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Using ARM templates to deploy solutions on Azure

Kevin Timmerman – November 15th 2018

Office 365 & SharePoint Connect

Meet the speaker

Kevin Timmerman

- Working at Avanade Netherlands since 2008
- Manager in the Data Engineering community

- Worked on multiple (large) projects implementing and migrating SharePoint 2007, 2010, 2013 and Office 365 / SharePoint Online
- Currently working on a IoT Azure project
- Combined roles as developer/team lead & architect/PM

Hobbies

- Musician, playing trumpet since 1994
- ‘Do it your self’ home improvements
- Inline skating

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Agenda

- ✓ Introduction into ARM Templates
- ✓ Getting started
- ✓ Parameters, outputs and functions
- ✓ Linked and Nested templates
- ✓ Implementation into your CI/CD Pipeline
- ✓ Real life experiences (and challenges)
- ✓ Summary
- ✓ Questions

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Introduction into ARM Templates

Issues with classic (application) deployments

Have you ever faced:

1. Unexpected differences between environments
2. Difficulties/issues with manual deployment steps
3. Missing dependencies
4. (Undocumented) manual configuration changes
5. Long request time for application/resource to be available

Then ARM Templates help to solve the above!

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Why use ARM Templates

1. Grouping of related resources into one deployment
2. Consistent deployment throughout development lifecycle
3. Accelerated provisioning and deployments
4. Define dependencies between resources for correct order of deployment
5. Huge reduction of requirement for manual steps (and mistakes)
6. Can be reused within a project/solution, but also across teams and solutions
7. Many example/quickstart templates available

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Introduction into ARM Templates

1. Azure Resource Manager (ARM) is a management framework to deploy, manage and monitor Azure resources
2. Infrastructure as code
3. Declarative (JSON files)
4. Specify resources and dependencies
5. Repeated and consistent (incremental) deployments

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Introduction into ARM Templates

Each template exist of two files:

- JSON template file, e.g. **azuredeploy.json**
  - This is the main template file where the resources are declared and inpt parameters are defined
- JSON parameter file, e.g. **azuredeploy.parameters.json**
  - Provides values for the parameters at deploy time

Can be deployed from within Visual Studio, from Azure CLI or PowerShell:

Azure CLI

```
$ az group deployment create -g "MyGroup" --template-file "azuredeploy.json"
--parameters "@azuredeploy.parameters.json"
```

PowerShell

```
$ New-AzureRmResourceGroupDeployment -ResourceGroupName "MyGroup"
-TemplateFile "azuredeploy.json" -TemplateParameterFile "azuredeploy.parameters.json"
```

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Template format

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

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Template limits

	Limit
Parameters	256
Variables	256
Resources *	800
Output values	64
Template expression characters	24.576
Saved deployments per resource group	800
Template File size **	1 MB
Parameter File size	64 KB

* Including resources created in loops

** Final state of the template including all variables, loops etc

You can work around some of these by using nested/linked templates or by combining multiple variables/parameters/outputs into objects

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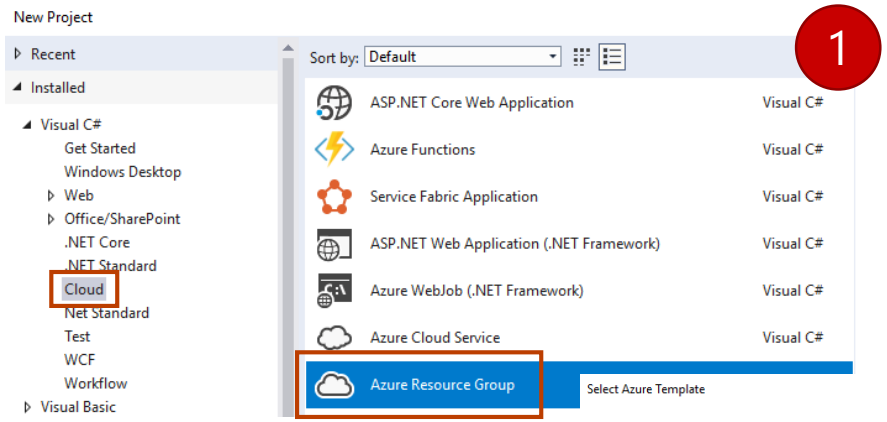
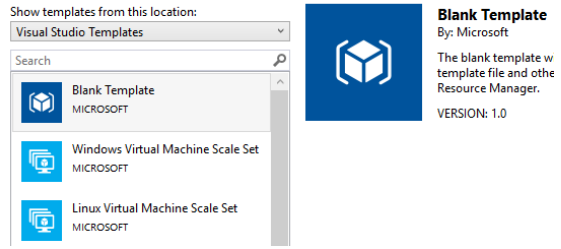
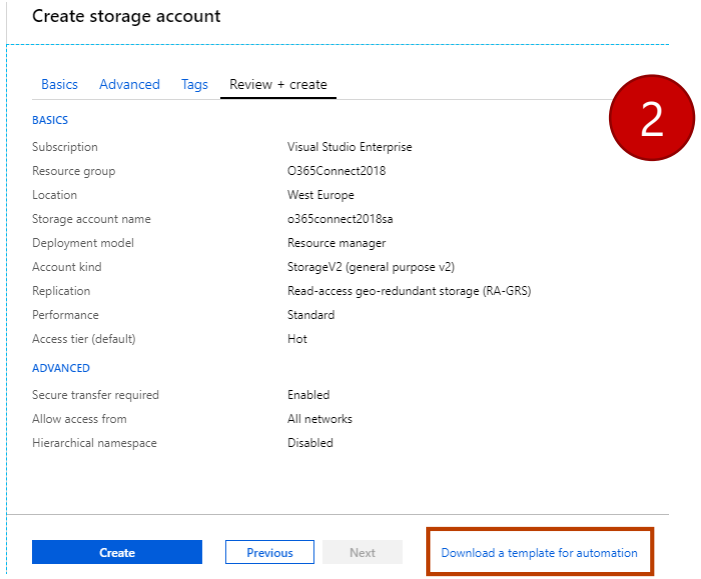
Getting started

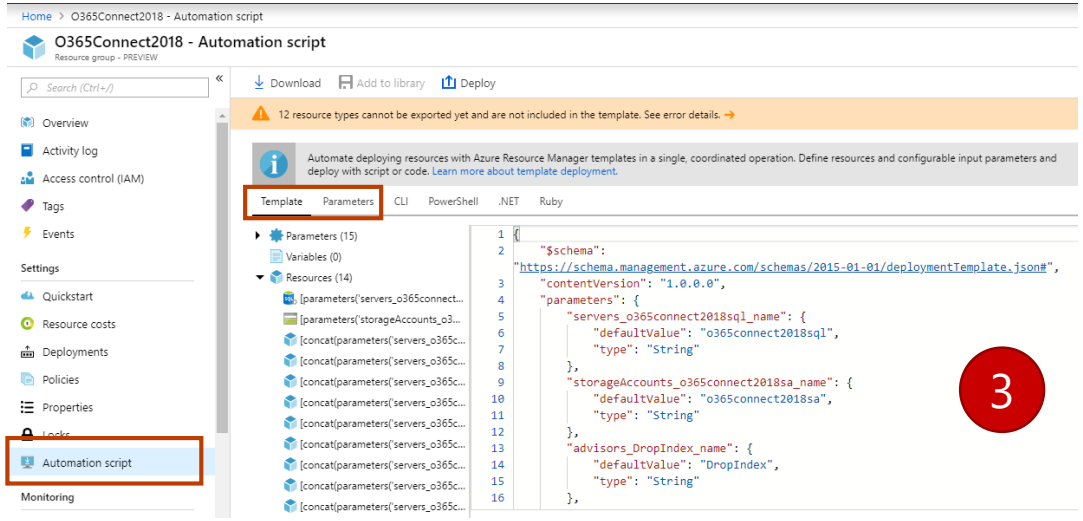
Getting started

1) From Visual Studio
   - Blank Template
   - Using a predefined template
2) By downloading template during manual creation in Azure
3) By downloading template from existing Azure resource group
4) By downloading template examples from GitHub
   - https://github.com/Azure/azure-quickstart-templates









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What next?

- Rename parameters and add comments
- Add/remove parameters
- Check which resources are not exported
  - Create them via ARM yourself using online documentation
  - Export resource content from within the resource itself
  - Let Visual Studio generate the ARM template for you
  - Create them via PowerShell scripting if not (yet) possible in ARM
- Ensure dependencies in the template are correct
- Create functions where required/useful
- Test your template deployment via PowerShell, Visual Studio or Azure CLI

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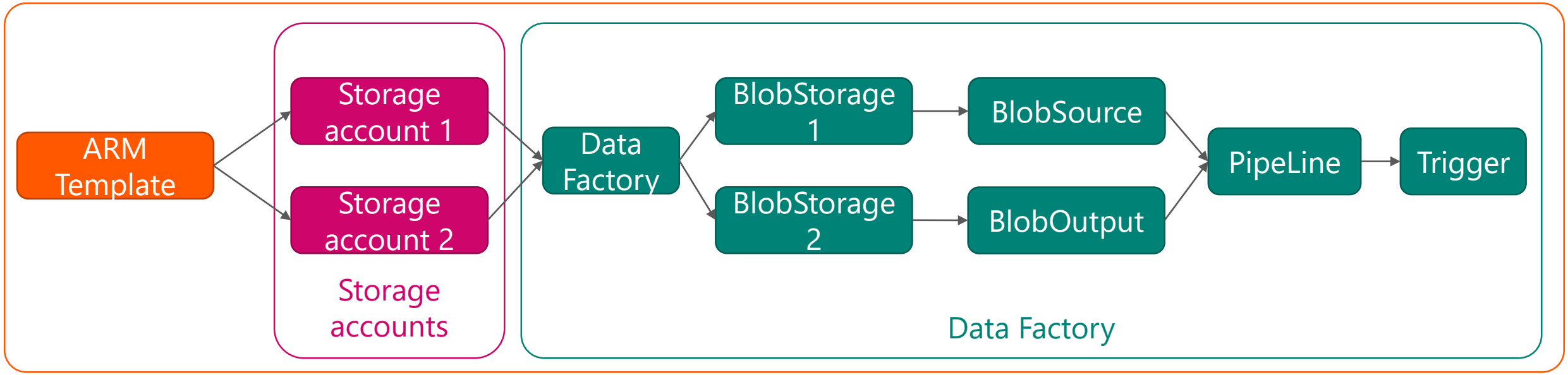
Demo – Data Factory to copy file from blob to blob

- 2 storage accounts
  - Each with one storage container
- 1 Data Factory
  - 1 pipeline, 1 input and 1 output blob, 1 trigger



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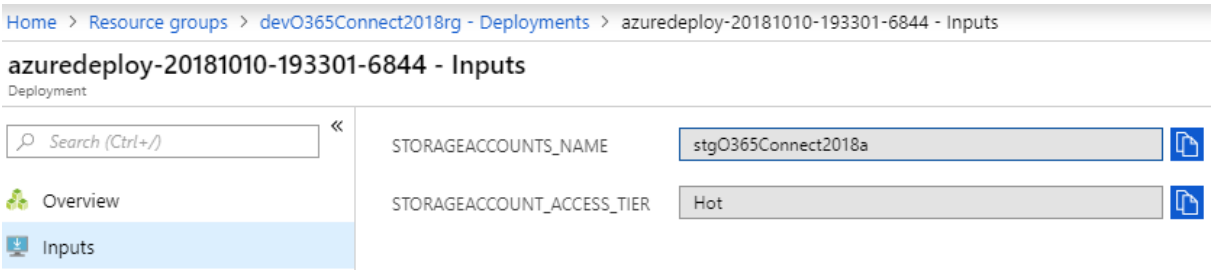
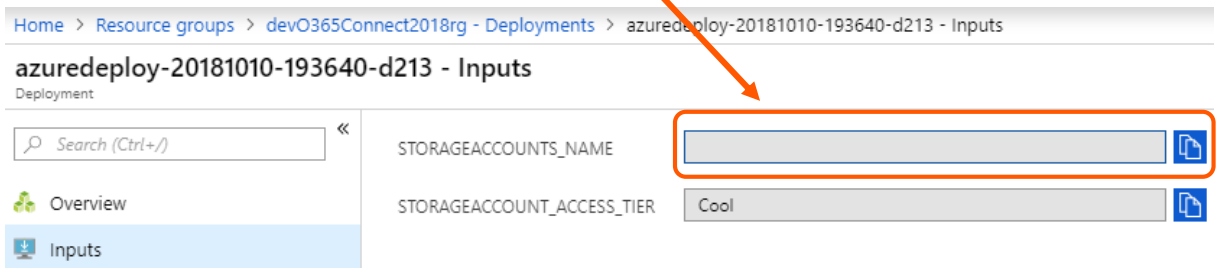
Parameters, outputs and functions

Parameters

Parameter JSON file per environment	CI/CD Variable group per environment
Maintained in solution	Maintained within the CI/CD pipeline
Multiple parameter files to keep in sync with the 'master'	Based on the 'master' parameters file
Not safe to maintain sensitive information	Variables can be shared between environments
	KeyVault can be linked to a variable group which the CI/CD pipeline will mask automatically

Note: Any sensitive parameters or output should have the type SecureString to ensure it's not listed in any deployment logs in Azure





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Outputs

- Used to return values from a ARM template deployment
- Useful for connection strings, IP addresses or other information from the created resources which is required in other depending templates or deployment steps and scripts

```
"outputs":
{
        "<outputName>" :
        {
                "type" : "<type-of-output-value>",
                "value": "<output-value-expression>"
        }
}
```

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Standard Functions

- ARM templates support a set of standard functions (reference)
  - Array and object functions
    - Array, contains first, length, max, concat
  - Comparison functions
    - Equals, less, greater, lessOrEquals
  - Logical functions
    - And, bool, if, not, or
  - Numeric functions
    - Add, copyIndex, float, int, mod, min
  - Resource functions
    - listKeys, reference, resourceId
  - String functions
    - Concat, endsWith, padLeft, replace, split, substring, uri, trim, toLower

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User Defined Functions

- ARM templates also supports creating your own functions
  - Make sure you use a unique namespace to prevent conflicts with standard functions
  - Best approach for reusing your 'code' within the same template

- Take into account that:
  - Default values for the function's parameters are not supported
  - Variables/parameters from the template can't be accessed (but can be provided into the function as parameters)
  - The 'reference' function can't be used inside the function
  - You can't call other user defined functions from within the function

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Demo's

- ✓ Parse parameter to array, concat, tolower
- ✓ Build same in function for reuse
- ✓ Getting id's, keys etc without hardcoding
- ✓ Output values
- ✓ Using 'CopyIndex' to repeat deployment for similar resources

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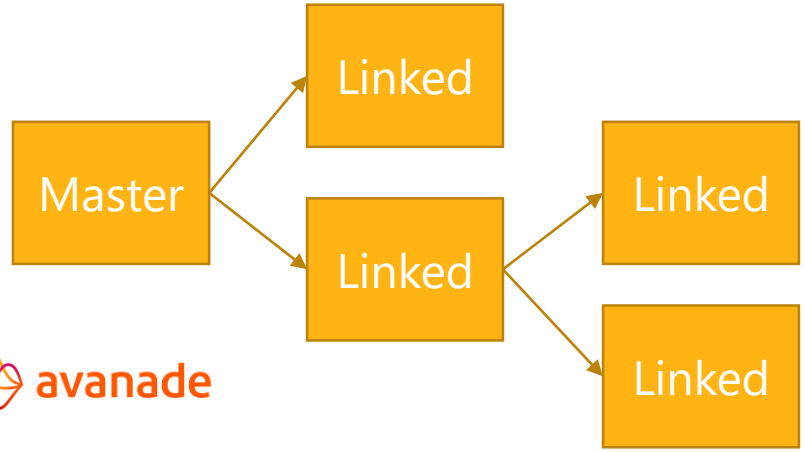
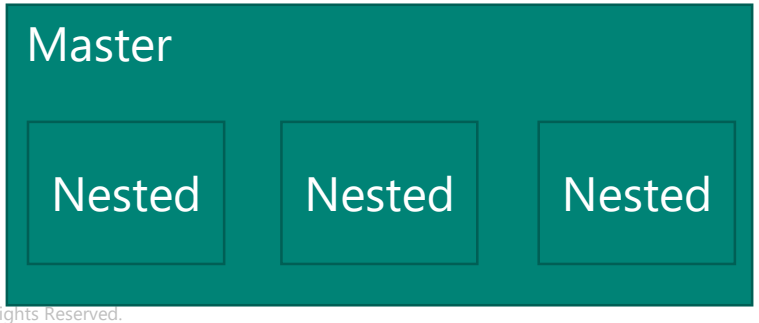
Linked and Nested Templates

Linked and Nested Templates

Linked Template	Nested Template
A separate template file, called from a 'master' template	A 'sub' template within one file
Needs to be accessible online by Azure during deployment (can be secured with SAS token)	Used to deploy resources across multiple resource groups (max 5)
Better reuse of developed templates	No need to upload to public storage location
Requires more time to create/setup	Simple solution, but reuse means 'copy/paste'
	Does not support inline parameters/variables and 'reference' function within the nested template





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Demo's

- ✓ Linked Template
  - ✓ 1 master template, calling 1 linked template to create 2 storage accounts
- ✓ Nested Template
  - ✓ 1 template deploying 1 storage account in 3 resource groups

Your deployment is complete

Check the status of your deployment, manage resources, or troubleshoot deployment issues. Pin this page to your dashboard to easily find it next time.

Deployment name: azuredeploy-linked-template-master-1111-1418
Subscription: O365 Connect 2018 subscription
Resource group: 222

DEPLOYMENT DETAILS (Download)

Start time: 11/11/2018, 3:18:40 PM
Duration: 43 seconds
Correlation ID: afc2ddea-4d5b-4bd9-8d7d-e9dc8834ab1a

RESOURCE	TYPE	STATUS	OPERATION DETAILS
linkedTemplateForResourceGroup1	Microsoft.Resources/deployments	OK	Operation details
linkedTemplateForResourceGroup2	Microsoft.Resources/deployments	OK	Operation details

Your deployment is complete

Check the status of your deployment, manage resources, or troubleshoot deployment issues. Pin this page to your dashboard to easily find it next time.

Deployment name: azuredeploy-nested-template-1111-1353
Subscription: O365 Connect 2018 subscription
Resource group: 222

DEPLOYMENT DETAILS (Download)

Start time: 11/11/2018, 2:53:27 PM
Duration: 47 seconds
Correlation ID: d7650a43-d89f-4f80-9b5c-1b7f63fac9a2

RESOURCE	TYPE	STATUS	OPERATION DETAILS
nestedTemplateForResourceGroup2	Microsoft.Resources/deployments	OK	Operation details
nestedTemplateForResourceGroup1	Microsoft.Resources/deployments	OK	Operation details
o365connectstgne1	Microsoft.Storage/storageAccounts	OK	Operation details

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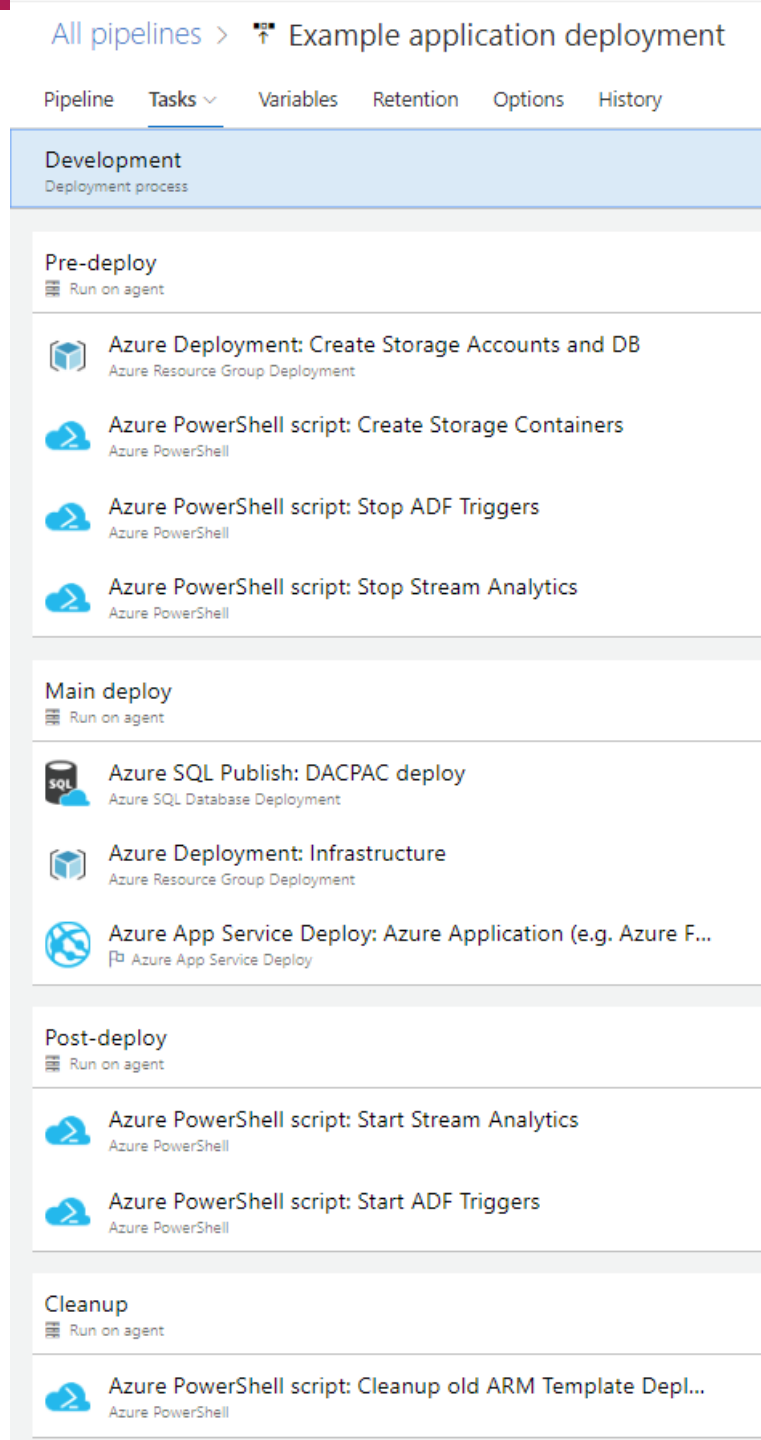
Implementation into your CI/CD Pipeline

CI/CD Pipeline structure

- Build
  - Validate if ARM Template structure is valid
  - Build your Visual Studio solution
  - Copy all ARM Templates and PowerShell scripts into package
- Release
  - Pre-deploy steps
    1. Create Storage Accounts and databases (ARM)
    2. Stop Stream Analytics / Stop ADF triggers (PS)
    3. Create Storage Containers (PS)
  - Main-deploy steps
    1. Deploy database tables (DACPAC)
    2. Deploy infrastructure (ARM)
    3. Deploy your application
  - Post-deploy steps
    1. Start Stream Analytics / Start ADF triggers (PS)
  - Cleanup
    1. Remove old deployed ARM Templates (PS)



Demo's

- ✓ Usage of variable groups and KeyVault
- ✓ Stages per environment
- ✓ Approvals
- ✓ Automatically test/unit test
- ✓ Build pipeline
- ✓ Release pipeline

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Real life experiences (and challenges)

Real life experiences (and challenges)

- Components not exportable to ARM (Stream Analytics)
- Components not deployable via ARM (storage container)
- Limited documentation/examples for some settings/resources
- Content from within components (ADF)
- 800 deployment limit per resource group
- Naming conventions of Azure resources (lower case, character limits, globally unique)
- Case sensitivity of some values within ARM template
- Secure strings / create connection dynamically, use KeyVault if possible
- Lock critical resources for accidental manual or ARM deletion
- At times, perform a disaster recovery test to ensure your deployment works from scratch as well (instead of incremental only)

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Summary

Summary

- Reduce errors and deployment timelines by using ARM Templates
- Automate your application lifecycle processes using CI/CD in Azure DevOps
- Use linked templates over nested templates where possible
- Properly secure sensitive information in your pipelines and templates
- For parameters which you reuse/modify, do this in variables
- Take into account the Azure naming conventions per resource
- Use ARM first, then PowerShell and as last option manually

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Questions?

Thanks for attending!

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