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Business Value Highlights

30 billion

"things" will be connected in 2020 representing a huge opportunity for app developers.

More than half

of IoT apps developed today are for internal corporate use.

Cloud-based data storage

is the most important tool for developers building IoT applications.

2/3

of developers will leverage a third-party IoT application.

The Developer's IoT Playbook: What to Expect and Where to Turn to Fast-Track Your IoT Initiatives

IDC OPINION

Organizations with Internet of Things (IoT) projects should seek technology suppliers that offer a centralized and comprehensive suite of services and tools but also support a diverse community of IoT developers who can support and innovate for a wide range of IoT projects.

IT and line-of-business stakeholders with IoT development agendas that evaluate such offerings should look for solutions that reflect the unique but also highly diverse requirements of IoT projects. Offerings should be dimensioned to permit flexible sourcing and consumption of services, tools, and support resources. They should also be accessible to the diverse range of mobile, embedded, and other developers now actively targeting IoT projects.

Organizations that leverage this type of service-oriented IoT solution stand to realize cost, efficiency, time-to-market, scale, security, and overall competitive benefits. At a macro level, this type of solution stands to accelerate the rate of innovation and IoT application development in general.

A majority (63%) of active IoT developers surveyed for this study indicated that their IoT development experience is less than satisfactory. This and other data presented in this study suggests that a majority of developers do not have such centralized access to the diverse set of services and tools that their IoT projects require or that the resources they are using are inadequate.

AT&T's M2X Data Service and Flow Designer IoT solutions are designed, built, and packaged to give organizations and their IoT developers the type of centralized but also flexible access to a diverse range of services and tools that developers indicate are required for IoT initiatives.

Methodology

In June 2015, IDC and AT&T fielded and completed a survey looking to gain a deeper understanding of developers and developer communities that are targeting IoT solutions, markets, and endpoints. The research also endeavored to understand developers' backgrounds, coding preferences, level of experience, and developer program affiliations as well as motivations for developing IoT applications.

The survey garnered responses from 274 respondents who were qualified as "active" developers and currently are employed and reside in the United States. Respondents were screened against two sets of criteria. First, they had to be at least moderately familiar with the term Internet of Things. Second, they had to be currently developing, or planning to develop, IoT applications within 18 months. Some characteristics of the respondents are:

- » 73% of respondents are currently developing applications, with 27% saying they expect to be developing IoT applications in 18 months.
- » The average amount of time respondents had been developing IoT applications was approximately 5 years.
- » Currently, on average, companies have 8 developers focused on IoT solutions, but they expect this number to increase to 12 or more in 12 to 18 months.

In This White Paper

This white paper focuses on current attitudes, practices, and trends among developers targeting the Internet of Things opportunity. The study highlights a need for a centralized source of comprehensive tools and resources that a diverse community of IoT developers can tap into in support of a wide range of IoT projects.

This white paper draws on primary research completed in June 2015 to provide fresh perspectives on the IoT opportunity for developers. Finally, the study also provides an overview of AT&T's M2X Data Service and Flow Designer platforms, which offer a specialized range of tools and services to developers bringing IoT applications to market.

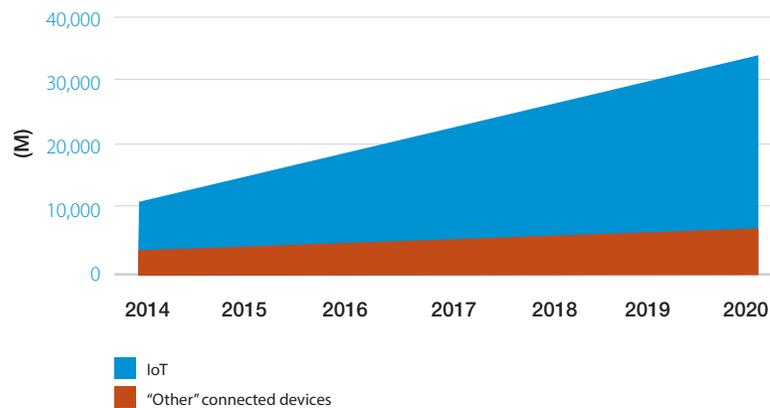
Situation Overview

The IoT Tipping Point

The Internet of Things continues to garner attention from a complex ecosystem of vendors, service providers, and application developers as well as from end users who are seeing the early instances of IoT affecting their lives. The IoT is defined by IDC as “a network of networks of uniquely identifiable endpoints (or “things”) that connect without human intervention to the Internet.” IDC predicts that by 2020, there will be 30 billion “things” connected to the Internet in addition to the already well-established smartphone, tablet, PC, and consumer electronic markets. Figure 1 provides a view to the potential of the IoT in relation to these other connected devices. To put things into perspective, IDC expects IoT to grow at a compound annual growth rate (CAGR) of 19.2% through the forecast period (2014–2020), whereas all the “other” connected devices will grow at a CAGR of 9.5%.

FIGURE 1

IoT Versus Other Connected Devices



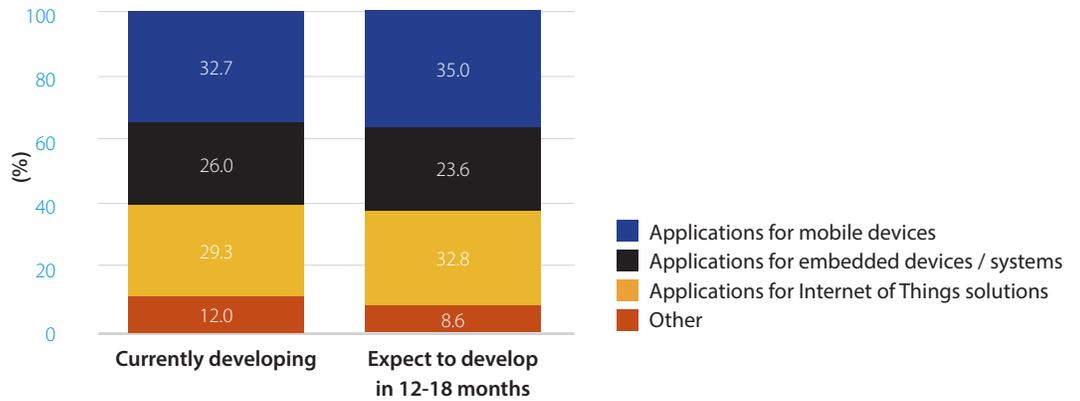
*Note: "Other" connected devices include smartphones, tablets, PCs, wearables, home connected devices, and servers.
Source: IDC, 2015*

While the IoT is not new per se, the market is still determining where the winning solutions, use cases, and applications will reside. The IoT is top of mind today because a variety of technical and market forces are conspiring to enable new efficiencies, deliver game-changing innovation, and unlock massive new business value. Challenges abound of course, but developers appear suitably motivated. Developers surveyed for this white paper said that they expect to spend more time on the IoT in addition to working on mobile applications over the next 12-18 months (see Figure 2).

FIGURE 2

Application Development Plans

Q. What percentage of your time do you currently spend working on each of the following areas?
How will you allocate your time in the next 12–18 months?



n = 274
Source: IDC, 2015

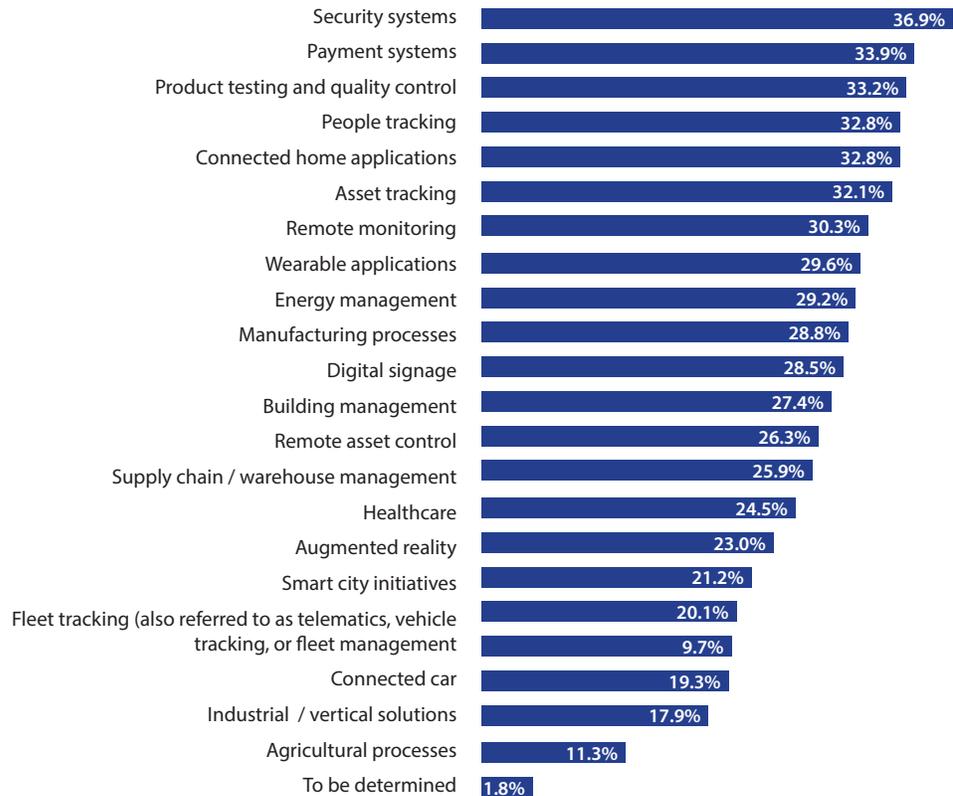
IoT Is a Business-First Opportunity

While the media sees connected pet collars, toothbrushes, and refrigerators as the driving force behind the Internet of Things, it is IDC's perspective that the business-to-business (B2B) market is really where the opportunity exists. This viewpoint is supported by the developer community as it indicates that much of its development cycles are spent on B2B — or business-to-business-to-consumer (B2B2C) — applications such as security systems, payment systems, asset tracking, and remote monitoring (see Figure 3). Consequently, IDC postulates that the B2B and B2B2C markets will drive the majority of IoT revenue and spending over the next several years. Over time, new business models will emerge where cost will be absorbed throughout the value chain that brings a product to an end consumer.

FIGURE 3

IoT Application Development Plans

Q. Which of the following best describe the type(s) of IoT applications you are developing/plan to develop?



n = 274

Source: IDC, 2015

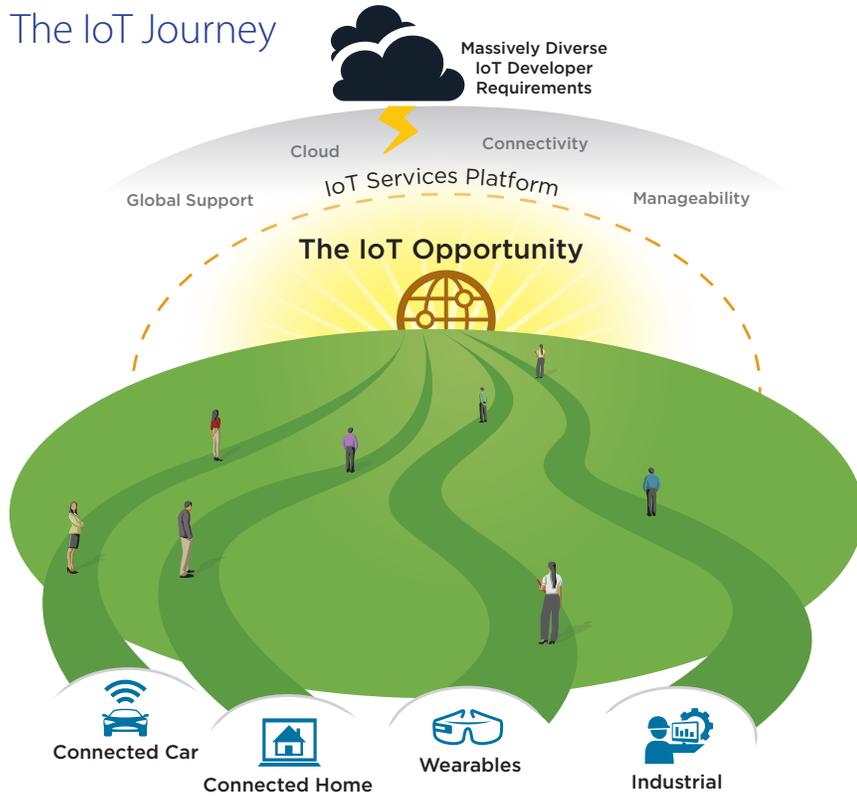
The Developers' Conundrum

There is clear evidence of positive momentum around the development of IoT applications. However, two central challenges remain. First, developers are challenged to cut through all the noise about the seemingly endless potential of this new market construct and find the right focus. The second challenge is finding the right partner to work with to bring to market an application or solution that is effective or, where applicable, revenue generating.

This partner selection process must tick all the boxes for the normal range of pre- and post-production development requirements in addition to those unique to the IoT. Organizations should source solutions with clear propositions around the following IoT development and data management considerations:

FIGURE 4

The IoT Journey



» **Development:**

- A comprehensive set of development tools that are familiar and intuitive to developers but also specifically designed for IoT projects
- Prototyping support for nonstandard or even ad hoc hardware configurations
- Visualization support for app testing
- Go-to-market, channel, and professional services support

» **Data management:**

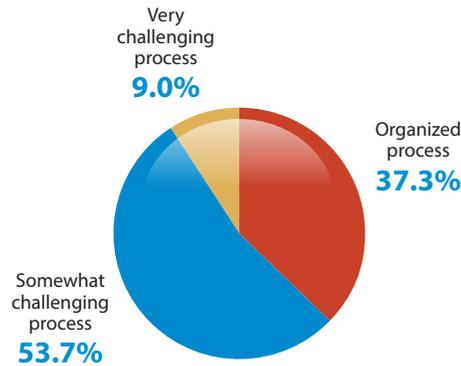
- Security, scalability, reliability
- Full management and configuration support
- Flexible data hosting and storage models
- À la carte access to best-of-breed components
- Dynamic network and connectivity provisioning and support on a global basis
- Low and predictable cost structures

It is no surprise that the majority of our developer audience (53.7%) found the process of developing applications somewhat challenging, with another 9% expressing it's been a very challenging process (see Figure 5).

FIGURE 5

Experience Developing IoT Applications

Q. Please choose the response that best describes your experience developing IoT applications.



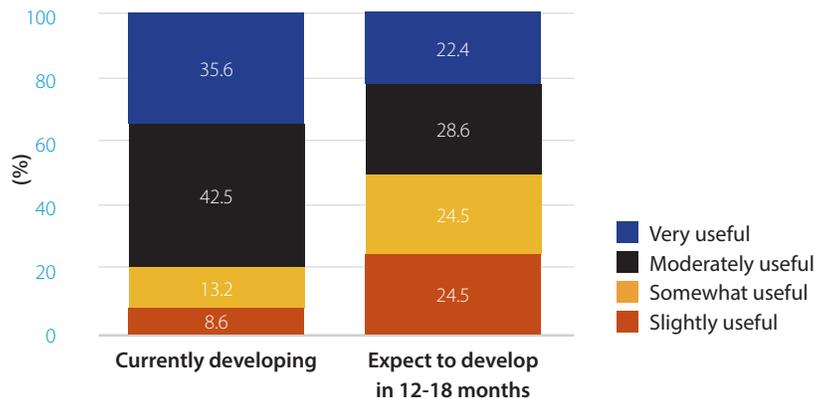
Source: IDC, 2015, n=201

An apparent lack of training almost certainly contributes to the development challenge. Almost one-third of aspiring developers indicated having no training in the development of IoT applications. The true training gap is likely larger. We expect that most developers will overestimate the extent of their preparedness to address the complexities in designing for a new environment. Our survey data further suggests that developers will struggle to find adequate research and training support in the public domain. Figure 6 shows, rather discouragingly, that active IoT developers find public resources and training only moderately helpful or worse.

FIGURE 6

Public Sources to Support IoT Training

Q. How would you rate the usefulness of the public information (i.e., Web sites, developer forums, vendor Web sites) you found in your research/training?



n = 223

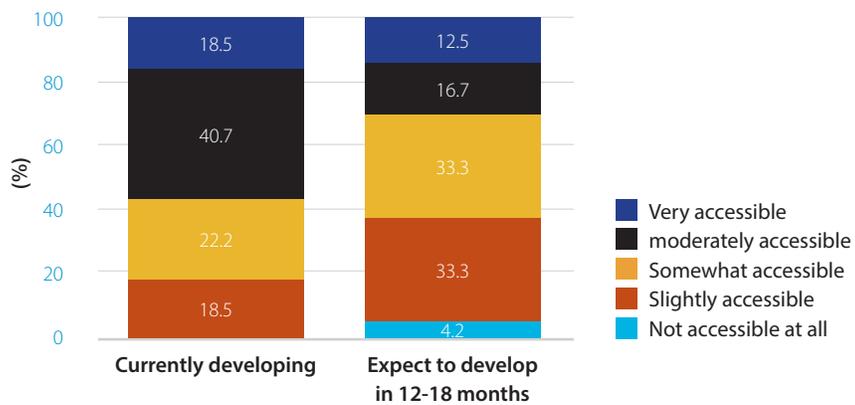
Source: IDC, 2015

Unfortunately, IoT developers' challenges extend beyond the suitability of public resources and into the domain of dedicated technical tools. 82% of active and 87% of aspiring IoT developers indicated less than readily accessible technical information is available (see Figure 7). This strongly suggests that developers are looking to vendors and service providers for better and more comprehensive toolsets and developer support resources and that where such resources exist, IoT development is poised to accelerate.

FIGURE 7

Accessibility of Technical Information on IoT Development

Q. How accessible is good technical information to help develop your current/future IoT application(s)?



n = 51

Source: IDC, 2015

Experience Summary: Attitudes Reflect Ability to Meet IoT Project Requirements with Current Practices

Developers' attitudes toward the tools and resources they're using for their IoT initiatives are a direct reflection of the resources' suitability to meet IoT project requirements. "Suitability" is a function of both the technical quality of resources (i.e., the extent to which they are built for or adaptable to IoT projects) and how readily they are sourced. IoT applications will have a number of unique requirements, including security, scalability, and connectivity configuration and support. Intuitively then, a centralized and comprehensive source of technical and business resources could substantially improve the IoT developer experience.

The Resource Challenge: Knowing What You Will Need and Where to Get It

Our survey of United States–based developers actively targeting or intending to target IoT projects in the near term illustrates a multiplicity of workflows, apps, and services targeted for IoT development. Support requirements will be correspondingly broad and deep and common and case specific. Yet the attitudinal data presented thus far suggests a relatively tepid disposition toward public and technical resources. Today's IoT developer support experience is less than satisfactory.

This section draws on our survey data to highlight:

- » Diverse configuration profiles and characteristics of current or planned IoT applications
- » Developers' specific or implicit IoT support and tool requirements for current or planned IoT projects
- » The diverse nature of developers targeting IoT applications in terms of their core markets (e.g., embedded, mobile) and coding competencies

The collective picture underscores a need in the marketplace for a comprehensive and dedicated IoT platform capable of accommodating an exhaustive, diverse range of IoT developer requirements.

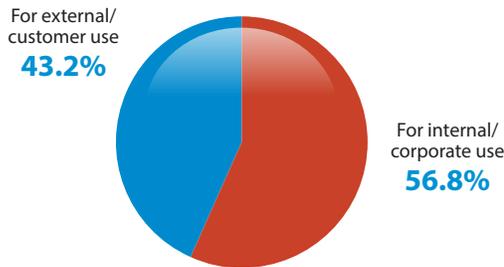
Probing further into connectivity requirements, we see a need to support multiple communication frequency configurations. We expect that in certain large or complex deployment scenarios, communications frequency requirements will be dynamic or not mutually exclusive, possibly requiring coordination between different local and wide area networks. The implied complexity of configuring and managing such a deployment is obvious and again underscores a need for sophisticated connectivity support.

As shown in Figure 3, there is active IoT development across a broad range of workflows, use cases, and deployment scenarios. Many of these instances will have specialized support requirements that are unique to use cases in the domain or subject to the vagaries of a given deployment scenario. Figure 8 reminds us that IoT apps will be extended to machine or human "audiences" both within and often well outside the enterprise firewall.

FIGURE 8

IoT Apps Will Reside Inside and Outside the Organization

Q. Is the IoT application you are working on ...



Source: IDC, 2015, n=201

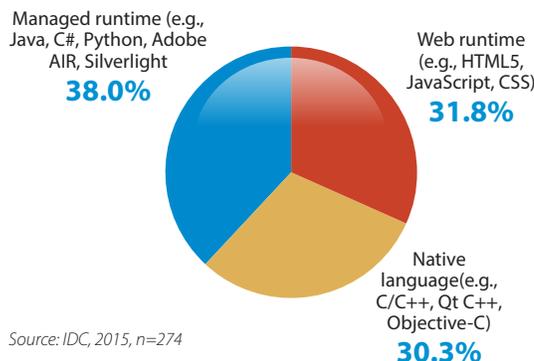
Core competencies among these developer populations are bound to be different. For example, an embedded systems developer may not have experience configuring an app for cellular or heterogeneous network connectivity. Similarly, a mobile developer may have no experience with microcontrollers. Support for both will be a common requirement in any variety of IoT deployment cases. Although a third of our survey respondents indicated a majority of their time will be spent on IoT projects, the results suggest that the pace of IoT development can be accelerated by platforms that bridge the gap for developers with divergent backgrounds.

Not surprisingly, given the diversity of developer populations targeting IoT apps, we also see an essentially exhaustive range of coding and development preferences in evidence across active IoT developers surveyed for this white paper (see Figures 9 and 10).

FIGURE 9

Code It Your Way: IoT Platforms and Services Must Accommodate All Development Approaches

Q. Which approach do you use most often for application development?



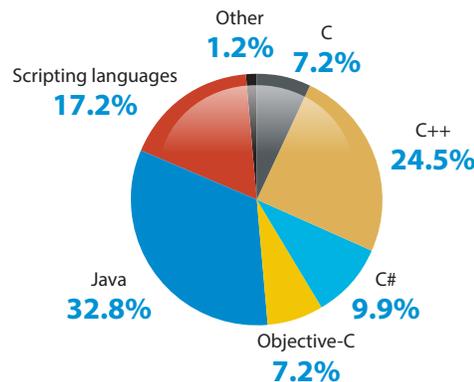
Source: IDC, 2015, n=274

The IoT opportunity reflects a heritage traceable through a universe of mobility, embedded system, and other use cases. Not surprisingly, we see developers with roots in these diverse domains all coming into the IoT fold. Similar to the mobile domain, one of several coding and development approaches may be more appropriate for a given type of application. Arguably, however, the nature of IoT applications will be more diverse and complex than what is currently observed across mostly iOS and Android app environments. Tools and solutions for IoT developers should be dimensioned to reflect the diversity of coding preferences.

FIGURE 10

Code It Your Way: Multilingual IoT Developers Will Require Multilingual Tools and Services

Q. What software development languages do you use?



Source: IDC, 2015, n=274

IoT Tools and Resources in Use Today Support the Case for a Comprehensive, Platform-Centric Resource

Active IoT developers surveyed tell us they are using a broad variety of tools and resources to support their work. Immediately in Figure 11 we see aspiring developers' expectations about resource requirements trailing what active developers tell us they are using in practice. This delta highlights how easy it is to underappreciate the need for resources in a new development domain like the IoT before projects are actively engaged.

Yet the most important lesson from Figures 9 and 10 is in the breadth of tools and resources being used by active IoT developers, not in any "expectation gap." The reality of these practical requirements is that it isn't practical, sustainable, or advisable for developers to source and integrate so many resources on an individual or piecemeal basis.

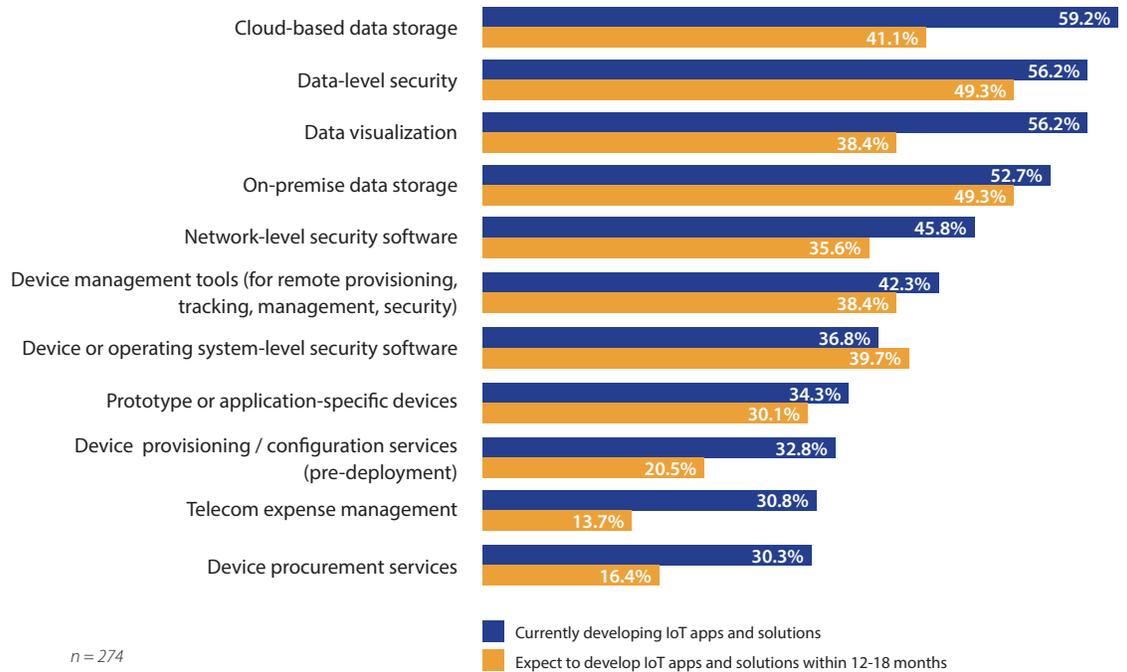
IDC believes this data supports the case for a platform-centric resource for IoT developers that facilitates coordinated access to a comprehensive range of tools and resources. In this

construct, it is critical that resources from a single source be available on a modular or à la carte basis. Requirements will change, both over the course of a given IoT development project and as the market matures over time. Developers should not be effectively forced by the platform structure to pay for more than they need. In this sense, the platform functions as a set of services that may be consumed as necessary.

FIGURE 11

Tools and Resources Used: Active IoT Developers Need Some of Everything

Q. What tools and resources do you expect to use in the IoT development process?



n = 274

Source: IDC, 2015

A Disconnect Between Developers' Resource Requirements and Adequacy of Today's Tools and Resources

Our survey of IoT developers paints a picture of broad tooling and support requirements for a diverse developer population. Certain requirements such as the complex connectivity configurations described will be unique to IoT deployment scenarios and may be best served by purpose-built solutions. Yet developers' attitudes toward public and technical resources for IoT suggest that the IoT developers' experience is less than satisfactory. The connection warrants further analysis.

It is reasonable to assume a direct connection between:

- » The tepid characterization by developers of their IoT experience
- » The complexity of a given IoT development and deployment scenario
- » The relatively new, dynamically evolving, and extraordinarily diverse state of the modern IoT domain
- » The diversity of resources a given development initiative might require

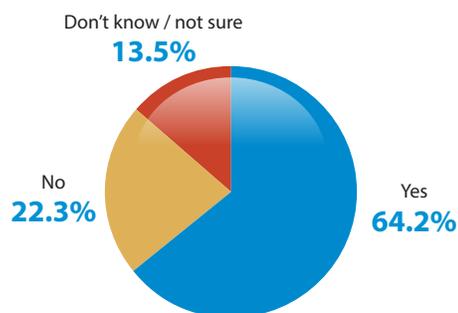
The collective results of our IoT developer survey support a market requirement for a centralized, platform-centric set of IoT development tools and resources. Ideally, this platform is flexibly designed to connect the broad range of IoT app development requirements and diverse developer communities with the right tools for the job(s). As noted, it is also important that the platform functions as a single source for a set of services that can be consumed (and paid for) as necessary. At present, it appears that developers are not broadly aware that such a platform exists.

A number of established solution providers are offering certain tools and resources in support of IoT initiatives, and not surprisingly, a majority of our survey respondents are using or planning to use them. In the case of application platform providers such as PTC's ThingWorx, IBM's Bluemix, and LogMeIn's Xively, there is a predictable preference for app enablement solutions designed with the IoT in mind. Indeed, we see a majority of IoT developers making use of these platforms (see Figure 12).

FIGURE 12

A Majority of Developers Are Making Use of App Enablement Platforms

Q. Do you use/plan to use a third-party application enablement platform to deliver your IoT application (e.g., Apple, Google, PTC's ThingWorx, Xively)?



Source: IDC, 2015, n=274

Getting Ahead of the IoT Developer Skilled Resource Gap

The right technical resources can substantially offset human resource challenges. A lack of available talent has demonstrably held back the pace of enterprise mobilization. In Appcelerator and IDC's 3Q14 Mobile Trends Report, both developers (41.3%) and IT decision makers (33.5%) cited "finding skilled resources" as the number 1 obstacle to timely app releases. This puts the shortage of skilled mobile developers as the primary barrier to efficient release cycles ahead of a number of well-known technical challenges. Encouragingly, we have seen broadening adoption of mobile application development platform functions aimed at overcoming the skilled resource gap, speeding time to market, and driving down mobile app development costs in the process.

Given the likelihood that IoT developer backgrounds will be more diverse than those of mobile developers and certain IoT projects may be considerably complex, it is reasonable to expect a skilled resource gap that is similar to or worse than what is evident in enterprise mobility. Organizations staffing up for IoT projects can mitigate the impact of skilled developer shortfalls by making the right tools and resources easily available to new or existing staff.

Future Outlook

Path to Success for the IoT Developer

Application developers represent a critical element in driving digital transformation across the consumer and enterprise markets. For the IoT to emerge in earnest, this community will need to look for partners that can provide holistic access to appropriate tools and support infrastructure. Some of the elements needed for IoT application developers to be successful are:

- » **Robust SDKs.** Developers surveyed ascribed the highest importance to analytics, cross-platform tools, and visual development tools.
- » **Third-party app development platform access.** 64.2% of developers surveyed plan to use an application enablement platform provided by a third party.
- » **Broad catalogue of APIs.** IoT developers will require a catalogue of APIs that allow access to functionality such as cloud infrastructure, location, social media, search, and billing/payments.
- » **Channel and go-to-market resources.** Access to sales analytics and customer information is an essential complement to a well-executed IoT app.

- » **Global reach.** 56% of current IoT developers are beginning with locally focused apps but have aspirations to extend internationally.
- » **Connectivity management.** The large majority of developers surveyed require support for real-time or regular, periodic communication and connectivity across multiple access protocols.
- » **Security.** It is difficult to understate the essentiality of end-to-end security in the IoT domain, which stands to have a much more dynamic “threat surface” than the mobile domain.
- » **Professional services capabilities.** 67% of experienced developers expect to require professional services during their development process.

AT&T IoT Services

AT&T is a global service provider and one of the leading vendors in the Internet of Things. In addition to providing connectivity to more than 21 million connected devices worldwide, the company provides services and support to IoT developers. AT&T's cloud-based M2X Data Service and Flow Designer visual development tools are the pillars of AT&T's IoT services offering. Both are purpose built for the Internet of Things and with the IoT developer's complex requirements in mind.

M2X Data Service is a fully managed time-series data storage service for Internet of Things applications and devices. Flow Designer is a standards-based visual development tool. Flow Designer aims to abstract development complexity at the device, network, and application layers such that developers can easily design, integrate, test, and deliver complex IoT applications.

Together, M2X Data Service and Flow Designer are designed to meet the complex and often heterogeneous needs of developers by providing a single, holistic source of IoT tools and resources with the highest degrees of scalability, reliability, and security.

Some of the key features of the M2X Data Service platform are:

- » Libraries and devices — provide a number of client libraries and AT&T-certified devices
- » Developer portal — a testing environment to vet IoT applications before they hit prime time

- » Data security — device data is stored on AT&T's secure infrastructure
- » Large-scale performance — storage of data collected from WiFi or cellular-connected devices, allowing the data to remain secure and accessible
- » Online community — a resource for IoT developers with tutorials, API documentation, and a forum for developers to access information on M2X Data Service

Flow Designer boasts a similarly comprehensive set of features, including:

- » An intuitive visual design interface that lets developers build, integrate, test, iterate, and deploy IoT app designs ranging from the relatively simple extension of connectivity to a given set of machine endpoints to the world's most complex and cutting-edge IoT projects
- » Pre-configured "nodes" that developers can use as simple but robust and reliable "building blocks" to access multiple data and cloud sources, device profiles, and connectivity configurations
- » Code reuse benefits thanks to open source communities and hosted code management tools
- » Flexible and cost-effective access to scale benefits of the cloud-hosted services model

Conclusion

Developers Are All In on the IoT, But They Need IT's Help

Developers from diverse backgrounds such as mobile and embedded are squarely and actively focused on the burgeoning IoT opportunity. But they need help. Our research shows that IoT development projects and the tools and resources required to support them are diverse, broad, and doubtlessly complex. Yet the suboptimal experiences and access to resources reported in research conducted for this study point the way to improving IoT development processes.

Essential Guidance for Organizations with IoT Agendas

Our research supports the case for organizations to strongly consider solutions that provide a centralized point of access to the extraordinarily broad range of development and data resources that IoT developers tell us they require. Of course, such solutions should meet the criteria for IoT specificity described in this study.

AT&T IoT services, including M2X Data Service and Flow Designer, are examples of such solutions that are available today and address a nearly exhaustive range of IoT data and development requirements. Organizations with IoT initiatives have an opportunity to deliver on the promise of robust, scalable, secure, cost-effective, and optimally designed IoT applications with the right choices in service and technology providers.

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