.

In hospitality, cobot bartenders are on the rise, including on some Royal Caribbean ships, where they mix drinks (and track guest consumption), and work alongside human bartenders. Restaurant kitchens are also starting to see cobots automating certain repetitive tasks, acting as sous chefs and line cooks.

Cobots are being used to automate an increasing scope of human-like activities and improve efficiency. Research so far suggests human and cobot teams can be more effective than either humans or robots alone.[3]

INVISIBLE AUTOMATION

Examples of automation we've discussed so far have resulted in physical outcomes—a cup of coffee made, a floor vacuumed, a package moved—but increasingly, automation is being applied to strictly digital domains, often in analyzing large data sets and making recommendations for action, or taking action if authorized. These automated processes, taking the form of bots, are becoming ubiquitous in many areas of computing. Bots fill roles in the digital world in much the same way robots and cobots fill roles in the physical
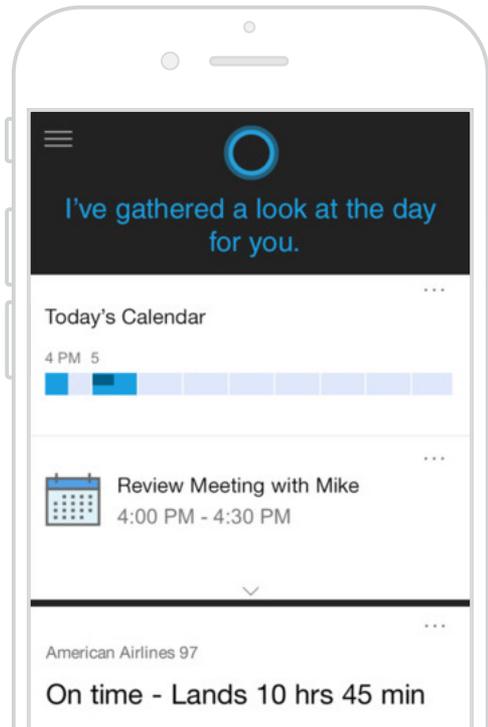
Microsoft's Cortana app acts as a digital assistant that can retrieve information and automate tasks. *Image: Microsoft.com*

[3] http://spectrum.ieee.org/automaton/robotics/industrial-robots/
collaborative-robots-innovation-growth-driver

world—they excel at repetitive tasks and in moving chunks of information from one domain to another.
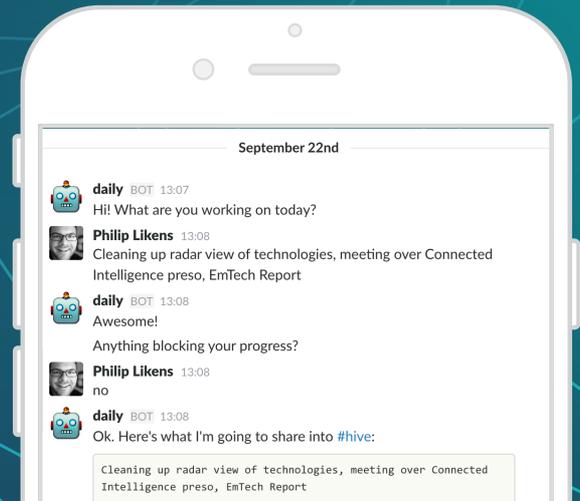
In the travel and technology industry, one of the key ways we see this automation playing out is in the rise of bots that serve as digital personal agents, designed to act on behalf of a traveler, responding to passive or active inputs. For instance, when you receive an event registration confirmation via email, a bot could see the confirmation and proactively search for travel reservations based on the dates and times for the event, suggesting or even booking air, hotel, and ground transportation, depending on the level of authorization you've specified. Currently, automation is useful for simple requests and frequently recurring scenarios, but human touch is still essential for more complex tasks and higher value interactions.

As previously discussed, the element of authorization or "agency"—the ability to act on someone's behalf—is essential for full automation. There are countless examples of digital assistants right now, including high profile artificial intelligence systems like Alexa, Siri, Google Assistant and Cortana, but for the time being, these systems primarily focus on providing informational responses to user input or questions, or carrying out minor tasks like setting an alarm, playing music or pulling up a map. These assistants are moving towards greater agency—greater autonomy—but it's not yet core to the way these systems are designed to be used. *For more information on distinctives of these digital assistants, refer to the *

We also see bots automating tasks like supply tracking and ordering—sensors can tell when products are used, removed or expired and compare usage to projected or historical demand, and reorder accordingly. Bots can also automate tasks like updating pricing and initiating product promotions, based on

SLACK BOTS

One ecosystem in which bots are thriving is Slack, an integrated messaging platform for teams. There are hundreds of publicly available bots in Slack designed to automate a wide range of tasks, such as scheduling meetings, ordering lunch, tracking expenses or providing weather or traffic updates. In Sabre Labs, two bots we use daily are a custom schedule tracking bot, which engages team members about their projects and shares status updates and barriers with the team, and giphy, a bot which uses keywords as inspiration to find and share animated .gif images, add humoring to some of our discussions.

September 22nd

daily BOT 13:07
Hi! What are you working on today?

Philip Likens 13:08
Cleaning up radar view of technologies, meeting over Connected Intelligence preso, EmTech Report

daily BOT 13:08
Awesome!

Anything blocking your progress?

Philip Likens 13:08
no

daily BOT 13:08
Ok. Here's what I'm going to share into #hive:

Cleaning up radar view of technologies, meeting over Connected Intelligence preso, EmTech Report

similar elements of understanding inventory, supply and demand, and taking into account variables like weather and local events.

2017 & BEYOND

Robots, cobots and bots are rapidly increasing their footprint, and their reach and utility will continue to grow as sensors continue to be added to the world, the data from those sensors is connected to central databases, and intelligent systems are able to analyze the data and trigger action in the physical world.

Ultimately, automation is about robots and bots acting in physical and digital worlds to streamline tasks and improve efficiency. Within this streamlining, specialization is key; automation is most effective within clear boundaries and limited tasks. Even within sophisticated automation platforms, like IBM's Watson artificial intelligence, there is a divide into dozens of specialized algorithms, each designed to help interface with and solve a specific set of problems and efficiencies, whether it's natural language processing, translation, or visual recognition. Automation is currently most effectively addressed on a task-by-task basis, and this is true of both robots and bots.

It's fitting to think back on how the best-known robots in cinema predicted our current view of specialization and the function vs. form divide. The odd-couple of R2-D2 (a squatty maintenance and repair droid) and C-3PO (a bumbling humanoid protocol droid specializing in translation) are close to what we're seeing occur as automation evolves.

AUTOMATION
TAKEAWAYS FOR 2017

Sabre Labs identifies the travel industry segments that will see the greatest impact from Automation.
Here are specific ideas to keep in mind as you strategize for the year ahead.

FOR AGENCIES & OTAS

- Agents have already embraced automation in a really powerful way through algorithms that automate price monitoring, deal finding, etc. These tools help expedite the manual work of itinerary building. Next generation automation can help with even more of the ground work, taking care of a greater share of the itinerary building for routine kinds of travel, and doing a better job of filtering down to viable itinerary options to save agents time.

- The increase in message based interfaces as a way of interacting with customers perpetuates the need for automation. New, preferred channels of communication can drive higher customer engagement, but that means there is more work to do. Improving service without increasing human workload requires allowing bots to filter low level requests and automate simple responses. Integrating bots to work hand-in-hand with human agents can give humans the time to stay focused on high value tasks and personal relationships with high value clients.

FOR TRAVELERS

- Software bots are handling an increasing load for travelers at all stages in the travel process. As travelers share more access and information with bots, those algorithms gain richer context about the traveler and become more adept at understanding personal and mandated preferences. This can allow bots to serve as digital personal agents, simplifying recurring booking activities, surfacing travel reminders, and automating extras like creature comforts across the traveler's experience.

- Robots are also beginning to offer conveniences for travelers, including delivery robots in hotels; automated quadcopters (drones) with cameras that can provide hands-free documentation for parts of the trip, including adventure excursions; and autonomous luggage able to follow its owner around airports, city streets and hotels, simplifying the act of travel.

Technology

INDOOR LOCATION

Buildings are often thought of as "hard spaces," or as "set in stone." After construction, buildings are seldom updated more often than once every few decades. In contrast, digital spaces are "soft spaces," and have evolved to be very nimble—both because they are easier to change than physical spaces and because we have analytics to quantify why and how they should change. Analytic capabilities for physical spaces are emerging, driven by the ability to track the indoor location of objects and people. A better understanding of how things move through physical spaces will change the way we live and work, increasing operational efficiencies and providing context and convenience for both businesses and individuals.

Image: Navvis.com

LOCATION ANALYSIS

Knowing the location of a person or an object's location is a powerful piece of data—especially when you can track location as it changes over time. Tracking movement results in huge data sets. Analysis of that data allows you to observe patterns in behavior. Identifying patterns allows you to predict and improve responses to that behavior.

Data analysis to improve traffic flow has been used extensively to study how people move through online spaces. Understanding digital behavior includes where people enter a webpage from, what webpage they leave to, where they click, how often they visit, what brought them to a website last time, their buying history, their recent web searches, etc.

Digital spaces also frequently use A/B testing—randomizing between two or more different color sets, layouts, or product offers to see which one is most effective. Frequent A/B testing allows continual refinement and metrics to quantify what works and what doesn't work between different designs. The more you know about someone's behavior, the more it's possible to optimize the experience and intentionally shape how they move through a space. Perhaps the most famous example of this is Expedia which has relentlessly utilized A/B testing to refine its travel booking site.[1]

Indoor location sensors allow for similar sorts of data gathering and analysis in the physical world, which can provide powerful data on the use of large spaces like airports, hotels, cruise ships, museums, train stations and entertainment venues. Analyzing traffic patterns—who goes where, when and how often—can give venues a better understanding of what's working and what's not working in terms of physical layout, signage and staffing, as well as a way to improve peoples' experience within a space.

MAPPING THE WORLD

Fifteen years ago, Global Positioning System (GPS) use was still a novelty for consumers. It's only become ubiquitous in the last decade, as smartphones reached broad adoption and navigation became a common feature in cars.

GPS uses a network of orbiting satellites to make it possible to accurately triangulate position virtually anywhere on earth. It has made possible sophisticated data gathering and analysis of all sorts of movement patterns, particularly for vehicles. But because GPS requires line of sight for precise applications, it's seldom effective indoors.

The varied makeup of buildings—steel, concrete, brick, wood, wires, piping, etc.—make it virtually impossible for signals to travel uniformly through indoor spaces. Inconsistent signals mean dynamic mapping and tracking indoors is really hard to do well. Indoor location is further complicated by buildings with multiple floors, adding an extra dimension of complexity to the navigation problem.

But just because indoor location is difficult doesn't mean it can't be done. An array of connected technologies are poised to do for

[1] https://skift.com/2016/02/25/expedia-relentlessly-tests-the-science-of-user-experience-and-vacation-planning/

indoor spaces what GPS did for outdoor spaces. And by pairing GPS with indoor location, it is possible to create seamless, ubiquitous position tracking moving between indoor and outdoor spaces.

MOVING INDOORS

Each indoor location technology requires localized hardware and/or software mapping in order to be accurate. Every location has to be intentionally mapped and made available, which means that highly used facilities including businesses and public buildings are the only interiors that make sense to map at this time. The larger the space, the more helpful indoor location is likely to be. Therefore, the most immediate locations are entertainment venues like malls and sports stadiums; cultural venues like museums; and travel venues like airports, resorts and train stations.

To help navigate and track use within these spaces, indoor location technologies provide one of two kinds of data:

1. *Proximity-based location* - Proximity sensors know when something is close to something else—in most cases, a particular Bluetooth device within a few meters of a location beacon. A series of proximity sensors can determine how something moves within a series of adjacent spaces.

2. *Precise indoor location* - Precise location attempts to know something's exact position and path through a space. Determining location is accomplished through some combination of on-device sensors, magnetic data, camera information, Wi-Fi triangulation, static maps, and sometimes even a tight network of beacons.

For many applications, knowing proximity is "good enough" to get the data needed to reach a solution. Proximity can be used to analyze traffic between spaces (customer or staff location and movement), to assess conversion based on signage or other advertising, or simply to gather general contextual information. Most indoor location technology currently in use is proximity-based, in large part because the Bluetooth beacon technology is relatively inexpensive, simple to deploy, and easy to relocate.

For other kinds of applications, proximity isn't enough and precision is required. The degree of precision needed varies by the application. To help a person navigate an airport, accuracy to within a few meters is sufficient. To help a robot fetch items within a warehouse, accuracy might need to be within millimeters.

Both proximity-based and precise indoor location technologies rely on devices being intentionally "opted in" to communicate with the indoor location networks. For instance, a smartphone would need to be running the appropriate, location-specific application in order to share and receive proximity information from beacons. Privacy and data ownership are always concerns, but we anticipate indoor location data will be treated much like GPS location information in terms of permissions and security. A person's ability to feel like they have control over their information is important, and there is ample precedent for how both businesses and individuals

will be likely to opt-in to using location information because of the significant convenience and operational efficiencies it can provide.

INDOOR LOCATION TECHNOLOGIES

At present, there is no single standard for indoor location tracking. Various technologies and competitors exist, and there does not yet
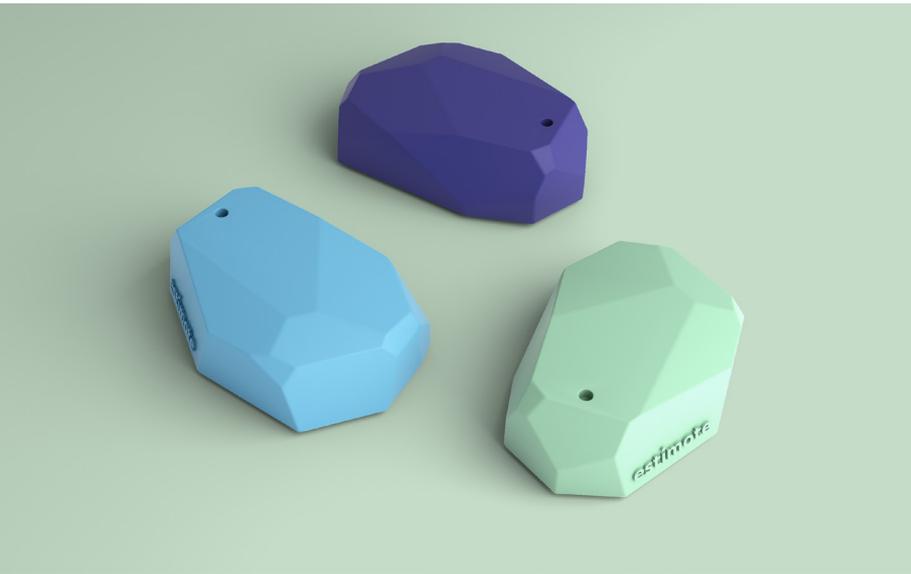
Proximity beacons come in all shapes and sizes, including these battery operated beacons by Estimote, each roughly the size of a Matchbox car.
Image: Estimote.com

appear to be a way to implement "indoor GPS" on a global scale parallel to how GPS satellite networks have been implemented.

The leading technologies, each serving a slightly different function, are:

- *Beacons* – The most widespread means of indoor location is through the use of beacons. A beacon sends out a low energy Bluetooth signal to communicate with smartphones or other connected devices like smartwatches. Individual beacons have limited precision and range (usually 70 meters or less), and while they can determine roughly how close something is to the beacon (immediate, near or far), they can't determine which direction something is in. Even if a network of beacons is used together to triangulate a rough position, it's only accurate to within a few meters, so it's seldom worth the trouble. However, for many indoor data applications, rough proximity is all you need. Beacons are an economical way to gather desired movement data or to share positional information with a consumer. For instance, having a beacon at every gate of an airport could allow an airport to track a traveler's proximity, and could allow a traveler to know where they are within the terminal, route them to baggage claim, to an airport lounge, or to in-terminal shopping.

- *Wi-Fi* – Using Wi-Fi signals to calculate a location relies on attempts to triangulate the position of a Wi-Fi device (like a smartphone) in relationship to the various open wireless

access points (WAP) in an area. If an area has enough points of access, algorithms on the mobile device can measure the signal strength of each access point, treating each WAP almost like a GPS satellite. Comparing enough signals can approximate location to within a few meters, similar to the potential accuracy of beacon networks, but using infrastructure that may already exist, as WAPs are increasingly common in businesses and in public spaces.

- *Magnetic positioning* – Magnetic positioning has the highest subjective "cool" factor of all indoor location technologies. The entire earth is surrounded in a magnetic field. The physical properties of buildings—the steel, concrete and other materials that make up their structure—distort the magnetic field within the building, creating a unique "fingerprint." A building's magnetic fingerprint can be scanned, saved and shared to almost any smartphone on the market. These geomagnetic maps allow positioning within a scanned building space, often accurate to within 1 or 2 meters.

- *Spatial mapping* – Not a single technology but an array of technologies, spatial mapping is achieved by on-device sensors which can include cameras, radar, laser, infrared, and other ways of helping a device actively determine location rather than relying on external signals. The Microsoft Hololens augmented reality device is a compelling example which uses depth-sensing cameras to read and map the planes of walls and physical objects within a room, determining where things are around the wearer. In a more familiar application, the cameras and radar sensors in iRobot's line of Roomba vacuums carry out a similar but simplified task of mapping wall locations and objects within rooms to make sure the entire floor is cleaned. Companies like NavVis are using similar technology to map indoor spaces for businesses.

Spatial mapping is critical for robots to improve their ability to navigate through spaces, especially spaces shared with humans. A device needs to be able to not only map the world around them, but to continuously respond to the other moving objects in order to avoid collisions. In the travel industry, good positioning data is making physical robots better able to function in airport or hotel environments. *For more information on robots, refer to Automation on page 41.*

APPLYING LOCATION DATA

Most of the data historically available about people's movements has been limited to checkpoints in the travel experience. For instance, airlines can track travelers at check in and boarding, but it's hard to know where they are in between. With proximity beacons, a smart phone app, and a traveler's opt in, it's possible to know where a traveler is inside the airport. Theoretically, this would allow a gate agent to know where a traveler is in order to push out directions and a departure reminder to help passengers make a flight. Or, if a VIP traveler has a delayed flight resulting in a long layover, an

airline could push out a complimentary pass and directions to the nearest airport lounge. Or an airline could send a message pertaining to in-flight dining options as a passenger leaves the security area but before they end up in a food line.

For a hotel, knowing whether a guest is in their room, somewhere else in the hotel, or off-site makes it possible to synchronize room service when it's convenient for the guest. It also helps understand whether or not guests are using particular amenities. If guests are off-site, a timely message could potentially lure them back to the hotel for a dinner special, a cocktail hour or a similar guest benefit. Location data can also help provide information about customer conversion due to changes in signage or messaging. For instance, through syncing digital signage with location beacons, you could A/B test different advertisements for an on-site restaurant and know through proximity data which guests were likely to have seen which ad, and how it affected their dining decisions.

For travelers, the most straightforward benefit to indoor location information is wayfinding—the ability to get turn-by-turn directions
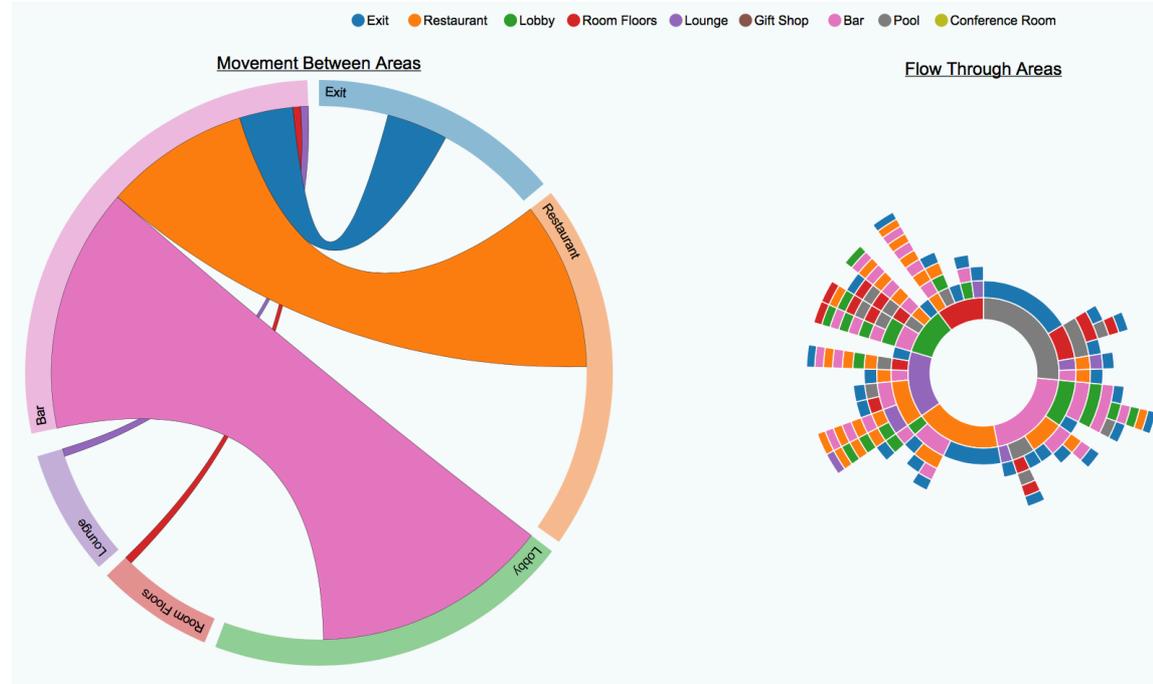
Gathering data is relatively easy; making it useful is a much bigger challenge. When Sabre Labs built a beacon-based indoor location prototype, the team spent the bulk of the time creating the interactive data visualization tools necessary to show how people were moving through a theoretical hotel space.

and distances to a gate, a meeting room, a hotel room, a stadium seat, or a particular store. But location also comes with contextual information—if you know where you are in a museum or a tour, an application could provide specific information about the painting in front of you. You could also access other rich content, such as a slideshow of historic photos and videos of important events that took place in a particular room. Location-based special offers for retail establishments are also likely to be prevalent as businesses continue to explore new ways to connect to consumers.

On the operations side, knowing where staff are located is incredibly powerful for businesses like airlines and hotels. Maintenance and cleaning crews can be monitored and redistributed efficiently in real time based on needs. Staff can be redistributed throughout an airport terminal based on demand to help reduce bottlenecks. And if you know where travelers are, and the paths they are likely to take, you can even preemptively move staff to the appropriate roles and locations in anticipation of customer needs.

2017 & BEYOND

Maps—and the boundaries they represent—have long been at the heart of many aspects of culture, nowhere more evident than in travel. As technology has progressed, humanity has expanded its vision, working to map everything from the cosmos to the human genome, and every layer in between. But for all their significance, maps are just a starting point—their value increases exponentially as we're able to learn how things move within a space, and the locations of each thing in relationship to everything else.

Indoor location technologies help not only create new maps but also provide the data to give maps of indoor spaces a new significance. They help enrich our understanding of the way people and objects move. This will transform how designers create robust shared spaces, how businesses distribute staff and resources, and how consumers navigate indoor spaces.

From a practical perspective, we can look forward to a near future where, once we walk inside a building, we no longer have to rely on signage, memory and guesswork to navigate. Where the environments themselves will be richly layered with digital content. And we'll share those spaces seamlessly with robots, each carrying out our respective tasks and travels.

INDOOR LOCATION
TAKEAWAYS FOR 2017

Sabre Labs identifies the travel industry segments that will see the greatest impact from Indoor Location.
Here are specific ideas to keep in mind as you strategize for the year ahead.

FOR AIRLINES

- Proximity beacons offer airlines a way to know where staff and physical resources (such as baggage carts) are at any point in time and to track how those resources are utilized throughout the day as they move through the terminals. Tracking of movement patterns may allow for improving allocation of resources and preemptively moving staff where they will be needed to help reduce bottlenecks in the travel experience.

- If airlines can incentivize travelers to opt-in to sharing their location, it will improve the ability of airlines to track travelers up to the gate. This could result in the ability to reduce delays and help ensure more travelers make their connecting planes. It could also create room for highly targeted and contextual push offers to improve traveler experience and drive revenue. For instance, a timely reminder of in-flight dining options may help drive revenue from passengers who are known to be short on time.

FOR HOTELIERS

- Proximity beacons offer hoteliers a way to know where staff and physical resources (such as luggage carts) are at any point in time and to track how those resources are utilized throughout the day. Analyzing patterns may offer opportunities to improve efficiency of service staff.

- If guests opt-in to share their location, it allows hotels to improve the guest experience; for instance, knowing when to clean rooms without disturbing guests. It also allows hotels to track flow through the hotel, and ultimately to track conversion rates on hotel messaging for services and amenities.

- Knowing when guests are off-premise allows hotels to push out targeted promotions, such as spa specials or complimentary happy hours, to encourage travelers to come back to the hotel, potentially driving additional revenue throughout their visit.

Technology

MESSAGE BASED INTERFACES

Everywhere you look, people are tapping away at their screens, sending emojis, pictures and quick notes to friends, family and colleagues. Increasingly, brands are competing for a slice of users' messaging activity, angling to move inside these trusted, personal messaging circles—not just with advertising, but through two-way interaction to build and strengthen relationships with customers. Message based interfaces will have an expansive impact on the travel industry in 2017 and beyond, and it is vital for companies to understand how engaging with consumers via messaging platforms can transform business operations.

THE SHIFT TO MESSAGING

At their core, message based interfaces (MBIs) are language (as messages) sent back and forth to allow a human to interact with another human or with a computer system. MBIs aren't new—in their most simple form, they've been around since early experiments in the 1960s[1]—but they reached a tipping point in the past year that will transform how people interact with businesses.

At the end of 2015, messaging platforms surpassed social media platforms in total monthly active users[2]—a landmark highlighting a tectonic shift in consumer online behavior. In 2016, key messaging platforms like Facebook Messenger and Google Allo opened access to be brand and corporate friendly, following in the footsteps of WeChat in embracing business connectedness as core functionality of messaging platforms. MBIs are not exclusive to smartphones—there are plenty of cross-system messaging platforms and MBI interfaces optimized for browsers and web interfaces—but the majority of MBI interaction and the most significant areas for growth are all in the smartphone space.

So what upsides do MBIs provide over other types of communication? It comes down to a few basic features:

- *Messaging is efficient* – And is getting even more efficient and streamlined as smartphone input technology improves. If you were born before 1995 you probably owned a "dumb" cell phone at some point in the 2000s and you remember the revolution of

[1] https://en.wikipedia.org/wiki/ELIZA
[2] http://businessinsider.com/the-messaging-app-report-2015-11

T9 typing. But for anyone born after 1995, their first cell phone was likely a smartphone, and they have the "smart thumbs" and the mobile touch typing skills to prove it. Input methods like Swype and "suggested replies" have helped increase the speed and accuracy of messaging on smartphones for all users. And as voice recognition input is increasingly integrated into MBIs in the form of dictation, this efficiency will continue to increase.
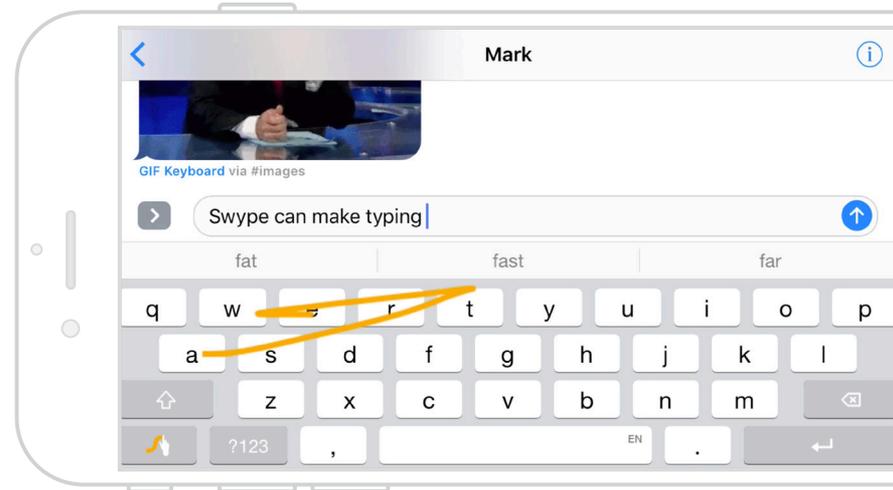
Swype and other keyboards have added to the efficiency of typing on the small screen, making messaging faster.
Image: Swype.com

- ***Messaging is semi-synchronous*** – A phone call is a synchronous form of communication—each party needs to be continuously engaged in the conversation at the same time. Synchronous communicating limits multitasking (e.g. it's tough to read a book and carry on a meaningful phone conversation). Email is asynchronous on the other end of the spectrum; it's professionally acceptable to reply to an email an hour or a day later (even longer for casual communication). Messaging is a middle ground, ideal for many types of interaction. With messaging, you don't have to reply immediately, but you can reasonably expect a reply fairly quickly. You don't have to devote all of your attention to messaging, and you can participate in short bursts, fitting messaging into whatever gaps you have between other demands, or carrying on multiple simultaneous conversations.

- ***Messaging is expressive*** – Often messaging includes photos and videos, interlaced with or in place of words. Stickers and emojis are a several hundred million dollar a year business.[3] We joke around the Sabre Labs office that images are "post verbal" methods of communicating ("a picture is worth a thousand words," right?). In some ways, the fluid integration of words and pictures in casual communication is unprecedented and represents a new and unique form of language.

Ultimately, consumers are using messaging platforms because they are a happy medium, offering the best of many worlds and allowing people to easily and conveniently connect to each other and to juggle social and professional interactions. For businesses who have built brand-specific smartphone apps, MBIs are a way to extend lessons learned about what your consumers want, need and use to a much broader pool of potential users. It's often easier to engage a consumer via MBI than to convince them to download a new app. In the travel industry, we need to meet people where they already are in whatever environment they prefer. Which is to say businesses need to prioritize finding the best ways to interact with customers (and potentially with employees) via MBIs.

CONNECTING THROUGH MESSAGING

Businesses have been trying to connect with customers via messaging ever since online chat started to flourish in the 1990s via IRC, AOL Instant Messenger (AIM), ICQ, and the like. Early bots were established to access specific databases, helping provide quick access to current news, weather, sports scores, movie times, etc. One of the most successful message bots from AIM's heyday was SmarterChild, which engaged over 30 million users, approximately 10 percent of all Internet users at the time.[4] Some companies would also have select employees share out contact information for one or more of the leading messaging platforms to provide services like real time, message-based technical support for products.

As online technology evolved, companies became able to include chat interfaces on their websites, then in their mobile apps. As the

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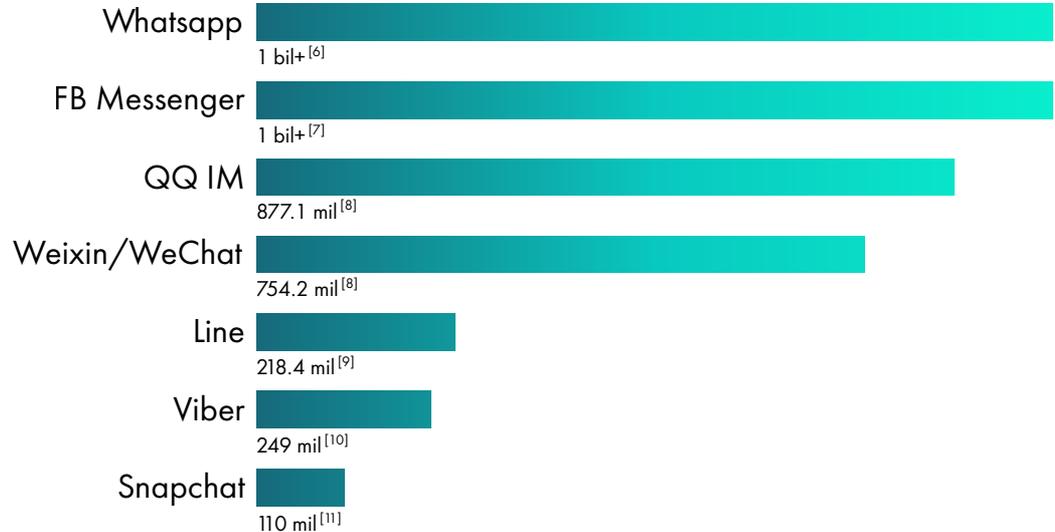[3] https://techcrunch.com/2016/06/13/chat-app-line-makes-over-270-million-a-year-from-selling-stickers/

[4] http://venturebeat.com/2016/06/15/the-trouble-with-bots-a-parents-musings-on-smarterchild/

app landscape has grown, messaging on phones has expanded beyond SMS to WeChat, Facebook Messenger, SnapChat, WhatsApp, Slack, etc. For platforms like Facebook Messenger that already have our contacts, it's a natural migration to new functionality. For startup platforms like SnapChat, novelty and a desire for self expression drive new user adoption. New or native, these messaging platforms have grown into massive online communities. As these communities have grown, demand has grown to be able to reach people on these platforms.

We've been watching WeChat with intrigue over the last few years as TenCent (owner of WeChat) allowed businesses to create official accounts. TenCent was early to welcome businesses, but other companies have followed suit. Platforms like Slack were created with businesses in mind from day one. SnapChat and Google Allo are both open for business development. And Facebook Messenger has seen massive growth since they opened up to official business accounts in April 2016. Hipmunk, Hyatt, Kayak, KLM, TSA, Uber and countless other travel-related companies jumped on the opportunity to create business accounts in an attempt to reach the more than 1 billion active

MESSAGE BASED INTERFACES
MONTHLY ACTIVE USERS IN 2016

Whatsapp
1 bil+ [6]

FB Messenger
1 bil+ [7]

QQ IM
877.1 mil [8]

Weixin/WeChat
754.2 mil [8]

Line
218.4 mil [9]

Viber
249 mil [10]

Snapchat
110 mil [11]

[6] https://blog.whatsapp.com/616/One-billion
[7] http://newsroom.fb.com/news/2016/07/thank-you-messenger/
[8] http://www.tencent.com/zh-cn/content/ir/fs/attachments/ProductlistofTencent.pdf
[9] https://linecorp.com/en/pr/news/en/2016/1348
[10] http://global.rakuten.com/corp/investors/documents/results/
[11] https://techcrunch.com/2016/05/26/snapchat-series-f/

monthly users on Messenger.[5] The Messenger ecosystem also allows companies to link bots to the chat interface.

The easiest way for businesses to engage via MBIs is through creating chatbots which help personify a company or a brand. A chatbot is simply a computer system powered by artificial intelligence that can carry on a conversation with a human. Many of these chatbots are designed to hand off communication to human beings to handle interactions too complex for current artificial intelligences.

For now, these chatbots are primarily used to answer questions and provide information; a subset of chatbots, referred to as "digital personal assistants (DPAs)" can also handle basic tasks like scheduling a meeting, ordering lunch or booking a room at a hotel. Chatbots—including digital personal assistants—are where we expect to see most MBI innovation and development in 2017 and beyond.

ROOM TO GROW

Message based interfaces and its technological underpinnings still have a long way to go to be frictionless for users. As an industry, the platforms and tools for creating bots and

[5] http://newsroom.fb.com/news/2016/07/thank-you-messenger/

THE STATE OF MESSAGING

Several factors converged to make semi-automated messaging a reality over the last 12 months.

- *Messaging apps are where people are* - Messaging apps have a massive install base, and their usage is growing faster than other segments of users' smartphone attention. For most companies, using MBIs and creating chatbots is a smart decision, one which may preclude or replace developing new apps.

- *Message based apps lead to more engagement* - In instances like customer service and support, messaging is a far more welcome alternative to sending an email or waiting on hold on a phone. Messaging increases engagement, regardless of whether the responses are coming from a human, a chatbot, or some combination of the two.

- *AI and machine intelligence are increasing MBI functionality* - Natural Language Understanding allows computers to decipher both words and context. Natural Language Generation allows computer to create grammatically-appropriate, text-based replies. Connecting the two is an artificial intelligence layer to help ensure relevant responses.

- *Automation and AI make increased engagement manageable* - Having chatbots and AI shouldering the burden of answering many basic questions is a time saver. It gives human agents the opportunity to focus time and skills on higher level problems and on relationship building with customers.

messaging interfaces are still fairly rough. Over time these tools will mature, language support will expand, and better intelligence tools will mean there's less manual setup involved in deploying these systems.

In addition, the design practices for MBIs are still in their infancy. We have a handful of best practices, but more will emerge in 2017. Some of the most immediate user interface challenges include:

- Getting passed the initial "blank slate" to encourage users to start conversations with businesses within MBIs.

- Handling security and authentication within a chat interface is a complex problem and is likely to be different on each MBI platform.

- Messaging privacy is an issue of who has access to conversations within a MBI platform.

- Strategies for re-engagement are still being worked out to help ensure every interaction is providing value for the consumer and strengthening relationships.

These challenges are normal for any interactive platform. Designers and developers are hard at work improving the user interface experience around each of these issues. Many of these issues have already been solved for similar systems and best practices just need to be adapted.

Finally, we're looking toward future capabilities like the virtualization of apps that will allow a system like Facebook Messenger to pull up Uber's app even though the user has not downloaded it. The app could run virtually in the cloud for that specific user at that specific time even though it is not installed on their mobile device. This will mean a more seamless experience and integration between companies.

WHAT MESSAGING MEANS FOR TRAVEL

Businesses are using message based interfaces in all sorts of ways. Some are delivering news, others are selling goods. Some are using MBIs primarily to advance branding, others are using them primarily as service and support for their goods and services.

In travel, we see three dominant early models emerging for consumer engagement.

- *Shopping* – When searching for a particular good or service, people are often trying to consider more information than can easily be parsed and displayed in an MBI. Despite the challenges, companies are working to make MBI shopping viable. An upside of offering shopping in a conversational context is that people often reveal their travel intent as they converse. The ability to know a user is booking a hotel for their honeymoon as opposed to a business trip is very useful service information. And the more information a company has about the user and about the user's intent in travel, the more personalization can be offered and the more viable shopping becomes via MBI.

- *Service and Support* – This is perhaps the most obvious application. A 2016 survey showed approximately 70 percent of consumers would rather use an MBI for service and support vs. an email or a phone call.[12] So this is not just meeting users

[12] https://twilio.com/white-papers/global-mobile-messaging-consumer-report-2016

"70 PERCENT OF CONSUMERS WOULD RATHER USE AN MBI FOR SERVICE AND SUPPORT VS. AN EMAIL OR A PHONE CALL.

where they already are, but also in the method they most prefer. Specifically for those inquiries most repeated, a service and support model can work very well. Some pieces of service and support can be automated to chatbots, with humans as a backup for questions and answers the chatbots aren't yet capable of handling, and to offer personalized support where appropriate. The semi-synchronous aspect of MBIs also allow greater efficiency in allowing staff to handle multiple customers simultaneously. Chat interfaces embedded into websites already provide much of this functionality for online commerce, but having to keep switching back to a webpage to engage in conversation is often frustrating for users. Web chat interfaces are also seldom optimized on mobile browsers, if they work at all. Moving service and support to broadly supported MBI platforms addresses the need to meet customers where they already are.

- *Merchandising* – We have seen very few examples of merchandising via message based interface, but we expect that to change in 2017. Merchandising is only really effective in context. So you need an existing service or shopping conversation (or relationship) to be able to suggest additional products or services. But just as ancillaries represent a significant source of profit for both airlines and hotels, merchandising can be a way to further monetize an effective message-based shopping or service and support program.

We expect the rise of chatbots representing celebrity personalities[13] will offer a wealth of endorsement opportunities within a conversational context, creating greater affinity for endorsed products and services, and potentially offering both sales and merchandising opportunities. The scale of this growth will depend on

[13] http://www.seriouswonder.com/future-chat-bots-might-reside-in-selena-gomez-seriously/

the amount of context that's shared with celebrity chatbots and the kinds of interactions users start to have with these personalities.

Each of these models benefits from travel's existing infrastructure. Travel is one of the industries with the greatest natural affinity for MBIs. Travel already has an existing contingent of experts who are ready and able to answer questions any time they're called upon. These experts can provide both a significant initial knowledge base from which the automated "intelligence" layer required for chatbots can be pulled, as well as a strong backup for obscure requests and personal service for high value customers. Couple that with the value of knowing travel intent and strong merchandising upside from ancillaries and you have a winning combination.

INTERNAL MESSAGING

Messaging does not have to just be consumer facing. We see applications of MBIs impacting business operations. Slack is a good example of a messaging application impacting the way teams work in a business and software development context. We can see a future where travel businesses use a staff messaging app which will allow employees to communicate centrally, while also handling details like translation automatically, for those who may share an employer, but not the same native language.

Streamlining internal communications through MBIs may also improve operational efficiencies for businesses with distributed employees, such as staff spread across an airport or a hotel property.

Ideally, integrating bots into MBI infrastructures can add a layer of automation in communication, such as relaying message-based room service requests directly to an appropriate staff member.

2017 & BEYOND

It's a time to be excited. Message based interfaces are here, they are transforming user behavior, and they offer businesses a chance to improve interaction with both consumers and employees. The collaboration between humans and chatbots to handle consumer interaction promises to allow humans to focus on the more exciting and challenging parts of the travel experience.

The move to MBIs is a chance to bring businesses into the trusted messaging space shared with users' friends and family members. It also allows brands to engage in regular, conversational, two-way interactions with consumers, building relationships in a new way. Understanding and acting on the shift to MBIs has the potential to transform business operations in a powerful and positive way.

MESSAGE BASED INTERFACES
TAKEAWAYS FOR 2017

Sabre Labs identifies the travel industry segments that will see the greatest impact from Message Based Interfaces.
Here are specific ideas to keep in mind as you strategize for the year ahead.

FOR AGENCIES & OTAS

- In 2017, some companies will have to decide whether to fund a mobile app or a message based interface strategy. Message based interfaces have shown immediate promise for service and support, whether human-powered, bot-powered or a combination of the two. Conversational shopping interfaces, specifically in travel, will still be considered experimental in 2017.

- By opening up communication with the traveler via message based interface early in the planning process, businesses can enable post booking engagement directly with the traveler.

- Message based traveler interaction is just ramping up, but should continue for many years. Investing in a common platform on the backend to handle various types of requests—email, message based, etc.—could pay dividends in the long term.

FOR AIRLINES

- Shopping for flights via message based interface requires either quite a bit of data up front, access to a lot of personal data, or a very robust flight recommendation and revision engine. Companies like Facebook Messenger are encouraging complex interactions to be handled outside chat contexts (e.g. in a web browser). Given the early nature of these interfaces, customers may be tolerant of suboptimal MBI shopping experiences. 2017 represents an opportunity to experiment with flight shopping interfaces in a new way, but achieving a streamlined experience remains a complex problem.

- Offering service and support through a preexisting messaging service may help cut down on social complaints via services like Twitter. Using preexisting services also represents an immediate natural area of adoption.

- Opening a conversation with a consumer via a message based interface could provide merchandising opportunities to a new set of consumers.

MESSAGE BASED INTERFACES
TAKEAWAYS FOR 2017 – CONTINUED

FOR HOTELIERS

- For large hotels and resorts or chains, service and support with an eye toward merchandising represents an interesting way to reach consumers. Consider implementing a strategy that spans existing messaging platforms rather than limiting the messaging interface to a custom hotel app. Remember message based interfaces do not have to be automated. Concierge answering SMS may be a place to start.

- Chatbots, such as the kind that can be built for Facebook Messenger, have the ability to provide operational upside by handling some of the repetitive question and answer functions. This can free customer support individuals for higher value interactions. Monitoring front desk, call center and concierge interaction should quickly reveal the most relevant content for service and support bots.

- Hotels can use MBIs to streamline interactions not only with customers but also with staff. Utilizing or building a team communication application could improve team communication, resulting in a smoother running hotel.

- Millennials and Gen Z guests may be more comfortable communicating via a messaging service than via a phone call or face-to-face conversation. Providing messaging services is an inroad to build and strengthen rapport with a growing segment of your customer base.

FOR TRAVELERS

- Travelers who currently use WeChat, Facebook Messenger and other messaging services will see a large number of companies begin to use service and support capabilities on these platforms in 2017. This will give travelers quick access to service and support from travel companies without having to download a proprietary app or access a mobile website.

- Messaging interfaces by Apple, Google, and others are beginning to integrate services like location sharing, group polling, calendar syncing and destination information inside the chat interface. Closer integration of branded services into messaging apps in 2017 may significantly streamline planning and coordination around group activities and family travel.

Technology

VIRTUAL REALITY

Virtual reality has its roots in film. In 1895, one of the first films ever shown was a 50-second clip of a train pulling into a station. The film has long been rumored to have caused panic in the theater because it seemed possible the projected train might hit the patrons. True or not, the story helps capture the well-documented awe people felt at seeing the real world captured as moving pictures for the first time. Filmmakers have a 130+ year legacy of working towards transforming the reality we see into ever more immersive experiences. In the last year, technology has finally started to bring to life the promise of fully immersive visual experiences.

Image: Oculus.com

EARLY VR

History is filled with false starts. "Virtual reality" (VR) has been brought to life every few years since the 1960s, with limited visibility or success. But the attempts were always accompanied by bullish optimism for what was just a few years off. The term VR came to popular recognition in the 1990s when Hollywood began integrating VR into film plots. At the same time, the first wave of consumer-focused devices came to market. Through the early 2000s, attempts to drive consumer adoption of VR remained unsuccessful. Much-hyped devices were scrapped before market or languished on store shelves. Technical challenges caused nausea and motion sickness in users, and low-fidelity content barely resembled the real world. The technical realities for VR spent more than 50 years as a mirage, seemingly visible but just out of reach.

TECH GROUNDING VR

In the last year, VR has finally tipped the scales, beginning the shift from mirage to mainstream. The changes finally making VR viable are twofold: 1) an ecosystem of incremental improvements in the components necessary to fool the senses into accepting another reality; 2) broad access to content creation devices and tools necessary to ensure an endless supply of ever richer VR content.

Smartphones have been the driving force for many of the sensor and screen advancements necessary to make all current VR headsets effective. VR requires high-definition displays and motion sensors to know which way the wearer is looking. Smartphones have incorporated increasingly high-resolution, high-density, lightweight displays along with advanced gyroscopes and accelerometers that provide the sensor input necessary for head-tracking. There are other technologies and refinements beyond these that can enhance the immersion of a VR experience, but getting displays and head-tracking right are the basic foundations of effective VR.

Though the visual fidelity still has a long way to go for users to truly forget they are not in the physical world, the current technology has ironed out the key challenges that arrested development for the last 50+ years. The technology will continue to iteratively improve, but there are no deal-breaking technical issues this time around.

TYPES OF VR CONTENT

The content that can be viewed in VR breaks down into two broad categories – captured content and rendered content.

Captured content is 360° photos and videos. In these VR experiences, the user is stationed wherever the camera was when the photo or video was taken. You can move your head 360 degrees to look at all parts of the captured world, but you can't move your perspective freely within the space. If multiple photos were taken, you can move between the various perspectives; if multiple simultaneous cameras were used for a video, you can move between the cameras, getting different perspectives, but you can't see what wasn't filmed. Multiple video perspectives were broadcast in VR for events like the 2016 Rio Olympics.

> # "THESE EXPERIENCES ARE MORE THAN DOCUMENTARIES. THEY'RE OPPORTUNITIES TO WALK A MILE IN SOMEONE ELSE'S SHOES.
>
> *– Chris Milk, Within CEO*

Rendered content is fully digital 3-D content. Entire objects or environments are built and rendered in software. Because these environments are being created by the software, you can typically navigate within the environment, look under and behind objects, walk up to and peer over ledges, etc. Rendered worlds are used for games as well as a wide range of professional applications, like touring architectural models and conducting virtual meetings.

CONTENT DEVELOPMENT

The range of captured content available for consumption in virtual reality is startling, and the content ecosystem is exponentially expanding. Much early travel content was destination focused—photos and video from locations serving to inspire travelers to visit. Content creation was driven by a mix of innovative professional filmmakers and hobbyists. Media by both groups continues to increase in scope and quality as the cost of virtual reality cameras and the drones often used for filming fall in price.

Some of the most exciting images and videos to date have been created by AirPano, a not-for-profit project that has captured 360° views of hundreds of the most iconic and majestic locations on earth, everywhere from the Taj Mahal in India to Victoria Falls in Zambia to Machu Picchu in Peru.

Chris Milk, a leading VR filmmaker, describes the technology as "the ultimate empathy machine." He adds of VR films, "These

experiences are more than documentaries. They're opportunities to walk a mile in someone else's shoes."[1]

We're starting to see more and more brands using VR for product differentiation, allowing consumers to get a taste of an experience

[1] http://vanityfair.com/news/2015/11/director-chris-milk-virtual-reality

Debuting in 2014, Marriott's Get Teleported VR experience included sensory elements such as wind, heat and moisture to create an immersive environment.
Image: Marriott.com

before purchase. Producing polished, brand-worthy 360° photo content is becoming mainstream; 360° video content is still very expensive compared to traditional film, but cost is falling fast as more and more producers gain experience with filming in VR. Best Western is one travel company making an early investment in VR, having recently launched VR tours on YouTube of all of the chain's ~2,000 North American hotels (the videos are slideshows of 360° photos, not native video content). Marriott has taken a very different approach, going more for depth than breadth in its content creation with "Get Teleported" experiences. These are immersive, phone-booth sized VR projects incorporating heat, wind and moist air to engage more senses. The experience creates the illusion of being on a beach in Maui, showcasing the power of VR and attempting to inspire travel to one of Marriott's star properties.

Creating rendered content is still the most seldom used option for businesses, in part because of high costs. But that hasn't slowed several companies from developing unique customer experiences. United Airlines created a 3-D environment for the Oculus Rift headset to showcase its new Polaris business class. Polaris class is based around Boeing's new 777-300 planes, which weren't ready in time for United's marketing department to show footage of the actual planes. Instead, the team used VR to show the planes, the business class cabin, and the associated Polaris airport lounges to help draw customers to the premium experience before it was actually available.

CURRENT VR SETUPS

VR consumption is currently divided into use of two basic types of systems: 1) mobile VR on smartphones and 2) tethered VR connected to high end computers or video game systems.

- *Mobile VR* is relatively inexpensive if you already own a high-end smartphone, requiring a sub-$100 investment for headgear like a Gear VR or a Google Daydream View. Standalone mobile VR headsets (no smartphone required) are coming to market, but we don't expect them to be a huge factor for 2017. Mobile-based VR can be used anywhere, and has no cords attached. It's accessible to more people in more places, but is limited in its fidelity and in the short term will primarily be used for consumption of video and photo content.

- *Tethered VR* represents a higher investment and a more niche market, but confers advantages beyond just higher fidelity and greater rendering power. Tethered VR systems to date incorporate external sensors and motion controllers to track users' movements, which enables deeper interaction with the virtual environment. The most significant investment into rendered VR content is being made for these tethered VR systems that can take advantage of the upsides and interactivity of a fully 3-D environment.

(Left)
Also from Oculus, Gear VR is an example of a smartphone powered headset able to be used on the go.
Image: Oculus.com

(Below)
The Oculus VR headset must be tethered to a computer or other system to operate.
Image: Oculus.com

2017 & BEYOND

Virtual reality established a foothold in the market in 2016, demonstrating that the capabilities and technology are in place for

United used VR to allow customers to preview its new Polaris branded business class cabin and airport lounge prior to launch.
Image: United.com

VR to have staying power in this iteration. However, widespread adoption and simplified distribution channels are needed to move the technology to the next level. 2017 will see much broader adoption of both mobile and tethered VR experiences. Google's October-launch of Daydream as both a hardware standard and a content distribution platform is expected to democratize both hardware development and content development for mobile VR. The October launch of Playstation VR is already accelerating access to tethered VR, lowering the cost of entry and encouraging an existing install-base of more than 40 million PS4 owners to purchase tethered VR.

Neither of these factors will be enough to create significant household consumer adoption in 2017, but they will at least help ensure that much of the population will have a chance to try VR sometime during 2017, helping pave the way for a likely tipping point towards broad adoption sometime in 2018.

The greatest strength of VR—its full immersion—is also likely to be its greatest challenge in terms of adoption. VR demands a user separate from their existing environment and fully engage a new environment, which requires a tremendous amount of time and attention. One of the reasons smartphones have been as successful as they have

is that they allow multitasking anywhere, anytime. You can split your attention—watch the kids, watch TV, work on a document, and text with other people. Smartphones allowed people to do more in the same amount of time. At least for now, VR doesn't coexist well with any other activities, making it more challenging for people to integrate into daily life.

Fortunately, travel is often one of the best opportunities people have for large, uninterrupted blocks of time. Travel is also an industry often in control of both media access and physical environments, so it doesn't have to wait for consumer adoption to take advantage of VR technology. People in transit—especially in planes—are often looking for opportunities to be distracted or entertained, which are core elements of the VR experience. So travel companies—including airlines, hotels, cruise lines and brick and mortar agencies—need to be looking into using VR to sell travel, to make money from advertising, and/or to sell access to both hardware and content (in flight or in room).

In terms of content creation, hotels and resorts, cruises, tour operators, and other in-destination attractions need to think about what kind of VR content they should be creating. Many experiences can't be scaled for mass audiences—there is only one presidential suite in the hotel; there are only so many seats at the chef's table in a kitchen—but through VR, you can provide these limited experiences to everyone:

- A tour of the kitchen by the chef
- A tour of a private beach
- The concierge talking about some of his or her favorite attractions and activities in the area
- The bartender making their favorite cocktail
- A snippet of tour showing what a particular excursion would be like
- The ability to explore different rooms or cabins and in-resort or on-ship experiences

Travel providers have a window to get ahead of the curve in creating content and an opportunity to be the innovators that help introduce travelers to content through promoting or making available the necessary mobile and tethered VR devices. Virtual reality still has the advantage of being novel to most travelers, and novelty inspires curiosity.

Once the novelty of VR wears off and it becomes commonplace, the barriers will escalate to gaining customer engagement and attention in the VR space. Which means that now is an ideal window to tap into novelty while travelers are still receptive to engaging the experiences you want to provide, especially if you inspire them and give them an experience worth talking about.

VIRTUAL REALITY
TAKEAWAYS FOR 2017

Sabre Labs identifies the travel industry segments that will see the greatest impact from Virtual Reality.
Here are specific ideas to keep in mind as you strategize for the year ahead.

FOR AGENCIES & OTAS

- Broad in-home consumer adoption of virtual reality is still a number of years away, so now is a great time for brick and mortar agencies to use VR to provide inspirational shopping opportunities for customers. The cost of VR is relatively low, but allows agents to offer a unique experience for customers to preview potential destinations.

- For all agencies, VR offers a powerful opportunity for product training. Agents can use VR to experience hotel, resort and cruise products before booking for clients, improving their confidence and ability to answer questions and describe destinations in detail.

- Agencies should also consider targeted advertising on platforms where existing VR content is being consumed. If you specialize in tours of Iceland, you want your agency's "book here" ad to appear every time a potential traveler watches a YouTube VR video of the Northern Lights.

FOR AIRLINES

- Airlines are becoming more advanced in how they use VR, moving from VR as travel inspiration to VR as a way to position and sell premium products. VR can show people how luxurious and comfortable air travel can be, not just in planes, but in the private lounges and amenities that are part of an end-to-end premium experience.

- On planes and in lounges, airlines have a captive audience and providing VR headsets—either as an upsell or as a premium amenity—is an opportunity to appear cutting edge as well as a chance to provide a curated content environment. Distributed headsets can include a healthy dose of inspirational travel content as well as destination ads, all of which are made more palatable for the viewer because of the current novelty of the medium. Travel is a natural fit for VR viewing.

- Airlines should also consider targeted advertising on platforms where existing VR content is being consumed. When a potential traveler watches a VR video tour of a foreign city, they should see a "let our airline take you there" ad allowing them to book a flight to the city they just saw.

VIRTUAL REALITY
TAKEAWAYS FOR 2017 – CONTINUED

FOR HOTELIERS

- Hoteliers are increasingly creating VR photos and videos to allow potential guests to tour public spaces, amenities and private rooms. It's also a way to showcase upsell opportunities by giving people a better understanding of how a more luxurious room could influence their travel experience. Virtually experiencing the ocean view from a room with a balcony may convince some travelers to upgrade their stay.

- VR can also be used to help train staff, walking new employees through anything from best practices for cleaning a room, to how to prepare a particular dish in the kitchen, to tips for interacting with guests at the front desk. The ability to immerse in an environment adds richness to the training experience without subjecting guests to the training environment.

- Offering in-room loans or rentals of VR headsets is an opportunity to provide curated content displaying a mix of entertainment and paid advertising. This may be an ideal way to feature VR videos of local tours, adventure excursions or space-limited opportunities like a meal at the chef's table in the hotel's Michelin-starred restaurant.

- Hoteliers should also consider targeted advertising on platforms where existing VR content is being consumed. When a potential traveler watches a VR video tour of the Eifel Tower, they should see a "stay with us and see Paris" ad linking to your hotel property on the Champs-Élysées.

Technology

VOICE BASED INTERFACES

Speaking is natural for us, whether it be to other humans, to animals or even to inanimate objects. So it's no surprise we've spent more than 50 years dreaming of talking with computer systems. In the 1960s *The Jetsons* and *Star Trek* showcased the idea in popular culture, inspiring generations of researchers and scientists to imagine how future interfaces could and should behave.

Conversing seamlessly with a computer is the holy grail of voice technology, but there are still significant challenges to overcome. Much closer at hand is the ability to use voice as our primary input mechanism, because transcription doesn't need to understand context. Both use cases will have tremendous impact on businesses and consumers as voice interfaces become ubiquitous in everyday life.

Image: Google.com

VOICE RECOGNITION

On the surface, the human voice seems like a virtually frictionless way to engage the world: words convey information, and we're audibly sharing words. Voice recognition has matured to a point where our literal words are fairly well captured when we speak, especially in quiet environments. With a large enough data set of samples, current algorithms can basically solve transcription regardless of language, pacing and tone. For tasks where voice recognition is an input tool, replacing keyboard, mouse or touch input, accuracy is all that is needed to achieve maximum utility. In these cases, context is provided by the humans involved, not by the software.

Noisy environments still provide a challenge for voice recognition, even for humans. Think about how often you have to ask someone to repeat a word or clarify an idea during a phone conversation, especially if either side of the conversation is taking place in a noisy environment. Improvements in microphones and noise filtering algorithms increase accuracy for voice recognition—filtering is a known challenge with continuing gradual improvement.

Microsoft recently claimed a milestone in voice recognition, with its Cortana engine achieving 94 percent accuracy in recognizing human speech, putting it on par with professional human transcribers.[1] In a separate study, Baidu showed its voice recognition software is three times faster and significantly more accurate than manual typing as a smartphone input device.[2] As voice transcription nears 100 percent accuracy, many devices, regardless of form factor, will have a way for users to seamlessly input commands.

Consumer-facing companies have made a big push for voice adoption. In part, because being able to talk to machines fulfills a childhood dream for many adults, which creates implicit goodwill towards novelty, even when not wholly successful. Amazon's Alexa, and now Google's Home are advancing in-home, always-listening voice interfaces as a key part of making voice ubiquitous in daily living.

The "hub-and-spoke model" these are based on has a primary device connecting to and sending commands to a host of different systems like lighting, thermostat, music, alarm systems, etc. These are bringing the benefits of voice-controlled connected intelligence into homes and business spaces. *Read more about the Connected Intelligence megatrend on page 10.*

TECHNOLOGIES DRIVING VOICE

Many separate technological triumphs have converged to make voice interfaces a possibility. As each of these technologies evolve, they will continue to advance the sophistication and capabilities of human and machine voice interaction.

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[1] https://techcrunch.com/2016/10/18/microsoft-hits-a-speech-recognition-milestone-with-a-system-just-as-good-as-human-ears/

[2] http://www.npr.org/sections/alltechconsidered/2016/08/24/491156218/voice-recognition-software-finally-beats-humans-at-typing-study-finds

- Speech recognition has made tremendous strides in the past decade, particularly because of improved algorithms, faster computers and exponentially larger data sets to use as points of reference for peoples' speech. There's also been a huge shift from having to historically train a system to understand each individual voice vs. today's data-set grounded systems that attempt to understand all voices.

- Microphones, paired up with noise cancellation software, keep getting better, which makes it ever more possible to identify

Siri's response to the spoken question "Siri how old is Mike Krzyzewski today?" is impressive given the challenge of transcribing the coach's last name.
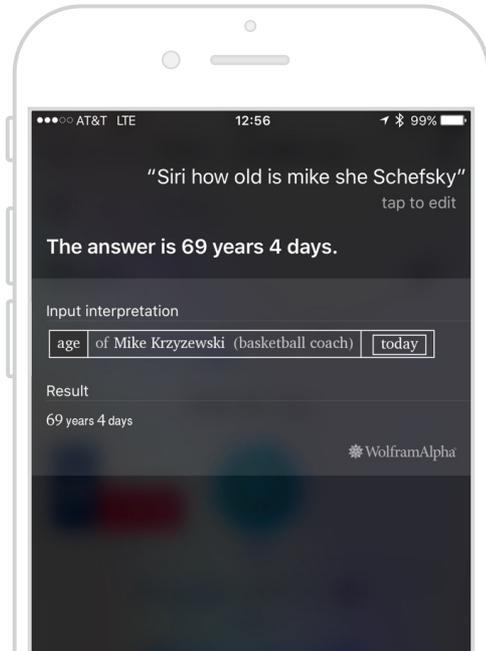
the one person in a room who is intentionally talking to the computer (and not trying to "hear" all the other people in the background), as well as determining the language the person is speaking.

- Tone analysis helps provide one of the most rudimentary, yet significant forms of context. We're just beginning to see it used as a separate part of some voice engines. The software is still basic, limited to recognizing a speakers' tone to help discern broad emotions like anxiety or frustration. This offers value in service roles, to help give human support agents additional insight into customer moods to help optimize interactions. Analysis of in-call customer tone compared to post-call satisfaction survey results allows businesses to measure how emotion relates to outcomes, helping quantify service efficacy.[3]

- Natural language understanding as a kind of software has also made strides in the ability to know what people are actually talking about—this is also seeing improvements in large part due to robust data sets. In Sabre Labs, one of our favorite examples was using Apple's Siri to ask about the age of Duke basketball coach Mike Krzyzewski. Siri recognized the query as: "Siri how old is mike she Schefsky". But the understanding part of the engine resolves to "age of Mike Krzyzewski today" and output the answer as 69 years and 4 days.

[3] http://electronics-eetimes.com/news/can-call-centers-keep-you-cheerful-ai-listens

> ## "THE DESTINY OF SEARCH IS TO BECOME THE STAR TREK COMPUTER, YOU COULD ASK IT A QUESTION AND IT WOULD TELL YOU EXACTLY THE RIGHT ANSWER, ONE RIGHT ANSWER...
>
> *—Amit Singhal, SVP of Engineering for Google Search*

- Speech synthesis is slowly improving the ability of machines to emulate natural human speech instead of sounding "robotic."[4]

- Natural language response generation is the output side of the equation, and an area where creating a truly conversational system is very difficult; we've only scratched the surface in this area. Knowing how to respond in a natural and appropriate way is proving one of the most challenging parts of the entire voice experience.

[4] https://deepmind.com/blog/wavenet-generative-model-raw-audio/

CONVERSATIONAL CONTEXT

For all their growing success in transcription, voice recognition systems still lag far behind human listeners in their ability to understand conversational context. We're so accustomed to talking with one another we seldom think about the full complexity of interacting in natural language. But our speech is filled with far more than just words.

"The destiny of search is to become the Star Trek computer," says Amit Singhal, SVP of engineering for Google Search. "You could

ask it a question and it would tell you exactly the right answer, one right answer—and sometimes it would tell you things you needed to know in advance, before you could ask it."[5]

The real work of achieving the Star Trek dream is creating an algorithm capable of a conversation that mimics speaking with a human. For human-like conversation, you need the meaning behind the words, not just the words themselves. Meaning is governed by all the nuances of context as well as the peccadilloes of particular speech patterns and linguistic idiosyncrasies. And since language is always evolving, always fluid, models for interpreting meaning also have to be constantly adapting. Meaning of words also varies within people groups based on smaller cultural divisions based on age, interests, family, etc. And this same set of problems is true for each of the world's approximately 7,000 languages.[6]

These represent the challenges inherent to making meaningful sense of any voice content—the challenges our ears and brains face and solve every day and in every conversation. The same challenges computer language systems face in listening to our voices. Even taking into account all of these context issues, you've still only solved the listening side of the equation. Voice systems also have to figure out how to answer a question in a relevant way and learn what level of detail to provide. And as with every other element of conversation, context is crucial to both type of answer and degree of detail.

[5] http://slate.com/articles/technology/technology/2013/04/google_has_a_single_towering_obsession_it_wants_to_build_the_star_trek_computer.html
[6] http://linguisticsociety.org/content/how-many-languages-are-there-world

Talking to our appliances will be a normal part of the future. As we move from device-driven to distributed computing, we can envision voice interfaces in virtually every connected device with space for a microphone. For now we'll have to resort to speaking our commands through the Amazon Echo.
Image: GEAppliances.com

Context is not only what was said and how to reply, but how circumstances dictate the nuances of a reply. How many people are part of the conversation? How much do they each already know? How long is the conversation likely to be, so how much time is there to convey context? What is the purpose of the conversation? What is the mood of the room? In a business context, are there hierarchies or diplomatic considerations that need to be taken into account in framing a reply? What are the cultural backgrounds of the participants (not just country and language, but things like ties to particular schools or states)? Etc... the list is endless.

And all of this plays out on both micro and macro levels: there is a radically different context for a room full of people than there is for a one-on-one conversation, and knowing all of those levels, and all of those interactions is part of what human brains do remarkably well, and computers are remarkably far from emulating effectively.

Despite the challenges to emulating natural conversation, software algorithms are being used to engage humans in limited forms of conversation, usually focused on communicating basic pieces of information in response to spoken commands or questions. Siri, Alexa, Watson, Cortana, Assistant, Hound, etc., provide everyday demonstrations of the successes—and the limitations—of current voice interfaces in regards to conversations. Even the most "human" elements of these algorithms—like the humorous "Easter egg" answers they all provide to specific questions—are evidence for the necessity of human involvement. The most human parts of these voice interfaces are scripted by real people, not produced by software analysis of human patterns of communication.

VOICE IN TRAVEL

One of the primary benefits of voice interfaces is their potential for multilingual access. Travel inherently involves engaging with people of other backgrounds and cultures, so connectedness and voice translation are huge for travelers. On the other side, as global companies build geographically diverse, interconnected teams, voice—just like message based interfaces—allows for more streamlined teams as all staff are able to interface with systems and platforms in their native language, and still communicate with one another across language barriers.

Voice as a multilingual system conveys similar benefits across all domains in which we see voice affecting travel:

- *Retrieving Information* – This is the primary functionality associated with voice assistants like Siri. Sabre Labs has built out various voice prototypes looking at how voice information retrieval could work in a travel context. Analysis of in-call customer tone compared to post-call satisfaction survey results allows businesses to measure how emotion relates to outcomes, helping quantify service efficacy. Using voice for information retrieval allows us to create auditory data dashboards – quick, spoken language summarizing the key elements of large sets of information. Auditory data dashboards allow users to keep working visually and physically while still accessing important updates which they can choose to act on or ignore based on urgency.

- **Acting on Requests** – The ability to ask a system to take action on your behalf is a key feature of voice. *Delve deeper into the repercussions of this authority in the <u>Connected Intelligence megatrend on page 10</u> and in the <u>Automation technology on page 41</u>*. Assistance is currently the core value of Amazon's Alexa and Google's Home offerings. For now, asking for assistance is generally limited to basic actions such as ordering supplies via Amazon Echo when you run out of a household staple; finding and playing music on command; setting a timer; adjusting the thermostat, etc. In travel, we've experimented with using voice for things like flight and hotel search, and this is an area we expect to expand rapidly in the near future as the artificial intelligence behind voice interfaces become more sophisticated and are granted increasing levels of autonomy. We'll also see the ability to act on requests with improved functionality and accuracy as part of improving the customer service experience in automated systems like telephone support.

- **Active Assistance** – Connected home devices default to always-on listening, and smartphone assistants have similar options. Right now, this usually means the software waits in passive-listening mode until it hears its name or trigger command, but there is a near-future for always-on active listening. This is something we haven't seen used much yet, but the idea is that the system is waiting for the opportunity to volunteer information it believes will be useful based on the context of a conversation in progress.

You can imagine this being used in a call center to autopopulate flight search fields based on a customer's spoken words. Or inside flight operation centers, a spoken flight number could become a link on a sidebar that would allow a worker to quickly get additional information.

2017 & BEYOND

We're in the first phases of implementing voice for travel. Even though adoption is progressing quickly in the consumer technology market, we see a tremendous number of business and travel applications for voice that have yet to be built. The infrastructure overlap with message based interfaces is significant, so we're seeing the feasibility and tooling for these systems rapidly progressing which will enable better implementation in a business context.

First use cases are primarily include voice acting as a replacement for other input methods. Current and next step use cases are with voice as the basis for conversational interfaces, structured around basic sharing of information. Much longer-term use cases are with computer algorithms emulating human context and understanding.

Ultimately, in all cases, voice represents a natural user experience—our voices tend to be a very natural expression of what we want to happen. And every step we take towards getting voice right gets us closer to the *Star Trek* ideal of voice as our seamless, ubiquitous destiny.

VOICE BASED INTERFACES
TAKEAWAYS FOR 2017

Sabre Labs identifies the travel industry segments that will see the greatest impact from Voice Based Interfaces. Here are specific ideas to keep in mind as you strategize for the year ahead.

FOR AGENCIES & OTAS

• The latest advances in voice technology represent new ways for travel agents to increase service and support to travelers. One specific opportunity for phone based agents is to have a voice system actively listening during phone calls. The algorithm could listen for key words to capture information and perform search tasks during a call. With the computer capturing the details and beginning to surface potential answers, it leaves the agent free to focus all of their attention on the caller instead of on trying to talk and search simultaneously.

• Auditory dashboards built for voice interfaces like Amazon Echo offer agents a hands free way to quickly access daily updates and basic summary information about travelers. This can include details like where travelers are at a particular time, whether any travelers still need to check in, notification of weather events or safety issues, etc. Building ways for agents to use voice to access auditory dashboards with key information can allow agencies to save time and increase operational efficiency.

FOR TRAVELERS

• Consumer use of voice is here and has been widely adopted for basic queries and commands. There are no expected game changers for 2017, but the breadth and functionality of voice will continue to expand in meaningful ways.

• It's important for the industry to realize there is a growing expectation by travelers to be able to access information as conveniently as possible, wherever they are, and that will often mean making resources accessible via voice.

• For the traveler, speaking to a voice system when getting ready in the morning can provide traffic updates, flight reminders, weather reports, etc. This same spoken system should be able to follow the traveler throughout their day providing hands free on-the-go information. Itinerary management via voice will be one of the use cases we see emerging in 2017.

• Near real time voice translation will happen soon, and will enable smoother international experiences for both travelers and businesses.

THANK YOU

We hope you enjoyed reading Sabre Labs' 2017 Emerging Technology in Travel Report. For questions, media inquiries and speaking requests, contact us at SabreLabs@Sabre.com.

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