



Deep-Dive into SSAS Security

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About Me

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Working with Microsoft BI since 2006

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SSAS
MAESTRO
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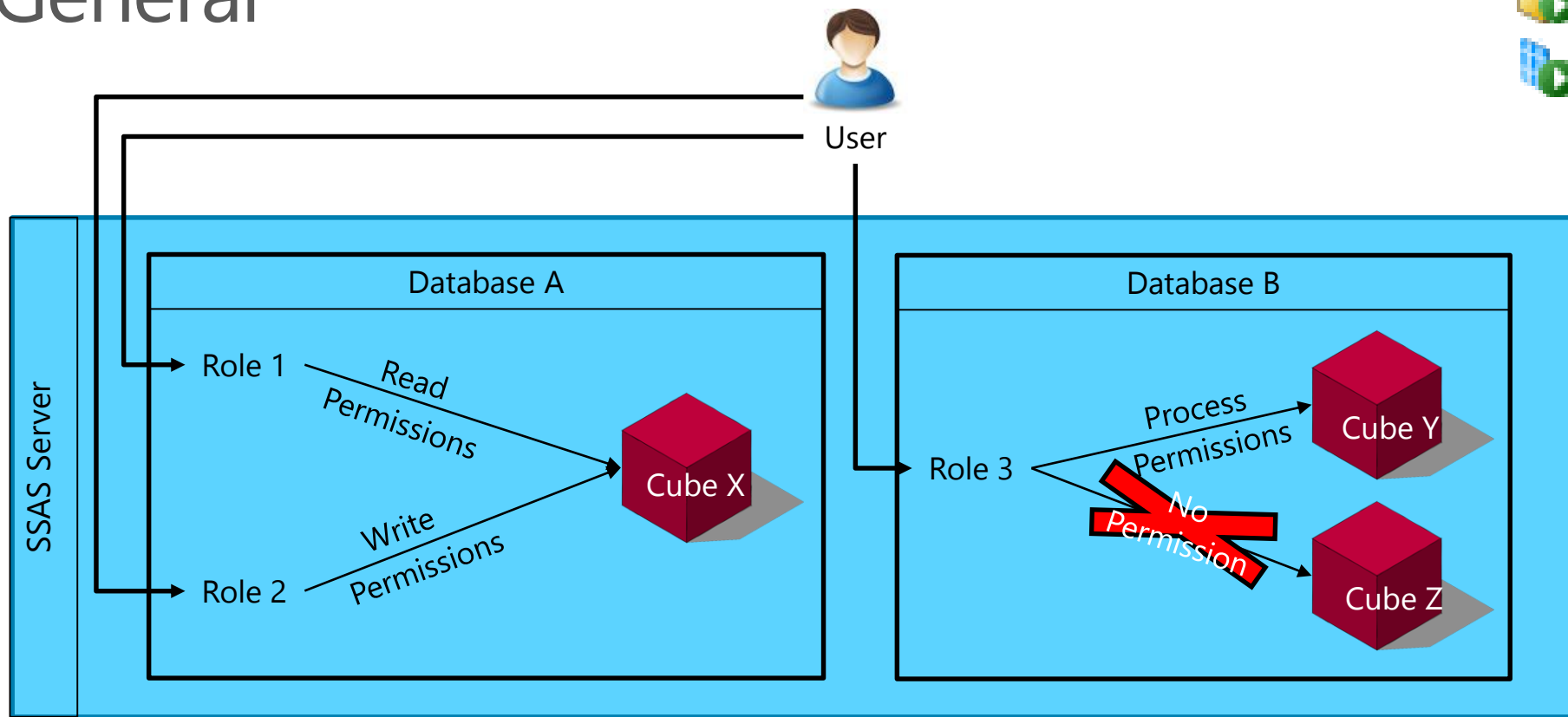


Agenda

- General
- Multiple Roles / Permissions
- Evaluation
- Caching
- Dynamic Security / Assemblies
- Dealing with multiple Roles



General



User, Roles and Permissions



Users and Groups

Active Directory or Local
Are assigned to Roles

For Non-Active Directory Environments

Using Local Users
msmdpump.dll via IIS and HTTP



User, Roles and Permissions



Roles

Belong to Database

Contains AD Users/Groups

Defines Permissions

Special Role

Server Administrator

General Membership Data Sources Cubes Cell Data Dimensions

The database role defines a category of users and groups that have the same permissions on the c

Role name: NorthAmerica

Role description:

Set the database permissions for this role:

- ☐ Full control (Administrator)
- ☐ Process database
- ☐ Read definition

User, Roles and Permissions



Permissions – Multidimensional

Database

Data Sources

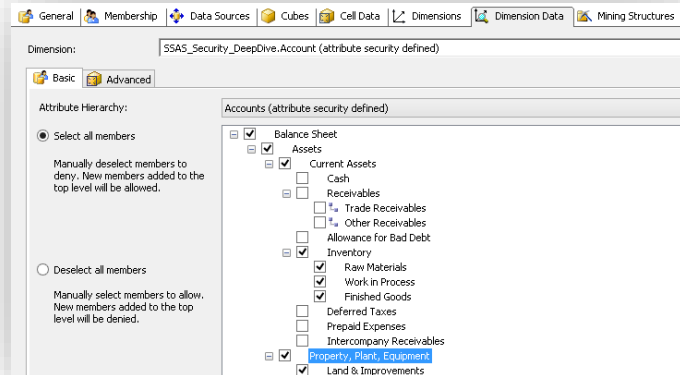
Cubes

(Cells)

Dimensions

Dimension Data

(Mining Models)

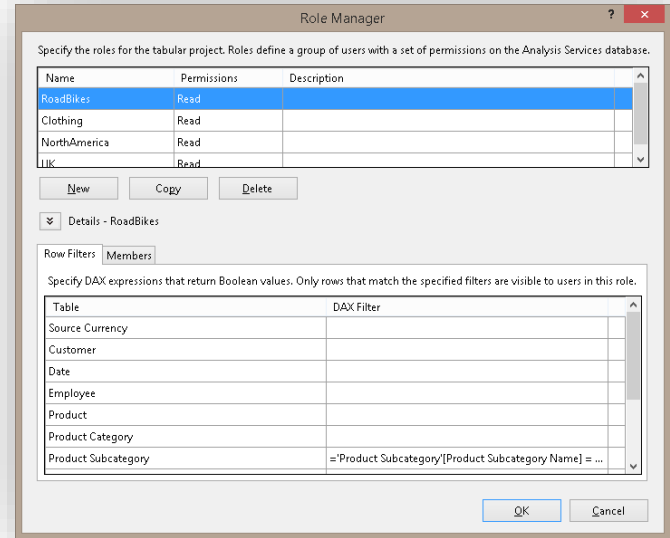


User, Roles and Permissions



Permissions – Tabular

- Database
- Rows (DAX)



User, Roles and Permissions



Database Permissions

Is created in the background

No GUI

AMO / XMLA

Power Shell

Deny access without removing Role or User



Multiple Roles and Permissions



Multiple Permissions



Multiple Roles are complementary

You cannot "lose" permissions

Roles can be selected using Roles-parameter in the connection string
"...;Roles=Role1, Role2;..."



Same Role – Same Dimension

Secured on ...

same Attribute

→ Union / SQL OR

```
WHERE [Country] = 'United Kingdom'  
OR    [Country] = 'Germany'
```



different Attribute

→ Intersect / SQL AND

```
WHERE [Country] = 'United Kingdom'  
AND   [Region]  = 'North America'
```



Use MDX Union() and Exists()

Same Role – Different Dimensions

1. Security for “Same Dimension” applies
2. Facts get filtered on all secured dimension
 - → SQL AND

```
SELECT ...  
FROM [Facts]  
WHERE [Country] = 'United Kingdom'  
AND [ProductCategory] = 'Clothing'
```



Multiple Roles – Same Dimension

Secured on ...

same Attribute

→ Union / SQL OR

```
WHERE [Country] = 'United Kingdom'  
OR    [Country] = 'Germany'
```



different Attribute

→ Union / SQL OR

```
WHERE [Country] = 'United Kingdom'  
OR    [Region]  = 'North America'
```



Multiple Roles – different Dimension

1. Security for "Same Dimension"
2. Final permission set is a combination of roles
 - → UNION / SQL OR



```
SELECT ...  
FROM [Facts]  
WHERE [Country] = 'United Kingdom'  
OR [ProductCategory] = 'Clothing'
```

We are in a
multidimensional world!



Multiple Roles – different Dimension

Role	Sales Territory	Product
Clothing	No Restrictions	[Category] = 'Clothing'
UK	[Country] = 'United Kingdom'	No Restrictions
{Clothing, UK}	No Restrictions	No Restrictions

All Countries

	DE	UK	US
Bikes			
Clothing			
Accessories			

All Categories

	DE	UK	US
Bikes			
Clothing			
Accessories			

All Countries

	DE	UK	US
Bikes			
Clothing			
Accessories			



Demo

Multiple Roles



Evaluation of Security



Evaluation of Security

At first connect

cached for subsequent requests

Per Dimension

Using all owned/selected Roles

Demo

Evaluation of Security – Multidimensional



Evaluation of Security – Multidimensional

Evaluated per Dimension

- Security gets translated to all Attributes → AutoExists

EventClass	EventSubclass	TextData	Duration
Query Dimension	2 - Non-cache data	0100001	
Query Dimension	2 - Non-cache data	1100000	
Query Dimension	2 - Non-cache data	0110000	
Query Dimension	2 - Non-cache data	0101000	
Query Dimension	2 - Non-cache data	0100100	
Query Dimension	2 - Non-cache data	0100010	

- This can take some time!
- Especially for Big Dimensions!

Evaluation of Security – Multidimensional

Several Issues

AutoExists

- Remove Attributes / Rows
- Move secured Attributes to separate Dimension → no AutoExists

Single-Threaded Evaluation

- Remove Attributes / Rows
- (Faster CPUs)

Expensive Allowed/Denied Set

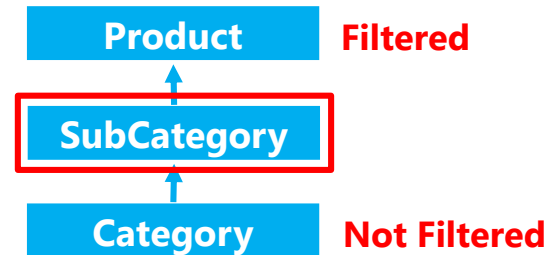
- Pre-Calculate
- Cache Sets (Assembly)

Evaluation of Security – Tabular

At query runtime

Propagated to all related Tables

- Not relating Tables!



Evaluation of Security – Tabular

Simple Expression

→ at Query Time

- e.g. [Category] = "Bikes"
- AND / OR

Complex Expression

→ at First Query / Query Time

- DAX
- Username() / CustomData()



Demo

Evaluation of Security – Tabular



Caching of Security



Caching – Multidimensional

Global Scope Cache

- 1) User connects
 - 2) Determine User's Role(s)
 - 3) Check if Global Scope Cache exists for Role(s)
 - 4) Evaluate Security
 - 5) Evaluate MDX Script
 - 6) ...
 - 7) Execute Query
- No** **Yes**
-
- ```
graph LR; No --> 4; Yes --> 7;
```

# Caching – Multidimensional

## Global Scope Cache

### For Static Roles:

- Cache is shared among Users with same Role(s)

### For Dynamic Roles:

- Cache is shared if:
  - Same Role(s)
  - Same UserName()
  - Same CustomData()

**Beware of the cache size!**

# Demo

Caching of Security



# Caching – Tabular

## In General:

Only Storage Engine Cache

No Formula Engine Cache – for DAX Queries

- But for MDX Queries!

## In terms of Security:

Simple: Pushed down to xVelocity Engine

- No Caching

Complex: RowFilter is evaluated once and cached



# Demo

Caching of Security – Tabular



# RowNumber and \$RowFilter

**[Product Category].\$ROWFILTER IN '0x0...004';**

## \$RowFilter

Binary encoded RowNumber

## RowNumber

SQLQueryMode=DataKeys

| RowNumber | Product Category | Binary          |
|-----------|------------------|-----------------|
| 0         | Bikes            | 0b0000 <b>1</b> |
| 1         | Components       | 0b000 <b>10</b> |
| 2         | Clothing         | 0b00 <b>100</b> |
| 3         | Accessories      | 0b0 <b>1000</b> |

**SELECT TOP 10 \***  
**FROM [Adventure Works].[\$Product Category]**

| Role             | Binary          |
|------------------|-----------------|
| Bikes + Clothing | 0b00 <b>101</b> |
|                  | 0x5             |



# Dynamic Security



# Dynamic Security

A Role is dynamic if ...

- USERNAME()
- CUSTOMDATA()

... is used

Security can be derived from ...

Mapping table

Assembly



# Dynamic Security

## Using a Mapping table

### Part of the Model

- MeasureGroup
- (Dimension)

Strongly tied to Model structures

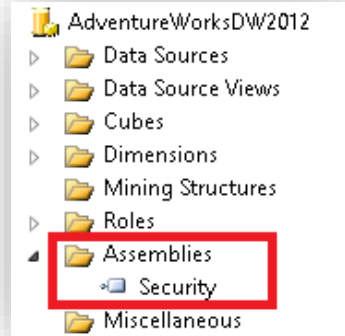
| Domain User | Company |
|-------------|---------|
| DOM\User1   | A       |
| DOM\User1   | B       |
| DOM\User2   | A       |
| DOM\User3   | C       |

# Dynamic Security

## Using an Assembly

Security is loaded from somewhere outside

- SQL Table
- Web Service



## Complex Development

- C# / .Net

## Great flexibility

- Not tied to Model structures

# Dynamic Security

## Using an Assembly

```
public static AdomdServer.Set GetAllowedSet(
 string dimension,
 string attribute,
 string username)
{
 // Connect to SQL/WebService/...
 // Pass in Parameters (Username, CustomData, ...)
 // Get ResultSet
 // Convert ResultSet to MDX Set
 // Return MDX Set
}
```

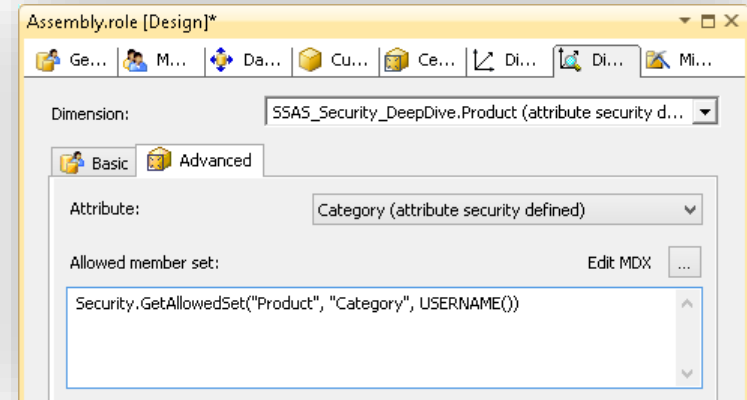
Compile the DLL

# Dynamic Security

## Using an Assembly

Add the DLL to the Project

Use the Assembly in the role's security definition



### **MDX Expression for Allowed member set:**

`Security. GetAllowedSet("Product", "Category", USERNAME())`

# Dynamic Security

## Using an Assembly Common Pitfalls

- Assembly throws an Error
- Using an Assembly slows down initial connect
- Security Settings



# Demo

## Assembly Error





# Dynamic Security

## Using an Assembly

Initial Connect is slowed down

→ Assembly is called several times

Remember:

"Security gets translated to all Attributes → "AutoExists"

→ Assembly is called for each Attribute!



# Dynamic Security

## Using an Assembly

Single Result/Execution is not cached

→ Cache within Assembly

```
string uniqueToken = username + dimension + attribute;

if (!CachedSecuritySets.TryGetValue(uniqueToken, out s))
{
 s = new Set(...);
 CachedSecuritySets.Add(uniqueToken, s);
}

return s;
```

# Dynamic Security

## Visual Totals

Can be set on Attribute-Level

Can be controlled by Assembly

→ only via AMO, not via UI

☒ Enable Visual Totals

```
oCubeAttributePermission.VisualTotals = "Security.GetVisualTotals(...)";
```

# Dealing with Multiple Roles



# Dealing with Multiple Roles

## Multiple Roles secured on different Dimensions

### Combine secured dimensions

- Use Union() + Exists()
- Strongly tied to Data Model

### Use an Assembly and CustomData()

- "business role"
- Only one role at a time



# Dealing with Multiple Roles

## Assembly and CustomData()

- What is a “business role”?
- User can select his “business role” using CustomData()
  - Connection String
  - Custom UI
- User has a default “business role”
  - Used if no CustomData() was supplied

# Dealing with Multiple Roles

## Changing the default role

- 1) Update default role in SQL table
  - User must own new role
- 2) Clear Cache
  - XMLA
  - SSIS
- 3) Execute Query again



# Demo

## Switching between Roles





# Dealing with Multiple Roles

## Advantages

Only one business role at a time

Flexible, no need to change cube structure

Change default-role

- Server-side solution
- Applied to all client tools
- (SharePoint Web Part)

Maintained in SQL

# Key Takeaways

Analysis services offers a rich set of features to secure the cube

- Use Dimension Security if possible

Can be further extended by custom code/Assemblies

- But use with caution!

Keep evaluation and caching in mind

- Especially for big cubes/models

Be aware of the implications of Multiple Roles

Thank  
You!

... don't forget to fill out the  
Session Evaluation Forms!



# Explore Everything PASS Has to Offer



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