Advanced Infrastructure as Code (IaC) with ARM Templates

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Background

- Multiple data center moves
- All with IaC
- Code base evolved with each project
- Now support very sophisticated deployments

HOW?

The Tech, Plus…

- Mostly Azure IaaS – some PaaS
- PowerShell and ARM templates
  - Have also used Azure CLI, Terraform, Ansible, Chef & Puppet
- + Governance, Management, Security, etc.

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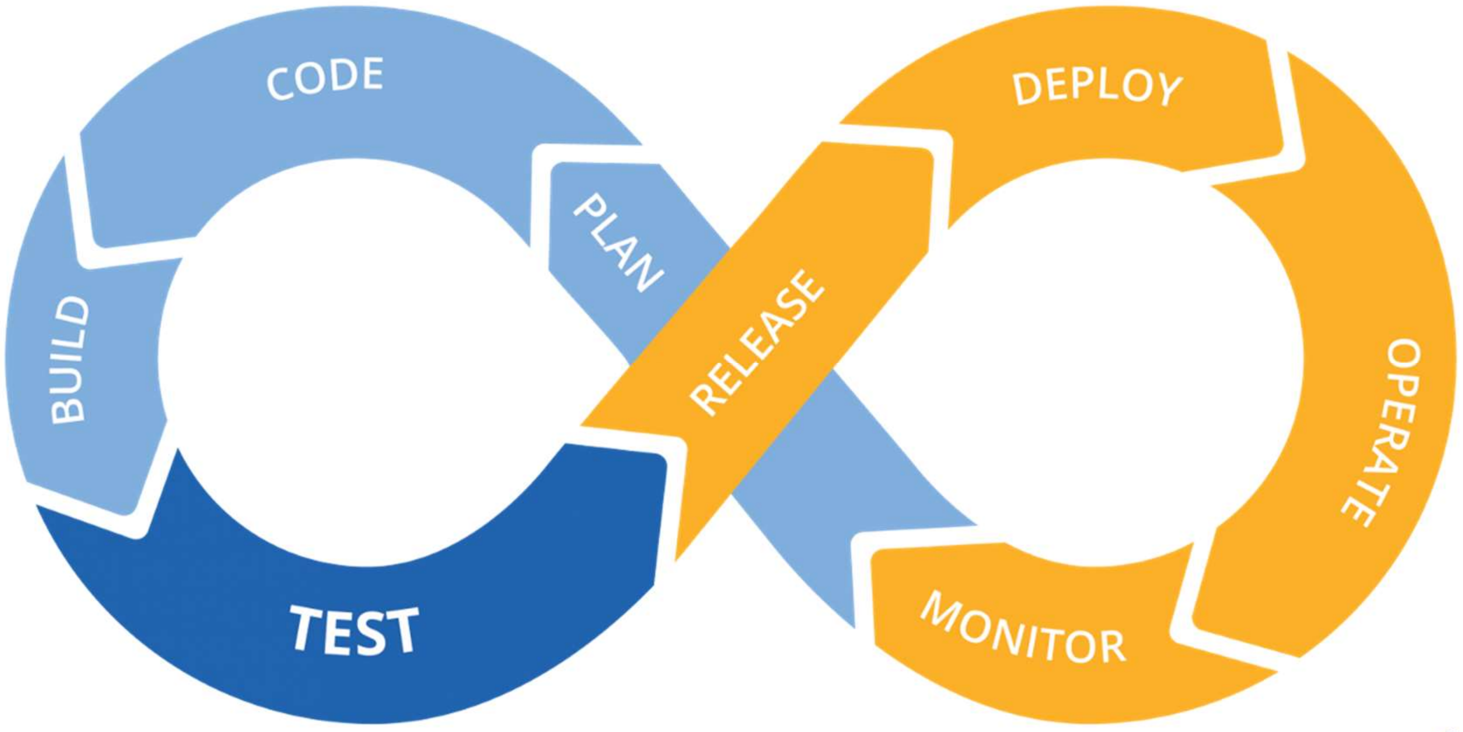
All Part of the Continuous Delivery Pipeline



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ARM TEMPLATES 101

Automation – ARM Templates

- JSON Files
- Parameters files => ARM templates
  - MyVM.parameters.json => windows-vm.json
- ARM templates for most resource types
- These get pretty COMPLEX!

ARM Templates – Getting Started

- Bing “Azure ARM Templates”
  - Structure and Syntax: https://docs.microsoft.com/en-us/azure/azure-resource-manager/resource-group-authoring-templates
  - Quick Starts: https://azure.microsoft.com/en-us/resources/templates/

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ARM Template Structure

```
{
  "$schema": "http://schema.management.azure.com/schemas/2015-01-01/deploymentTemplate.json#",
  "contentVersion": "1.0.0.0",
  "parameters": {
  },
  "variables": {
  },
  "resources": [
  ],
  "outputs": {
  }
}
```

ARM Template Structure - Parameters

```
"parameters": {
   "vnetName": { "type": "string" },
   ...
   "storageAccounts": { "type": "array" },
   ...
   "imagePublisher": {
      "type": "string",
      "defaultValue": "MicrosoftWindowsServer",
      "allowedValues": [
         "MicrosoftWindowsServer",
         "MicrosoftSQLServer"
      ]
   },
   ...
 },
```

Data Types

- string
- secureString
- int
- bool
- object
- secureObject
- array

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ARM Template Structure – Variables & Functions

```
"parameters": {
   ...
},
"variables": {
   "deploymentApiVersion": "2016-02-01",
   "sharedTemplateUri": "[concat(parameters('storageContainerUri'), 'Shared/')]",
   "sharedStorageDeployTemplateUri": "[concat(variables('sharedTemplateUri’),
      'Storage/sharedstoragedeploy.json', parameters('secureAccessString'))]",
   ...
 },
 .
 .
 .
```

ARM Template Structure – Resources

```
...
"resources": [
  {
    "apiVersion": "[variables('computeApiVersion')]",
    "type": "Microsoft.Compute/virtualMachines",
    "name": "[parameters('vmName')]",
    "location": "[resourceGroup().location]",
    "tags": "[variables('allTags')]",
    "properties": {
      "availabilitySet": "[parameters('availabilitySetName)]",
      "hardwareProfile": {
        "vmSize": "[parameters('vmSize')]"
      }, ...
], ...
```

ARM Template Structure – Linked Templates

```
"resources": [
    { ...
      "type": "Microsoft.Resources/deployments",
      "apiVersion": "[variables('deploymentApiVersion')]",
      "properties": {
        "templateLink": {
          "uri": "[concat(variables(‘templateUri'), 'Compute/NIC/create-nic.json’,
                  variables('ipTemplate'), parameters('secureAccessString'))]", ...
        },
        "parameters": {
          “networkResGroupName": { "value": "[parameters(‘networkResGroupName')]" },
          "vnetName": { "value": "[parameters('vnetName’)]” },
          ...
  ], ...
```

Evolution of ARM Templates

- Simple, single resource, few parameters
  - E.g. create a specific VM
- Generic, more parameterized
  - E.g. create a VM with these specs
- Free form & flexible, integrating resources
  - E.g. Create 10 VMs with these specs, behind a LB, etc.

Automation – PowerShell

- Use for some resources w/o [good] ARM support:
  - Key Vault
  - Azure File Share
- Orchestrate the deployment process
- Get ready to ramp up your PowerShell skills!

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TYPICAL DEPLOYMENT PROCESS

Typical Deployment Process

- Log into Azure
- Select an Azure subscription
- Create a storage account
- Copy ARM parameters files and templates up to blob storage
- Create the target Resource Group and its resources x N
- Delete the storage account

Typical Deployment Process

- Login-AzureRmAccount
- Select-AzureRmSubscription
- New-AzureRmResourceGroupDeployment
- Set-AzureStorageBlobContent
- New-AzureRmResourceGroupDeployment $\Big\}$ x N
- Remove-AzureRmResourceGroup

Typical Deployment Process

- [Initialize deployment]
- Deploy-Network -ResourceGroupName “…” -ParamFile “…”
- Deploy-AppGateway -ResourceGroupName “…” -ParamFile “…”
- Deploy-VmGroup -ResourceGroupName “…” -ParamFile “…”
- Deploy-VmGroup -ResourceGroupName “…” -ParamFile “…”
- Deploy-AzureFiles -ResourceGroupName “…” -ParamFile “…”
- ...
- [Tear down deployment]

PowerShell & ARM Template Hell!

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IMPROVEMENTS

How do you specify a large number of very similar VMs without repeating all the details?

VM Groups

From:

```
"virtualMachines": {
    "value": [
      {
        "name": "MGMTJUMPBOXP01",
        "vmSize": "Standard_D2_v2",
```

To:

```
"virtualMachineGroups": {
    "value": [
      {
        "vms": [
          { "name": "MTPPANFW001" , "privateIP":  "10.234.50.101" },
          { "name": "MTPPANFW002" , "privateIP":  "10.234.50.102" }
        ],
        "vmSize": "Standard_D2_v2",
```

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How do you coordinate which resources to deploy, and in what order?

Deployment Orchestration: From

```
Deploy-Network –ResourceGroupName “…” –ParamFile “…”
Deploy-AppGateway –ResourceGroupName “…” –ParamFile “…”
Deploy-VmGroup –ResourceGroupName “…” –ParamFile “…”
Deploy-VmGroup –ResourceGroupName “…” –ParamFile “…”
Deploy-AzureFiles –ResourceGroupName “…” –ParamFile “…”
```

Deployment Orchestration: To

Deployment Manifest Files

```
"DeploymentGroups": [
  {
    "Name": "Network",
    "ResourceType": "Network",
    "Resources": [
      {
        "DeployFlag": true,
        "ResourceGroupName": "ApplicationNetwork-rg",
        "ParametersFile": "network.parameters.json"
      }
    ]
  },
  {
    "Name": “Key Vault",
    "ResourceType": "KeyVault",
    "Resources": [
      {
        "DeployFlag": true,
        "ResourceGroupName": "ADMINVAULT-rg",
        "ParametersFile": "KeyVaults.parameters.json"
      }
    ]
  },
```

```
{
    "Name": “Base VMs",
    "ResourceType": "VM",
    "DependsOn": [ "Network", "Key Vault" ],
    "Resources": [
     {
      "DeployFlag": true,
      "ResourceGroupName": "ADINFRA-rg",
      "ParametersFile": "ActiveDirectoryVMs.parameters.json"
     },
     {
      "DeployFlag": true,
      "ResourceGroupName": "RTGEWEB-rg",
      "ParametersFile": "RTGEWebVMs.parameters.json"
     },
. . .
```

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Deployment Manifest Files

```
foreach ($group in $DeploymentGroups) {
    switch ($group.ResourceType) {
        "VM" { . . .}
        "ApplicationGateway" { . . . }
        "AzureFileShare" { . . . }
        "AzureDB" { . . . }
        . . .
    }
}
```

How do you tweak a “cookie cutter” deployment to morph as needed to handle different situations?

Parameter File Transformation

- For any given deployment, how do we control:
  - Which resources to deploy?
  - Differences in naming between dev vs. test vs. prod?
  - Differences in the number and size of VMs deployed to dev vs. test vs. prod?
- Without creating extra parameters files!

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Parameter File Transformation

- Which resources to deploy?
  - "DeployFlag": **%ActiveDirectoryVMDeployFlag%**
- Resource naming in prod vs. test vs. dev
  - "ResourceGroupName": " **%envCap%**GNTIBAPP-rg"
- Fewer VMs in dev than test/prod
  - "ignoreVmGroup": **%ignoreVmGroup%**
  - "vms": [**%vms%**]
- Parameter merge files
  - "ActiveDirectoryVMDeployFlag ": "true"
  - "envCap": "P"
  - "ignoreVmGroup": "false"
  - "vms": "{\"name\": \"PGNEDIFCSCF001\"}, {\"name\": \"PGNEDIFCF001\"}, …

Parameter File Transformation

- Types of merge files
  - Deployment merge files
  - Environment-specific merge files
  - Default merge file (defaults.parameters.json)

How do you speed up large scale deployments, with 100’s to 1000’s of resources?

Faster Deploys?

```
foreach ($group in $DeploymentGroups) {
  foreach ($resource in $group.Resources) {
    # Deploy
  }
}
```

Faster Deploys in Parallel

```
foreach –parallel ($group in $Params.DeploymentGroups) {
  foreach –parallel ($resource in $group.Resources) {
    # Deploy
  }
}
```

Faster Deploys in Parallel

```
workflow Deploy-VM {
  param {...}

  InlineScript {
    # Initialize new PowerShell session
    . . .
  }
}
```

How do you monitor the progress of a deployment when there are so many resources being deployed in parallel?

Easy to Monitor Deployments

- Already create storage account with deployment
- Added in a storage table
- Add row for each Resource Group being deployed
- Write status (deploying/success/failed) to table
- Works whether running in PowerShell or from VSTS

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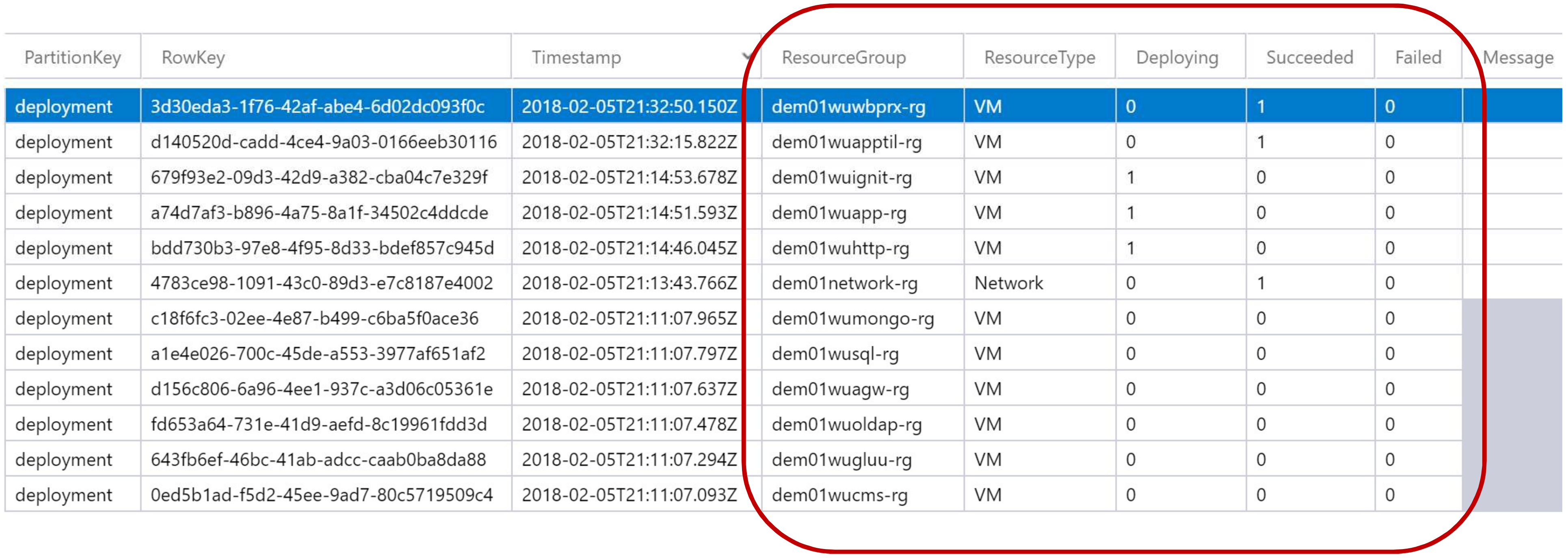
Easy to Monitor Deployments



PartitionKey	RowKey	Timestamp	ResourceGroup	ResourceType	Deploying	Succeeded	Failed	Message
deployment	3d30eda3-1f76-42af-abe4-6d02dc093f0c	2018-02-05T21:32:50.150Z	dem01wuwbprx-rg	VM	0	1	0	
deployment	d140520d-cadd-4ce4-9a03-0166eeb30116	2018-02-05T21:32:15.822Z	dem01wuapptil-rg	VM	0	1	0	
deployment	679f93e2-09d3-42d9-a382-cba04c7e329f	2018-02-05T21:14:53.678Z	dem01wuignit-rg	VM	1	0	0	
deployment	a74d7af3-b896-4a75-8a1f-34502c4ddcde	2018-02-05T21:14:51.593Z	dem01wuapp-rg	VM	1	0	0	
deployment	bdd730b3-97e8-4f95-8d33-bdef857c945d	2018-02-05T21:14:46.045Z	dem01wuhttp-rg	VM	1	0	0	
deployment	4783ce98-1091-43c0-89d3-e7c8187e4002	2018-02-05T21:13:43.766Z	dem01network-rg	Network	0	1	0	
deployment	c18f6fc3-02ee-4e87-b499-c6ba5f0ace36	2018-02-05T21:11:07.965Z	dem01wumongo-rg	VM	0	0	0	
deployment	a1e4e026-700c-45de-a553-3977af651af2	2018-02-05T21:11:07.797Z	dem01wusql-rg	VM	0	0	0	
deployment	d156c806-6a96-4ee1-937c-a3d06c05361e	2018-02-05T21:11:07.637Z	dem01wuagw-rg	VM	0	0	0	
deployment	fd653a64-731e-41d9-aefd-8c19961fdd3d	2018-02-05T21:11:07.478Z	dem01wuoldap-rg	VM	0	0	0	
deployment	643fb6ef-46bc-41ab-adcc-caab0ba8da88	2018-02-05T21:11:07.294Z	dem01wugluu-rg	VM	0	0	0	
deployment	0ed5b1ad-f5d2-45ee-9ad7-80c5719509c4	2018-02-05T21:11:07.093Z	dem01wucms-rg	VM	0	0	0	

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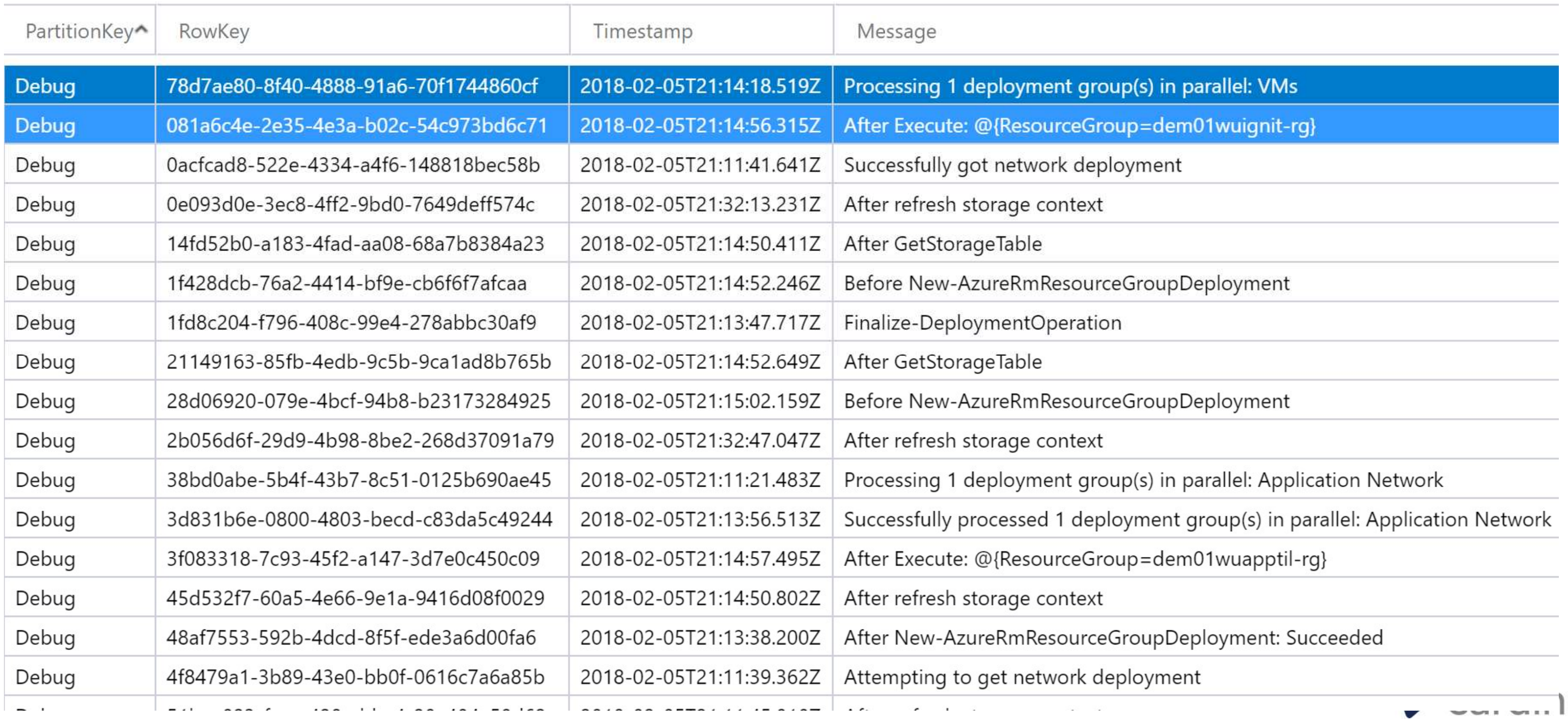
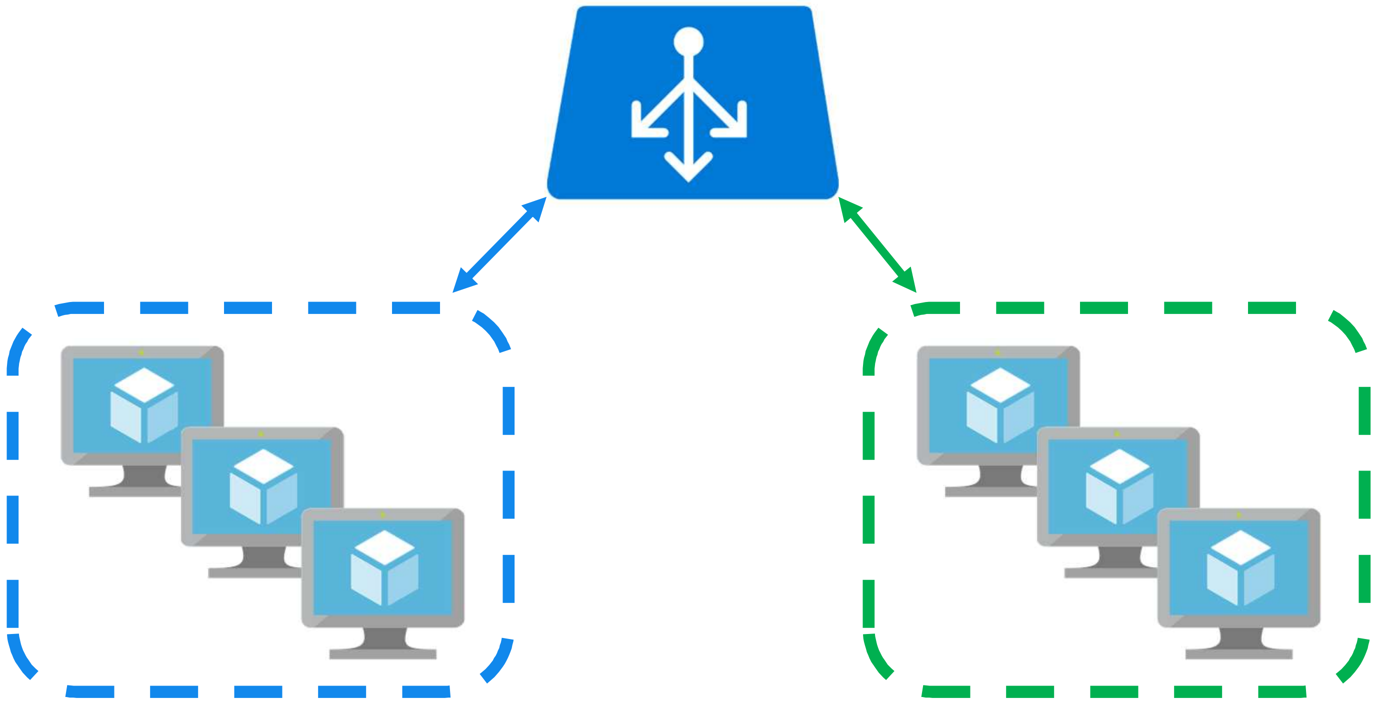
Easy to Monitor Deployments



PartitionKey	RowKey	Timestamp	Message
Debug	78d7ae80-8f40-4888-91a6-70f1744860cf	2018-02-05T21:14:18.519Z	Processing 1 deployment group(s) in parallel: VMs
Debug	081a6c4e-2e35-4e3a-b02c-54c973bd6c71	2018-02-05T21:14:56.315Z	After Execute: @{ResourceGroup=dem01wuignit-rg}
Debug	0acfcad8-522e-4334-a4f6-148818bec58b	2018-02-05T21:11:41.641Z	Successfully got network deployment
Debug	0e093d0e-3ec8-4ff2-9bd0-7649deff574c	2018-02-05T21:32:13.231Z	After refresh storage context
Debug	14fd52b0-a183-4fad-aa08-68a7b8384a23	2018-02-05T21:14:50.411Z	After GetStorageTable
Debug	1f428dcb-76a2-4414-bf9e-cb6f6f7afcaa	2018-02-05T21:14:52.246Z	Before New-AzureRmResourceGroupDeployment
Debug	1fd8c204-f796-408c-99e4-278abbc30af9	2018-02-05T21:13:47.717Z	Finalize-DeploymentOperation
Debug	21149163-85fb-4edb-9c5b-9ca1ad8b765b	2018-02-05T21:14:52.649Z	After GetStorageTable
Debug	28d06920-079e-4bcf-94b8-b23173284925	2018-02-05T21:15:02.159Z	Before New-AzureRmResourceGroupDeployment
Debug	2b056d6f-29d9-4b98-8be2-268d37091a79	2018-02-05T21:32:47.047Z	After refresh storage context
Debug	38bd0abe-5b4f-43b7-8c51-0125b690ae45	2018-02-05T21:11:21.483Z	Processing 1 deployment group(s) in parallel: Application Network
Debug	3d831b6e-0800-4803-becd-c83da5c49244	2018-02-05T21:13:56.513Z	Successfully processed 1 deployment group(s) in parallel: Application Network
Debug	3f083318-7c93-45f2-a147-3d7e0c450c09	2018-02-05T21:14:57.495Z	After Execute: @{ResourceGroup=dem01wuapptil-rg}
Debug	45d532f7-60a5-4e66-9e1a-9416d08f0029	2018-02-05T21:14:50.802Z	After refresh storage context
Debug	48af7553-592b-4dcd-8f5f-ede3a6d00fa6	2018-02-05T21:13:38.200Z	After New-AzureRmResourceGroupDeployment: Succeeded
Debug	4f8479a1-3b89-43e0-bb0f-0616c7a6a85b	2018-02-05T21:11:39.362Z	Attempting to get network deployment
[illegible]	[illegible]	[illegible]	[illegible]

How do you deploy with zero downtime, and rollback in case of a failed deployment?

Blue-Green Deployments



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FINAL SUMMARY

WHAT TO TAKE AWAY

1. ARM documentation is mostly “Getting Started”
2. Most ARM deployments quite simplistic
3. It’s possible to do very advanced deployments
4. Hope the examples sparked ideas for you!

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THANK YOU.

QUESTIONS?

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