

Build 2017

Scott Guthrie, Executive Vice President, Microsoft Cloud and Enterprise Group
May 10, 2017

SCOTT GUTHRIE: Good morning, everyone, and welcome to Build.

Satya just demonstrated some of the incredible opportunities that we as developers all have today and the amazing impact we can have on people's lives. I'm not going to go deeper into the intelligent cloud platform that we're building here at Microsoft and talk about the platforms and tools that we're building to enable you to take advantage of and build amazing solutions.

One of the defining aspects of cloud computing is really the ability to innovate and release new technology faster and at greater scale than ever before. The set of new technologies that's coming out, things like IoT, AI, micro-services, server-less computing and more, is all happening right now thanks in large part due to cloud computing.

And it's an incredibly exciting time to be a developer, and the opportunities to explore new approaches and new technology has never been greater. At the same time, I also recognize that while all this stuff is amazingly cool, it can also be just a little overwhelming. I hear this concern a lot from a lot of the conversations I have with developers around the world. The expectation to know all these new technologies and to be up to date with them all the time can leave you feeling sometimes like you're falling behind.

Certainly the expectations that your companies now have on you to be able to quickly deliver breakthrough experiences with all this new technology is also incredibly high. In a lot of cases now your companies are now betting on you to really deliver new digital experiences that don't just run the business, but really transform the business and drive new revenue streams.

And at the same time there's a constant worry that sometimes some of the apps that you build might be hacked and you now need to be careful not just about the security, but also while simultaneously trying to learn the new tech and deliver these breakthrough experiences. Needless to say, all of this isn't easy.

It's really with this understanding that shapes how we build and design and deliver Azure. Every day my team works to make Azure a powerful enterprise grade cloud service, but the more important thing that we're working on is really to build Azure to help guide your success. Having great technology and lots of features is necessary, but not really sufficient. It's really about how those features enable you to be successful with that technology and with the cloud.

To deliver on this we're focusing Azure innovations on your needs, and by making cutting edge technology approachable to every developer and doing the heavy lifting to really ensure that Azure uniquely meets the enterprise scenarios that you require.

Satya spoke about responsibility and trust quite a bit this morning when he was talking about technology. Trust is a core value of everything we do at Microsoft and specifically with Azure. And we now lead the industry in our work on security, compliance, privacy and responsibility. And in everything that we deliver we really tried to design the features that we build to drive results. And this means having an end-to-end experience across our platform services, our management tools, our development tools, that really provide the most productive developer experience possible, and really enables you to build amazing solutions that can truly transform your businesses.

What I'd like to do to kind of give you an idea of what this looks like and how all these pieces fit together is invite Scott Hanselman on stage now to show off a demo of the combination of Azure and our Visual Studio family of tools in action and to really highlight the end-to-end experience you now get when developing for Azure in the Microsoft Cloud. Here's Scott. (Applause.)

SCOTT HANSELMAN: Hi friends. You've heard how Azure is delivering innovation that's been customized for your needs, designed for results, all inside of the trusted cloud and one of the ways that we do this is through our management stack and the dev tools to give you the things that will guide you to success.

Now here I am in the Azure Portal. You've probably seen this many times before and you're familiar with it. But you can customize it and I've customized it here. I've built on top of this management stack by pinning information from all over Azure. I've pulled in an Application Insights application map. I've got requests from my website, database utilization, pulled in compute information, all inside of my customizable dashboard that I can then share with other people on my team.

One of the things that's exciting about this, though, is to understand why this is working. It's because of all those programmatic APIs that Azure exposes to you, the end user. Each one of these is coming from a different Azure resource and presenting its information in an easy to understand and customizable way.

That's an amazing UI experience for both developers and DevOps people. But we've also put a huge investment in to our C-aligned, or command line interface and we thought what better way to showcase that than to announce today the inclusion of the Azure cloud shell inside of the Azure portal. (Applause.) This is a real Bash shell with PowerShell coming soon. I can type top just to prove it to you if you don't believe me. And what's great about this is that I've got a persistent cloud drive. That means that these things on my drive are there and available to me everywhere. Included in the Azure Cloud shell is the Azure CLI pre-installed, pre-logged in, pre-set up with your credentials and your information. So I can immediately type something like Azure VM list and explore that rich API.

And here's I've got JSON, got back some JSON. Maybe JSON is not what I want, so I'll type Azure VM List and I'll change the output to a table and because it's a real container-

based system, with a real Bash shell, taking to real UNIX, I can go and GREP for something. This is using a great open source tool called XTerm.js, to experience all of this in the browser. I've left nothing. I have not installed anything on my machine. And I am immediately able to go and query Azure directly from here.

What's cool about this, though, is I can go and maybe do something complicated. Why not create 1,000 virtual machines on the command line, right? Why not? So let's just hit enter and make 1,000 virtual machines and then while that is firing off, just because I want you to really, really believe me, I'll run Vim and since I don't know how to exit Vim I'm going to just have to reboot Azure completely to get out of Vim. (Laughter.)

So now we're going to close the cloud shell and I will go and click on my resources in the corner here and those 1,000 virtual machines are coming up in a virtual machine scale set and we are going to 1,000 instances right now all inside of Azure. It's pretty fantastic stuff. I can look at those instances rolling in right now.

Now, it's great to have that beautiful UI that sits on top of the management stack, and now I have a great CLI, a cloud-based shell inside of Azure preconfigured for me. But I'm a remote worker. I'm always mobile. Wouldn't it be nice if I could monitor and deal with those virtual machines on the go?

So another great announcement today is the Azure Mobile App on iPhone and Android.

(Applause.)

I can go in here and look at my web application, I can see my charts and graphs, I can start and stop it. But when you have something great like peanut butter and something great like chocolate, you've got to combine the both of them. So you put the cloud shell in the mobile app. So now I'm with my family and Chili's and I SSH into production -- (laughter) -- and I know that nontechnical spouse will appreciate my attention to detail there with the family. There's no way that that will affect my relationships at all. (Laughter.)

So I can manage all that great stuff in Azure, but, you know, I noticed something earlier when I logged in. I saw that there was an error here in my application map that was making me a little uncomfortable. I saw that my availability wasn't very high. I've got an issue here on the server side.

So I'm going to go and look at the full application map and go from the portal into Application Insights. This gets you this great experience that shows all of your dependencies. You can see that my web application depends on this API, and it looks like we've got an out of range exception, and a number of them. So we've received a large number of exceptions. I'm going to go ahead and click on those exceptions and take a look where they happened, when they happened, how they happened.

This is going to automatically create a debug snapshot. The intelligent cloud has been watching what's happening and it's intelligently sampling. There's been hundreds of errors but it's picked the best ones, like a burst mode on your phone picking the one that makes you look best. And here it's got a debug snapshot that I can then open up.

I'm on production now. This is running in production on Azure. So let's switch over to Visual Studio that we know and love, and I want to call your attention to the upper left-hand corner here. Visual Studio is debugging an application running in Azure. And I want to point out that the URL is not local host.

What we're doing here is we're enabling safe debugging with production data. The intelligent snapshots are seeing the errors happen without affecting my users in production popping off these snapshots. But I can also give hints. If the automatic snapshots aren't enough, I could say, I'm suspicious of this and that line. And then I can start, and not make a break like we do when we do local debugging, but a snap point that is going to tell Azure when that line gets run, grab a dump for me.

And I'm going to go ahead and say start collection. We're in production still. I'm going to go and just do the things that one does in production.

And you'll notice in the center there in that diagnostic session I am automatically getting dumps that I can then visit. I can go and say view snapshot, attach to that. Without affecting production I am looking at the data that I need to in the debugger that I love to use. I've got the call stack, I've got the objects, all production apps in Azure.

This is kind of find those bugs that you just can't find unless they happen in production. And that is now integrated with the intelligent cloud of Azure and Visual Studio.

(Applause.)

You go and combine that with something fabulous like CodeLens that tells me when the team made the mistakes, and I know immediately that Dan has to go. (Laughter.) When he made the change. And there's the failed request code locally, because I can then continue to my debug session locally or see which exceptions happened, and then analyze the impact of those changes. It's all fantastic and integrated in Visual Studio.

So this is Visual Studio on Windows. What about our wonderful friends on the Macintosh?

Let's go over to our Mac. Here is Visual Studio for the Mac, and I'm running that application. And Visual Studio for Mac, based on the Xamarin technologies, I can say file, new solution, pick, a native app, and you'll notice I can pick my target platforms like Android and iOS. And there's a button right here that says add ASP.net core web API project, automatically giving me that .NET backend that would feed my native application.

I've got a great experience for adding packages, for bringing in libraries from NuGet, all inside of my IDE. And even better, I can right-click and say, publish to Azure after I've fixed that bug. It talks to Azure App Service. I can pick one or even create an app serviced directly from inside of Visual Studio for the Mac.

I want to go ahead and publish my fix over to staging. That will pop up here in the corner. We're going to go and build that .NET application, launch it, and I am now published to Azure, and I'm running that application from Visual Studio for Mac. And there we go.

And what's even more exciting about this, and what I am very proud to announce is the general availability and the release of Visual Studio for Mac. (Applause.)

You can go and download that right now, have a wonderful time doing mobile apps and web apps and unity apps and mobile apps. It's so fantastic; I'm very excited about it.

So all of these tools sit on top of that trusted cloud. So let's talk about trust for a second, and switch back over to the Azure portal.

If I have a thousand virtual machines in the cloud, that can be a little overwhelming. And I want to make sure that those things are secure.

I can go into the Azure Security Center and look at all of the different things I have from compute, networking, my web applications, and look at specific recommendations that Azure has as it calls into that management stack and explores what my applications are doing.

And I can see I should maybe add a next generation firewall, possibly put disk encryption on some of my virtual machines.

And I made a thousand VMs but I'm a little concerned that maybe one is being attacked. Security incident detected. Apparently Guthrie is in the back with the mobile app attacking my virtual machine, so I need to go and take care of that.

As you see here, we've got these amazing innovative tools for management, for development, and they're going to make you not just productive but they're going to get you results.

And I want you to know that we welcome every developer, every language, and every application, and we're going to guide you to success on the Azure Cloud.

Thank you.

(Applause.)

SCOTT GUTHRIE: So Scott gave you a look at the end-to-end developer experience that you get when you build for Azure, and really showed off a number of the great enhancements that we're shipping this week. And we have a whole bunch more, but he just kind of showed I think a nice sampling of these.

In particular, we're really excited to announce that the Azure Cloud shell is now available to use. And this gives you a fantastic way to manage all your Azure resources, not just from the CLI but a CLI directly inside a browser, so you don't even need to install anything locally. We also have the Azure Mobile Portal available for you to download and start using on your phone.

And with the Visual Studio snapshot debugging support, this now really enables you to debug production apps without impacting users.

And we're incredibly excited about the general availability release of VS for Mac. Every customer that has Visual Studio today is now licensed for both the existing IDE you have, as well as for Visual Studio on the Mac.

And this gives you now the ability to develop with a single codebase develop on multiple platforms, and you can now target both mobile and cloud, as well as .NET Core and ASP.NET core, all within IDE you love.

And including as you saw Scott show off with the Visual Studio for Mac support is for the first time Azure tooling support built-in directly with that, enabling you to publish all of that to the cloud.

So the focus we've had on sort of delivering on innovation, trust and results is leading to tremendous adoption of Azure right now. You know, 90 percent of the largest 500 companies in the world are now running their businesses using the Microsoft Cloud. And these are just a handful of some of the customers running on Azure today.

What I want to do is let's go ahead and watch a video of a few of them talking about the success they're seeing with Azure.

(Video segment.)

SCOTT GUTHRIE: So you can use Azure for infrastructure, and just take advantage of it for base compute, storage, and virtual machines, but you can also take advantage of a coherent set of highly engineered services to build your apps even faster.

So what I'm going to do for the rest of the keynote is walk through a couple of these key areas, and talk about some of the announcements this week that we're doing to make you even more successful with them.

Let's start by talking about data. Data is a core part of every app and experience being built today. And the couple things that we hear, that I hear a lot from developers is, you

know, one, you really love your particular database of choice, and you want to be able to keep using it as you move to the cloud.

And then secondly, as you start to move to use that database in the cloud, you'd really like to have a more efficient experience than just running it inside of virtual machines. You don't want to have to manually configure things like high availability. You'd rather not have to manually take care of backups. You want to be able to easily scale up and scale down your databases with zero app downtime. So let's talk about how we're making these things easy with Azure.

You know, last month, we announced our new SQL Server 2017 release. SQL Server 2017 is the fastest, most secure, and more intelligent database on the planet, and now provides ultimate flexibility.

And we're releasing SQL 2017 simultaneously on Windows Server, on Linux, as well as Docker-based systems. And it really delivers unparalleled performance with our new adaptive query processing engine, making it the fastest release of SQL Server ever.

And we're also with this release now building in machine learning capabilities and allowing you to do in-memory operations with it. This enables you now to use machine learning models built directly in R and Python, and run them inside the database, making your apps more intelligent than ever.

Now, one of the things that makes SQL Server unique is that it's the only data platform out there that's available both on-premises and as a fully managed service in the cloud, using Azure.

And what this means is that you can now take advantage of all of that SQL Server functionality everywhere, and get the best possible experience when using it as a fully managed experience in the cloud.

You can now stand up a new SQL database in Azure within 60 seconds, and have it be highly available, durable, secure, and fault tolerant, without you having to configure anything.

And Azure provides built-in backup and point in time restore capabilities, automatic performance tuning support, as well as threat detection capabilities that enable you to run your apps more securely.

And best of all, you get all these capabilities without having to manage or spin up any virtual machines, and without having to worry about patching them or tuning any of the infrastructure manually. Our SQL database as a service offering takes care of all that for you.

This week at Build we're launching a new Azure data migration service that's going to make it even easier for you to migrate your existing databases to use our Azure SQL database as a service.

You know, this data migration service really streamlines moving existing database systems to Azure, and provides a fully automated workflow to do so, you know, both for SQL Server instances, as well as for non-Microsoft database platforms as well, including Oracle based systems.

And this new data migration service, combined with additional capabilities that we're releasing this year with SQL Database, is going to make it truly easy to migrate literally every single SQL Server instance that you have to the cloud, without having to make any database changes and without having to make any code changes within your application, and really have a seamless near zero downtime migration experience.

You know, DocuSign is a great example of one Azure customer taking advantage of this new capability. DocuSign is one of the leading enterprise SaaS providers today, and supports more than 200 million users. And they historically run their transaction processing systems within their own data centers. And we're very honored that today they're announcing that they've chosen Azure as their cloud platform to run their systems on going forward.

Here's a video of them talking about this decision.

(Video segment.)

SCOTT GUTHRIE: So a few minutes ago, I talked about how we know that developers love their particular database of choice, and really want to keep using it as they move to the cloud. Some love SQL Server, some love MySQL, some love Postgres.

And today, we're really excited to bring two new databases of service offerings to Azure. One provides MySQL as a service, and the other now provides Postgres as a service.

Both of these are fully managed database offerings, just like our SQL database offering today. You can stand up a new MySQL or a Postgres database in Azure now using these in under 60 seconds. They have high availability and security built-in, and we automatically patch and update them for you.

And unlike other cloud providers, we enable you to elastically scale up or down the performance of these databases with zero application downtime. And best of all, they're 100 percent compatible with all existing MySQL and Postgres tools, drivers, and frameworks. And they're available for you to start using today.

(Applause.)

Now, as you use the cloud to reach new global users, your data also needs to scale, scale in terms of the volume of data that you're managing, the different variety of data models that you want to represent inside your application, and above all in terms of the performance that you need to achieve. And each next generation application really needs a strategy to handle all these different types of scenarios.

And today, I'm also really excited to announce Azure Cosmos DB, which is the first globally distributed, multimodal database service that delivers turnkey horizontal scale-out, with guaranteed millisecond latency, and uptime. And it's designed to explicitly enable these types of next generation apps.

So imagine a horizontally scalable database that puts data everywhere that your users are. With Cosmos DB we've built a database service that does just that, and can automatically replicate data to any Azure region around the world, to give your users lightning fast performance, regardless of wherever they're accessing your application.

Cosmos DB allows you to choose the data model that fits your application use case, and gives you the flexibility to access it using the API of your choice. So for example, you could store data in a key value format or graph or document data, all inside Cosmos DB.

Cosmos DB automatically indexes all the data and allows you to use your favorite NoSQL APIs, including DocumentDB, MongoDB, Gremlin, Azure Table Storage, to query this data and work with it.

And Cosmos DB allows you to elastically scale your storage and performance throughput across one or multiple Azure regions, with zero application downtime. You can start with just a few gigabytes of data and scale up to store petabytes of it. And you can start processing with say just a hundred transactions per second, and scale up to millions of transactions per second, with zero downtime.

And best of all, with Cosmos DB you pay only for the storage and the performance throughput that you actually use, which enables you to really change the economics of how you store data in the cloud.

And Cosmos DB is the only database with comprehensive SLAs not just for availability but also for data consistency, as well as performance. Cosmos DB we guarantee single millisecond response time at the 99 percentile as one of the SLAs that's built-in. That's really a game-changer.

And what's great is unlike any other service, you can actually monitor that SLA and that metric directly inside the Azure management portal to see how your application is doing and to ensure that it's reaching that point. That enables you to build just amazing solutions unlike any others out there today.

Jet.com is a great customer who's running entirely on Azure today. This is a fantastic example of the type of service that can really take advantage of a global database like Cosmos DB. Here's a video of them talking about Jet.com and how they're using Azure.

(Video: Jet.com)

SCOTT GUTHRIE: So Jet's been using Cosmos DB this past year, and now runs their Jet.com solution across three Azure regions and replicates using Cosmos DB their data across all of them. This enables them to deliver amazingly fast performance to their users and enables a highly durable and available application.

Jet's gained some really just incredible business growth this past year. You know, Black Friday is the biggest shopping day of the year here in the United States. And Jet scaled their Cosmos DB deployment to support 100 trillion transactions that day.

And they were able to achieve single-digit latency, millisecond-digit latency at the 99th percentile, something they could not have achieved with any other data service offering.

And not only is Cosmos DB incredibly powerful, it's also incredibly approachable from a developer perspective.

What I'd like to do is invite Rimma, who is one of the architects of Cosmos DB, on stage to show off how you can build solutions with it. Here's Rimma. (Applause.)

RIMMA NEHME: Azure Cosmos DB, our globally distributed, multi-modal database service.

Now, imagine you want to build a planet-scale intelligence app with users worldwide. It has to be super-fast, it has to be incredibly elastic, and it has to be highly available all over the world.

In this demo, I'll show you how easy it is to do it with Azure Cosmos DB.

So we've taken Marvel Universe data set, which represents a complex network of comic characters, and built a simple Web app around it, where fans from all over the world can come to this app, click on their favorite character, and ask them any type of question they want, as if they're interacting with a real human being. For instance, Ironman, who are your friends? And get the response back.

Or I can ask even more sophisticated questions. For instance, who are your enemies that work for Hydra? And get the response back.

Now, behind the scenes, the data is stored as a globally distributed graph inside Azure Cosmos DB. And we provide a near-real-time response latency to all of the questions that I'm asking that actually get translated into graph queries that get submitted to Cosmos DB.

So how do you build such an app? In fact, how do you even create a globally distributed database that spans the entire world? It's very easy, let me show you how.

So you come to Azure Portal, you click new, you go to databases, then you pick Azure Cosmos DB right here.

And then you specify what you normally would specify for any Azure service, IDs, subscription, resource group. But what's really interesting here is a new set of APIs that you can choose from. If you want to use SQL, you can pick DocumentDB API, if you want to use Mongo, you can pick MongoDB API.

And today, we're announcing a public preview of two new APIs, Gremlin for graphs, and Table API for premium table experience.

Select the API, then the location where you want to start out, and then click "create," and that's it. You're done. We have just created a globally distributed database with very powerful capabilities.

Now, applause? Thank you. (Applause.)

Now, our data set is already stored inside Cosmos DB for the app that I showed you at the beginning. We can come to the data explorer and actually visualize it in the form of the graph itself.

I can actually click on the node, see the connections between them, I can even specify a Gremlin query directly inside Azure Portal and get the results in near real time, right here in the form of a sub graph.

Now, remember, this is not just a regular graph. This is a globally distributed graph. And, in fact, the data is already distributed across nine regions worldwide.

So let's assume my app goes viral and I get a lot of fans in Asia. All I need to do in order to add new locations is just select the locations where I want my data to be, click "save," and that's it. The data gets seamlessly replicated into those regions.

And this is called global distribution turnkey capability, which is very, very powerful.

And all this time, my application continues to be highly available thanks to the multi-homing capability that Azure Cosmos DB provides.

Now, remember also, Cosmos DB is the first service that gives you horizontal scale-out of both of your storage and throughput. So my graphs will be able to accommodate to this very diverse workload worldwide.

And in addition to that, I can answer any of my graph queries worldwide with less than 10 milliseconds read latency guaranteed.

Now, the key message here to remember, though, is that regardless of the data model, regardless of the API you're using, regardless of the data distribution or even the failures, we continue providing you with a single system image for all of these globally distributed resources worldwide so that you developers can concentrate on your application, not on the database behind it.

Now, another unique capability that Azure Cosmos DB provides is a set of five well-defined consistency models. Now, this is a fascinating area.

When you're building an application with the data that is globally distributed across the world, you're facing a fundamental tradeoff. Do you want your applications to serve perfectly consistent data all across the world to all of your users, but at the price of the performance?

Or do you want your applications to be incredibly responsive, but at the price of serving sometimes the data that is not up to date?

Most of the database systems force you to choose between these two extremes known as strong consistency and eventual consistency.

Now, the effect here is that most of the real-world applications and use cases don't fall in between these two, into these two extremes.

So Azure Cosmos DB is the first database in the world that gives you five well-defined consistency models, including three intermediate consistency levels including bounded statements, session, and consistent prefix. So you can go and further optimize this tradeoff that your application faces and pick the right tradeoff between high availability, performance, and consistency of your data.

Finally, the SLAs. Now, a true measure of any cloud service is measured by its SLA. After all, it's a service, it's not just a software. So while most of the other cloud services give you the SLAs for high ability, Azure Cosmos DB is the first service in the world that gives you comprehensive SLAs on all of the dimensions that application developers really care about.

These include latency, throughput, consistency, and availability at the 99th percentile worldwide.

So let's see what the application code actually looks like when we interact with Cosmos DB.

Our application is a simple Node.js app. And all we had to do was add a Gremlin package and then I have a very simple function called January Gremlin Query that takes

my questions to the superheroes and translates them into corresponding Gremlin queries. Because it's a Gremlin end point, any open-source Gremlin client will work.

So there you have it, Azure Cosmos DB, Microsoft's globally distributed, multi-modal database service. Because we truly believe that your applications deserve a database that is out of this world.

We're very excited to see the type of applications that you're going to build with Cosmos DB. With that, back to you, Scott. Thank you so much. (Applause.)

SCOTT GUTHRIE: As Rimma mentioned, you know, we're incredibly excited to see the types of apps that you build with Azure Cosmos DB. All of the capabilities that we've talked about this morning and that Rimma demoed are now available for you to use today. And, in fact, the Azure Cosmos DB service is now generally available for you to use in all regions across Azure.

And because Cosmos DB is an evolution of our DocumentDB service, all of our existing DocumentDB customers have been automatically migrated and upgraded to take advantage of Cosmos DB, and you can now take advantage of all these additional capabilities with it starting immediately.

So we talked about data. Let's switch gears now and talk about something else that a lot of developers ask me about, which is how best to modernize your applications as you move them to the cloud.

You know, specifically, you know, a lot of companies, a lot of developers don't want to just lift and shift their apps to the cloud, they also want to take advantage of new technologies, things like containers, micro services, serverless-based computing, to make them cloud native.

And to do so, without having to gut and rewrite all of their code from scratch, which is something that, hey, we'd all love to do, but we usually don't have always the luxury in order to actually do it.

Alaska Airlines is one of the many companies that's in the process of modernizing their systems as they move to the cloud and to make them cloud native. And they're doing that on Azure. Let's hear their story.

(Video: Alaska Airlines.)

SCOTT GUTHRIE: Let's talk about how developers like Alaska are doing that. You know, and with Visual Studio 2017, we now have integrated Docker support that delivers a fantastic container-based development experience. You can now easily develop, run, debug and test container-based solutions directly within the Visual Studio IDE, and our DevOps support with Visual Studio Team Services now makes it easy to stand up a

CICD environment that can be used to automatically build and deploy any container-based solution.

You can, of course, use all this support for what I call "green field applications" or new applications that have been specifically designed with a micro-service-based architecture. And these green field apps can leverage, for example, the new .NET Core framework that we released to build very lightweight micro-service-based applications that can run in both Windows and Linux-based container systems.

You can also leverage all this new container support to also gracefully update your existing applications to be containerized as well, so it doesn't require you to completely rewrite all your systems at once.

In fact, you can take full, existing .NET Framework apps, including ones explicitly written to use IIS, that use WCF and other native Windows components, and now easily containerize them using Docker and run them within Windows Server containers as well.

This means you can really start to take advantage of a micro-service-based approach in every application and really start to get the agility and benefits that they provide, and then able to continually tune and update your applications with new capabilities after that.

What I'd like to do is invite Maria on stage to show off how you can take an existing .NET application and easily modernize it with containers. Here's Maria.

MARIA NAGGAGA: Thank you, Scott. (Applause.)

Wow! Isn't this exciting? As Scott mentioned, with Visual Studio and Azure, we're making it easy to build amazing new applications and modernize your existing ones for this cloud-native architecture.

Over here, I have an application that might look like some of the ones that you in the room are running on Windows today. I'm going to show you how you can easily containerize your application in Visual Studio by simply right-clicking on it and adding Docker support.

Visual Studio then goes and generates a Docker file for us that immediately detects this as an .NET Framework application requiring Windows, IIS, and ASP.NET to run.

And let's say you want to enable different services into your application. You can do that right here in your Docker file. Look, I've just enabled .UCF.

Now, since we've containerized our application, let's go ahead and make sure that it's running as we expected.

Over here, I have a completely containerized version of my application and I'm going to play around with it and it's completely running locally on my machine. And I want to play around with it to see what's going to happen.

Okay, it looks like we've hit a breakpoint. The first breakpoint I've hit is in my CRM application, Web application, that is in a container on my left. And then when I hit "continue," it goes to my Web API, which is in a completely different container.

Visual Studio now supports cross-container debugging. These are the experiences that you have become used to in Visual Studio and we're just bringing them over to containers.

Now, my application is running as expected. So I'm feeling good about it. So I'm going to go ahead and put it into production.

We understand that the modern workflow is very focused on being continuous. And that's why now you can right-click on your solution and configure continuous delivery.

Continuous delivery enables us to specify the Azure container registry where we want to push our containers. We can also specify the type of host where we want our containers to run. And you have options. You can use App Services, and we also have Kubernetes coming soon.

And today, I'm excited to show you Service Fabric. In just a few clicks, we have configured Visual Studio Team Services to manage our build and release pipeline.

In our build pipeline, it will compile our code, it will build our container, and it will push it to a network close Azure container registry.

And just in case you wanted to add additional tasks, you can do it right here in VSTS, and pick on from the thousands that we have in the marketplace.

From our release definition, you will see in one step how we are telling Service Fabric to take our Docker compose file and push it to Azure. And I have to say, Azure is the best place to host your containers.

Over here, we have our application running in a five-node Service Fabric cluster. You can see how many applications we have, both new and existing, running in this high-density, highly reliable environment.

And because of the dependency isolation that we get with containers, we can make sure that our applications are running comfortably together without interfering with each other.

Scott Hanselman earlier showed you how we can begin to get rich telemetry on how our applications are performing. And we're bringing the same experience to containers. You

can see how our application is performing at the infrastructure level to the container level, as well as in the application itself.

And with the application map, you can see how all our different services are interconnected together. Visual Studio is the best place to debug and containerize your applications, and Azure is the best place to host them.

Thank you, and back to you, Scott. (Applause.)

SCOTT GUTHRIE: You saw how Maria was able to take an existing full .NET Framework application, you know, one written years ago, and able to use Docker to containerize it, then set up a CICD build pipeline, and then use it to easily deploy inside Azure. And she used Service Fabric to run the containerized application.

Service Fabric is an incredibly powerful micro services framework that we provide here at Microsoft that you can use, and we also build most of our services inside Azure on top of it, including Cosmos DB and including our SQL DB offering.

And what's great about Service Fabric is it really enables you to take advantage of a micro-services-based approach and now natively supports Docker images, including the Docker compose framework.

This allows you to take the best of the Windows ecosystem and the best of the Linux ecosystem and use it together. And now you can take applications, including ones with existing code that you already have, update them to be a micro-service-based architecture, add additional micro services maybe with .NET Core or even with other different languages or frameworks, and run them all seamlessly inside a single cluster as part of it.

And I think this is really going to enable you to do some amazing things and build some amazing applications.

What's great about Service Fabric is it runs both in Azure as well as on Azure Stack, and you can even stand it up on premises on existing bare metal servers or in VMs, including in other cloud-based environments. This gives you maximum flexibility to modernize your applications, and to be able to start doing it immediately.

So in addition to supporting containers using Service Fabric, we also enable you to build apps using containers in pretty much every Azure compute service now.

You know, for example, you can now use containers in Azure Web Apps, in our Azure Batch Service, which provide very optimized platform-as-a-service offerings for web and scale-out processing scenarios.

And with our Azure Container Service, we now enable you to build applications with every popular container orchestration framework out there including Kubernetes, Mesos and Docker Swarm-based systems.

No other cloud provider gives you as much flexibility as Azure does when it comes to containers, and you can use all of these great capabilities today.

Now, as you look to modernize your applications and adopt a micro-service-based architecture, one of the things that you'll probably want to start taking advantage of is serverless-based computing.

You know, a serverless approach allows you to execute code in an event-driven way, which should really help guide you to design your applications to scale better. And serverless computing can also, though, help you save money by enabling you to avoid having to pay for server resources that you might not be fully using.

And Azure enables you to build robust, serverless-based solutions now that can trigger off of literally hundreds of different event sources.

So, for example, you could write code to execute in response to an HTTP request or an IoT event, as you saw earlier in Satya's keynote, or even something like a CRM records change in either Dynamics or Salesforce.

Our Azure Function Service enables you to execute this on-demand, serverless code, written in a wide variety of different languages including C#, JavaScript, Java and more.

And with our new Visual Studio 2017 tooling support that we're releasing today, we now provide an incredibly rich way that you can develop Azure function apps locally inside your IDE. This makes it incredibly easy to take advantage of serverless-based computing, and we're now the only cloud provider that gives you this type of end-to-end experience where you can develop, run, debug, and test entirely locally on your development machine.

We also now have CICD support for Azure Functions with both Visual Studio Team Services as well as GitHub-based back ends.

And our Azure Logic App Service enables you not just to execute code, but also to execute now on-demand, serverless workflows. And these workflows can use more than 100 built-in data and app connectors that we provide, enabling you to trigger serverless workflows from systems like Dynamics 365, Office 365, Salesforce, Adobe, SAP and more. And securely process and route data across long-running processes and workflows and business logic.

And these workflows can also include Azure Function Apps, giving you a really robust way that you can now marry both code and declarative workflows together and all run it in a serverless environment.

We're really excited today that we're announcing a bunch of updates around serverless that you'll be able to start taking advantage of. This includes the great new Visual Studio 2017 tooling support for both Azure Functions as well as for Azure Logic Apps.

And we're also releasing serverless computing support with Azure Application Insights.

You saw Maria show off Azure Application Insights as part of containers. You saw Scott Hanselman show it earlier in the context of a web app.

The nice thing with Azure Application Insights is you can span all types of apps inside Azure, written in all types of languages, and now have a single view across them.

We know that the lack of monitoring insight into serverless-based apps has been one of the things that developers both using Azure, but also other cloud platforms have always said is really, really hard to monitor these systems.

Now, with this new release today, we're making it incredibly easy for you now to get rich monitoring support across your apps, which is going to make developing and running them even easier.

Domino's Pizza is a great customer of ours who's running their systems on Azure today. And they're starting to leverage our Azure serverless functionality together with all the other Azure platform-as-a-service capabilities we provide to really update and modernize their apps. Let's hear their story.

(Video segment.)

SCOTT GUTHRIE: So we've been talking about so many incredible capabilities that Azure provides. But I also hear from a lot of developers that there are scenarios where you just can't use the public cloud yet, and it's really that reality that compelled us to build Azure Stack.

Azure Stack is an extension of Azure. Azure Stack provides a consistent cloud experience with the same management API, portal and developer services available inside Azure. And it's a cloud that you can deploy and run literally anywhere.

For example, with Azure Stack, you can now use the cloud for edge and disconnected scenarios. Carnival Cruise Lines is one of our early Azure Stack adopters. And Carnival has been using Azure now for several years and runs their fleet management software on Azure and has a large Azure Data Lake where they take all this data from their ships and perform analytics on top of it. They're big believers in the public cloud.

The problem that they have is that sometimes they can't connect to the Internet when their ships are out at sea. When you're in the middle of the Pacific and maybe there's a storm, it's not really good to have to rely on a satellite network link to connect to the Internet to

run something that's critical on the ship. And what's nice about Azure Stack is it now provides the ability for them to use Azure everywhere, not just when the ship is in port, but now when it's available out at sea. Now they're able to upgrade their onboard systems to be built and managed using Azure Stack and be able to use the same application logic, same set of core Azure services, even when running disconnected and be able to build even better systems with it.

The combination of Azure and Azure Stack also enables you to meet literally every regulatory need now. Azure today has more compliance certifications than any other cloud provider. We also now have 38 unique Azure data center regions around the world. From that perspective, that's more locations and countries than AWS and Google combined. This enables you to meet more data privacy and cloud residency requirements than any other public cloud solution.

Yet we also know that there continues to be scenarios where data and applications must still reside in a country that doesn't yet have public cloud provider with a data enter inside it. E&Y is one of the largest professional services firms in the world. They're using Azure to run many of their applications and being a trusted secure cloud was the key reason why they chose Azure. The documents and data that E&Y stores are amongst the most sensitive pieces of data in the world.

The challenge that they've had has been how to use public cloud for all of their clients. There are certain countries in the world where there's legal requirements that company documents are not allowed to leave that country's soil. And in some of those cases there are no public cloud providers currently operating in those countries.

And the beauty of Azure Stack is it basically now gives E&Y the ability to write their application once and deploy it both in Azure and run it in its own facilities with Azure Stack for those particular countries. And this gives them literally the ability to meet every regularly requirement in every country in the world with a single code base. Let's hear their story.

(Video segment.)

SCOTT GUTHRIE: And Azure Stack enables you to also begin modernizing your on-premises applications even before you move them to a public cloud environment.

What I would like to do to kind of show off kind of how to use Azure Stack, how to build applications and what the experience is like is invite Julia White on stage to give it a demo. Let's do it.

JULIA WHITE: Thanks, Scott.

All right, now let's take a look at Azure and Azure Stack working together to address the disconnected and edge scenarios that Scott talked about. Now, in this case, it's a shipping company, North Wind Traders. And they're using Azure for the global operating system,

and they're using Azure Stack for the app that's running locally on the ship. Now here is their global operations system running in Azure, they're monitoring the ship across the globe.

I'm going to switch over to the Azure Portal to see how this app was moved. And you can see here in Azure they're using a number of different services, in this case Event Hubs to process and receive millions of transactions coming off of each of those ships. I'm also going to -- they're also using this Web Apps service to do their live monitoring of the ships all over the sea.

Now this is the global operations system. Let me switch over to Azure Stack and talk about the system running on the ship locally. So I'm switching over here to Azure Stack and you notice that, let me zoom in so you can see that, Azure Stack. You'll notice that the experience is entirely consistent and that's the point. Azure Stack is an extension of Azure. The portal, the APIs are all consistent. This means you can leverage the same investment in people skills, in processes, and the applications across Azure and Azure Stack.

Now Azure Stack has both IaaS, as well as platform-based services. So I can use the same services in Azure and that global system, as well as what's being used here local on the ship's system. So you're seeing I have that same web app service. I'm using Azure Stack, but I'm also using Azure in that global system.

Now, again, this is a disconnected and edge scenario. And so while at sea sometimes bandwidth can be limited, or super-expensive. So it's a perfect scenario for serverless compute with Azure Functions. You see I'm using Azure Functions to actually parse data real time on the ship to decide what stays local and what goes up to my global operating system and when it goes, as well. I can even go in and I can monitor all the events hitting my serverless compute system here, right from my Azure Stack system, just like I would from Azure. Again, that same serverless computing experience.

Let me flip over to Visual Studio and look at how this hybrid application was built. And again, because the APIs are consistent across Azure and Azure Stack I have the same developer experience, as well. You see in Visual Studio I have that global system running here and then I also have that local system that's running on the ship and there, in fact, is a function service that I talked about parsing the ship's data.

Now I can update my update my app here, maybe add a new feature perhaps, and then go ahead and deploy it directly to Azure or Azure Stack. I can even integrate it with my CIDC pipeline to do an automated deployment and test, targeting both Azure and Azure Stack. In this case I'm going to go ahead and manually just kick off this deployment. Go over to my application here. Now thanks to Azure Active Directory it actually pulls my subscriptions across Azure, as well as Azure Stack. So if I open that up and zoom in you can see there, in fact, are my Azure subscriptions, as well as my Azure Stack subscription running that app locally on the ship.

I'll go ahead and deploy that out to Azure stack. Deploy. Now I just right here in Visual Studio push that app out to my Azure Stack deployment running on the ship. Azure Stack is truly an extension of Azure, enabling you to design, to develop and operate your applications wherever your customers and your business needs.

Thanks so much.

(Applause.)

SCOTT GUTHRIE: So you saw from Julia there in terms of how easy it is to build Azure Stack-based systems and that consistency that it gives you with the public cloud.

Now Azure stack is just one part of our overall hybrid cloud consistency story. In Azure your hybrid cloud runs really as one holistic system and can span identity, data, application platform and infrastructure. And this really takes the complexity out of running a hybrid cloud and really enables you to start taking advantage of cloud immediately, again, for pretty much every scenario.

So we've talked a lot about technology this morning. Let's switch gears now and talk about how Azure helps grow your business. I know a lot of software companies attending Build this week are delivering their software now as a service or are looking to do so soon. And many great companies here are already running their solutions already on Azure. And this slide here just highlights the full sampling of some of the SaaS providers running on Azure, really across a wide range of different industries and verticals.

Now last year Adobe chose Azure as their preferred cloud partner to deliver their SaaS-based offerings now going forward. And I'm really honored to have Abhay, the CTO of Adobe, on to join me on stage, to talk a little about their experience and what drove this decision. Please welcome Abhay. (Applause.)

ABHAY PARASNIS: Hey, thank you, Scott.

Good morning, Build. It's really great to be here. I'm excited to talk a little bit about the great partnership we have between Adobe and Microsoft.

SCOTT GUTHRIE: It's great to have you here. Can you talk to us a little bit about Adobe and the enterprise SaaS solutions that you're delivering?

ABHAY PARASNIS: I think probably most people in this room probably still think of Adobe as the Photoshop and PDF company. But over the last few years we have been in a really exciting transformation of our business and have become in the process one of the leading enterprise SaaS companies, with a very common and shared vision with Microsoft of a cloud-first mobile-first world, powered by intelligent content and data.

With our SaaS solutions we are completely reimagining the entire creative process, future of documents and perhaps most importantly, working closely with Microsoft, we are driving a very ambitious agenda to reimagine what the modern enterprise experience looks like with content, data, and intelligence at its core.

SCOTT GUTHRIE: That's pretty awesome. So the Adobe Cloud, they're really focused on content and data, as you mentioned, at the core. Can you talk about the solution and some of the unique things that you're trying to solve?

ABHAY PARASNIS: Yeah, I mean for us really at the heart of our product strategy and business strategy is this notion that blending the art of content with the science of data and doing so at massive cloud scale with a real focus on the real time intelligence. You heard a lot about that this morning and we share a lot of the same vision, whether it's hundreds of millions of images and photos and videos that process through Creative Cloud, or billions of document and PDF files that flow to Document Cloud, and frankly our Experience Cloud, which is our enterprise-focused offering, today globally we are measuring something on the order of 90-plus trillion analytics transactions for some of the biggest companies on the planet.

Now when you think about these services at the scale, it requires a platform that's engineered from the ground up for massive scale, rich portfolio of services, and an integrated tools ecosystem. For me personally as CTO of Adobe one of the biggest reasons I'm excited about our deep bet on Azure is it gives us a platform for innovation unlike any other.

So specifically, as Scott and team have been working with us, we are building a lot of these next generation solutions with a deep bet on Azure capabilities like Azure Data Lake, Data Factory, the work we are doing with common data models and even all the way to rich integration with visualization capabilities like Microsoft Power BI.

SCOTT GUTHRIE: So we talked about your core platform services. Can you also talk a little bit about sort of what it's like to partner with Microsoft to really reach enterprise customers at scale and the work that we're doing together to enable that?

ABHAY PARASNIS: Yeah, I think frankly a lot of you here in these partnerships, with press releases and marketing releases, this partnership is very different for us for a couple of reasons. First, it's actually a real deep engineering-level partnership. The amount of work that goes on between Redmond and San Jose between the teams is just unbelievable. Over the last six months we have already delivered three core joint solutions working with Microsoft teams.

First, Adobe Campaign Orchestration is now integrated with Dynamics CRM. Second, some of the biggest brands on the planet can now use Adobe's content management product, Experience Manager, natively on Azure. And last, but not the least, Adobe Analytics, which is our enterprise analytics offering, is now fully integrated with Power BI.

Now as we look at customers and see their interest in these solutions, the other thing I hear loud and clear from sort of the biggest enterprise customers is their extreme focus on global scale and availability, focus on security, trust, privacy, as well as increasing demands around data sovereignty, privacy and compliance.

So for us, frankly, at Adobe beyond just feature, function and checklist of which services, this is actually one of the unique things about Azure that gives us a major competitive advantage when we talk about enterprise customers in mission critical environments.

And for me personally, last but not least, as I look to the future, and even the announcement this morning, the collaboration with Microsoft that I'm excited about is the work we're starting to do in connecting our intelligence capabilities across solutions, and to really power new experiences with intelligence at their core.

SCOTT GUTHRIE: Awesome. As one of the world's largest software vendors, can you talk a little bit about the work that we're also doing across the broader ecosystem and some of the benefits that developers can expect?

ABHAY PARASNIS: Yes. I mean for us, when we thought about our needs as a company and one of the largest SaaS ISVs, going beyond just our own internal cloud platform needs, frankly, for us Microsoft's partnership was also strategic because of the broad developer ecosystem reach and increasingly the millions and hundreds of millions of end users in the Office ecosystem that we can reach to our SaaS solutions.

Now the second part of this is for our own business, we wanted a solution that lets us reach out to all of you as developers and ISVs and partners and Microsoft gives us that extensibility play in a very credible way.

So the work we're starting to do with your teams around defining common data models and a common industry taxonomy for a modern enterprise is really exciting. And, frankly, unlocks a whole new vista of opportunities, capabilities for developers in this room to innovate jointly on these platforms.

SCOTT GUTHRIE: That's awesome. Well, what's next and what's coming now?

ABHAY PARASNIS: I think for us really these are exciting times, and there are a lot of developers, ISVs in the room. This is an exciting time where each of you can really reimagine and deliver completely new radical experiences and deliver those to your customers. For us at Adobe, this really meant taking a long-view and choosing a cloud platform that goes well beyond just a commodity compute and storage and price point. For us a cloud platform of the future has to not only be best in class for developers, it has to pass that litmus test, but it really has to also solve mission critical enterprise needs of global customers, and frankly go all the way up to innovation for the business users.

So when we looked at Azure and more broadly the Microsoft ecosystem for us that was a very clear strategic choice. And, frankly, some of the joint customer dialogues that are going on probably tell me that we are off to a really good start. And so for me I'm super-excited about this partnership in terms of what it means today and the kind of work we can do together going forward in the future. So thanks for the partnership.

SCOTT GUTHRIE: Thank you so much. Thank you for being here at Build.

ABHAY PARASNIS: Thanks, guys.

(Applause.)

SCOTT GUTHRIE: As Abhay mentioned, you know, SaaS companies love Azure not just because of the core cloud and data platform capabilities it provides, not just because of the trust, compliance, security and enterprise needs that it meets, but they also like it because it really provides this opportunity to take their SaaS solution and offer it to enterprise business users that are already using the Microsoft Cloud and enable them to deeply integrate it in ways that makes their own solutions even more compelling.

Now one of the data points we shared recently in our most recent financial earnings call is that we now have 100 million monthly active enterprise users using Office 365. And Azure provides the easiest way for you to integrate with Office 365, reach those 100 million users, and grow your business.

Every Office 365 customer uses Azure Active Directory as their identity system. And using Azure Active Directory we've made it incredibly easy for you to securely integrate your SaaS apps into both the rich Office 365 app experiences as well as the online experiences as well.

We've also integrated many of our Microsoft apps and experiences to use the Microsoft Graph. You heard Satya talk and give you some demos of that earlier, and you'll see more throughout the conference. And this Microsoft Graph is all built on top of Azure Active Directory and it provides a REST-based API that developers can use to securely integrate data and functionality across Office 365, Dynamics 365, Azure and Windows.

And in addition to enabling your SaaS apps to be integrated into the Office 365 ones, we're also making it easy for the Office 365 apps, things like Power BI and Power Apps and Flow, to securely integrate with your SaaS apps and enable rich integration scenarios to make your SaaS apps and SaaS data even more valuable to enterprise customers.

And with our new Azure App Source Marketplace, we make it incredibly easy for all of our Office 365 and Dynamics 365 enterprise users to be able to find and discover your applications and try them out. With just a few clicks an end user can securely integrate and try out your SaaS app together with all the existing solutions that they've already deployed in the Microsoft Cloud.

And when one of our enterprise customers tries out the SaaS application using App Source, one of the nice things we do is actually automatically push a lead through an API into your CRM system regardless whether it's a Dynamics or even a Salesforce CRM system so that you can immediately follow-up directly with that customer and try to close that business. And that is a great way to kind of accelerate your go to market in a tremendous way, and enables Microsoft to deliver to you potentially thousands of super high quality leads of enterprise users every single month for your SaaS capability.

If there are SaaS vendors who run their systems on Azure and qualify for our co-sell program, we're even now going one step further and as part of that lead that we pass to you, we'll actually connect you with the Microsoft sales person that manages that particular enterprise account. And we'll even now pay the Microsoft sales person every time you close a SaaS deal with one of their customers, so they're incredibly incented to help you every step of the way with those conversations with those enterprise users.

Now the opportunity for all of us to build applications that can change the world has really never been greater. Each of you now has access to cloud resources that were unimaginable just a few years ago, and I say this every year but it's always true, there's never been a better time to be a developer. And all of us at Microsoft are really looking forward to seeing what you build.

What I want to do now is hand it over to Harry who is going to basically walk you through, now that I've established the core Azure platform, how you can take advantage of AI in even richer ways and infuse it through all your apps to make them even smarter.

Thanks a bunch and have a great Build.

(Applause.)

END