LEAD WITH CURIOSITY

REST Connector in the world of IoT

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Agenda

- Introduction to REST
- Prepare your work with an API
- Working with Qlik REST Connector
  - Demystifying the Rest Connector
  - Workflow for connecting to a new REST API
  - Examples: Google Spreadsheet API
- Some Qlik Script tricks
  - Transposing Data
  - ISO-Date handling
  - Paging Techniques

LIVE!

Introduction to REST

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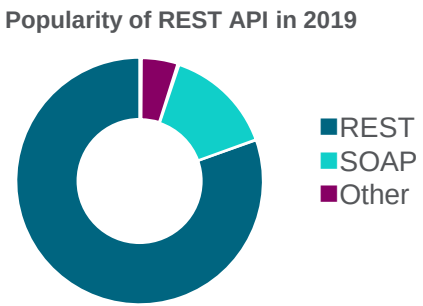
Before we start ...

REST vs SOAP

- REST
  - Representational State Transfer
  - started to spread in 2005
  - is a design style
  - Uses an URI to access information
  - Many different data formats
- SOAP
  - Simple Object Access Protocol
  - Is a protocol (“envelope”)
  - A service interface (calling functions)
  - More overhead
  - XML data format



Before we start ...

JSON vs XML

XML
Extensible Markup Language

```
<?xml version="1.0" encoding="UTF-8"?>
<authentication-context>
   <username>my_username</username>
   <password>my_password</password>
   <id>32443</id>
   <validationfactors>
      <validationfactor>
         <name>remote_address</name>
         <value>127.0.0.1</value>
      </validationfactor>
   </validationfactors>
</authentication-context>
```

JSON
JavaScript Object Notation

```
{
  "username" : "my_username",
  "password" : "my_password",
  "id" : 32443,
  "validationfactors" : {
     "validationfactor" : [
        { "name" : "remote_address",
          "value" : "127.0.0.1" }
     ]
   }
}
```

Strict notation!

Before we start ...

JSON vs XML

Language

```
oding="UTF-8"?>
>
ame</username>
ord</password>


ddress</name>
</value>


t>
```

JSON

JavaScript Object Notation

```
{
  "username" : "my_username",
  "password" : "my_password",
  "id" : 32443,
  "validationfactors" : {
    "validationfactor" : [
      { "name" : "remote_address",
        "value" : "127.0.0.1" }
    ]
  }
}
```

Strict notation!

```
{
  username : "my_username",
  password : "my_password",
  id : 32443,
  validationfactors : {
    validationfactor : [
      { name : 'remote_address',
        value : '127.0.0.1' }
    ]
  }
}
```

No relaxed notation ...

Prepare your work with an API

Read API Documentation
Play with the API using a tool

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Ask for the documentation

Documention

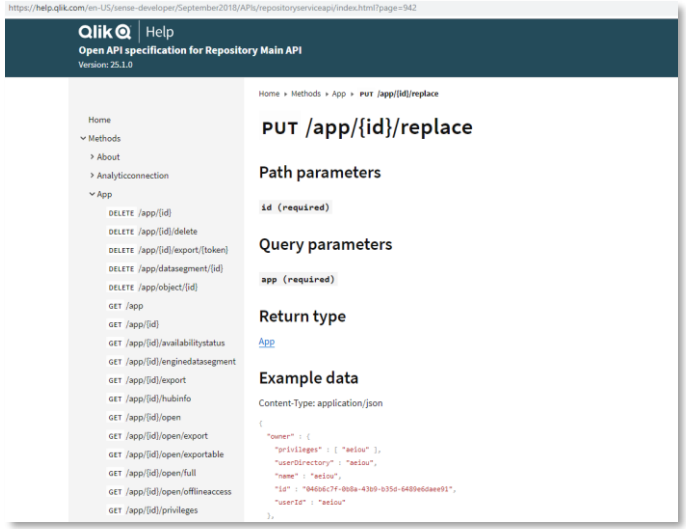
- Describe what methods (endpoints) are doing and which parameters they need
- Often created with Swagger

Sending Request

- Method (GET, POST, PUT ...)
- Path parameters
- QueryString parameters
- http-headers
- Body

Receiving Answer

- Response code
- Body

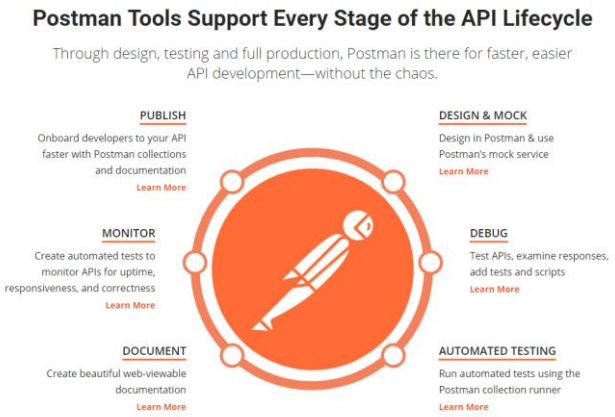


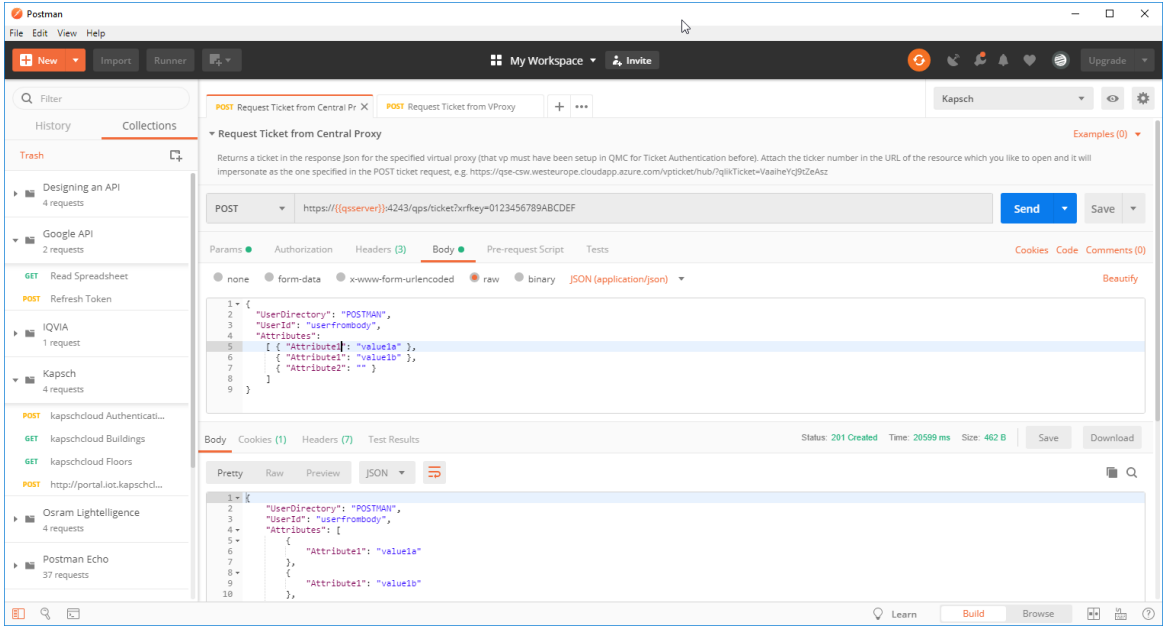
Example https://help.qlik.com/en-US/sense-developer/April2019/APIs/repositoryserviceapi

Play with the API using a tool

For example: Postman

www.getpostman.com





Play with API

Save in collections with variables

Echo Server

Mock Server

Copy Code

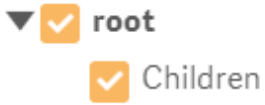
Working with Qlik REST Connector

Qlik REST Connector under the hood

De-mystify the generated script

Json Response

```
[
    {
        "Wife": "Martina",
        "Husband": "Christof",
        "Children": [
            {"name": "Julia"},
            {"name": "John"}
        ]
    },{
        "Wife": "Mary",
        "Husband": "Alexander"
    }
]
```



REST Connector Wizard

```
RestConnectorMasterTable:
SQL SELECT
    "Wife",
    "Husband",
    "__KEY_root",
    (SELECT
        "name",
        "__FK_Children"
    FROM "Children" FK "__FK_Children")
FROM JSON (wrap on) "root" PK "__KEY_root";
```

Field names are tolerant. The LOAD doesn‘t break if you attempt to load a non-existing key.

Qlik REST Connector under the hood

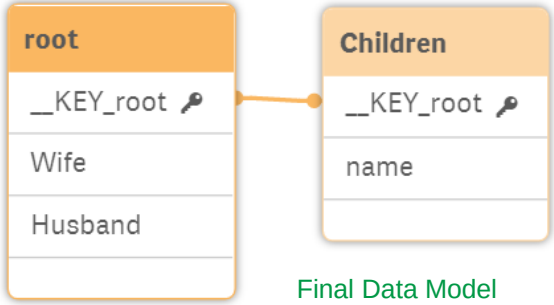
name	__FK_Children	Wife	Husband	__KEY_root	__extra_
Julia	1	-	-	-	-
John	1	-	-	-	-
-	-	Martina	Christof	1	-
-	-	Mary	Alexander	2	-

RestConnectorMasterTable (temporary)

```
[Children]:
LOAD    [name],
    [__FK_Children] AS [__KEY_root]
RESIDENT RestConnectorMasterTable
WHERE NOT IsNull([__FK_Children]);


[root]:
LOAD    [Wife],
    [Husband],
    [__KEY_root]
RESIDENT RestConnectorMasterTable
WHERE NOT IsNull([__KEY_root]);


DROP TABLE RestConnectorMasterTable;
```



Final Data Model

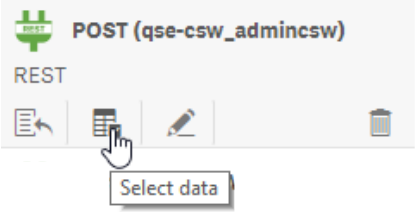
Embrace Qlik Scripting

It takes a program logic to interact with REST APIs

- In most cases, it is not a static, single call of a REST URI
  - The „Select Data“ wizard alone won‘t do the job
  - A series of calls are needed, which build on each other
  - Embrace the capabilities of Qlik Scripting

- For example
  - First of all, get a token for the next calls
  - Complex paging scenarios
  - Transposing results

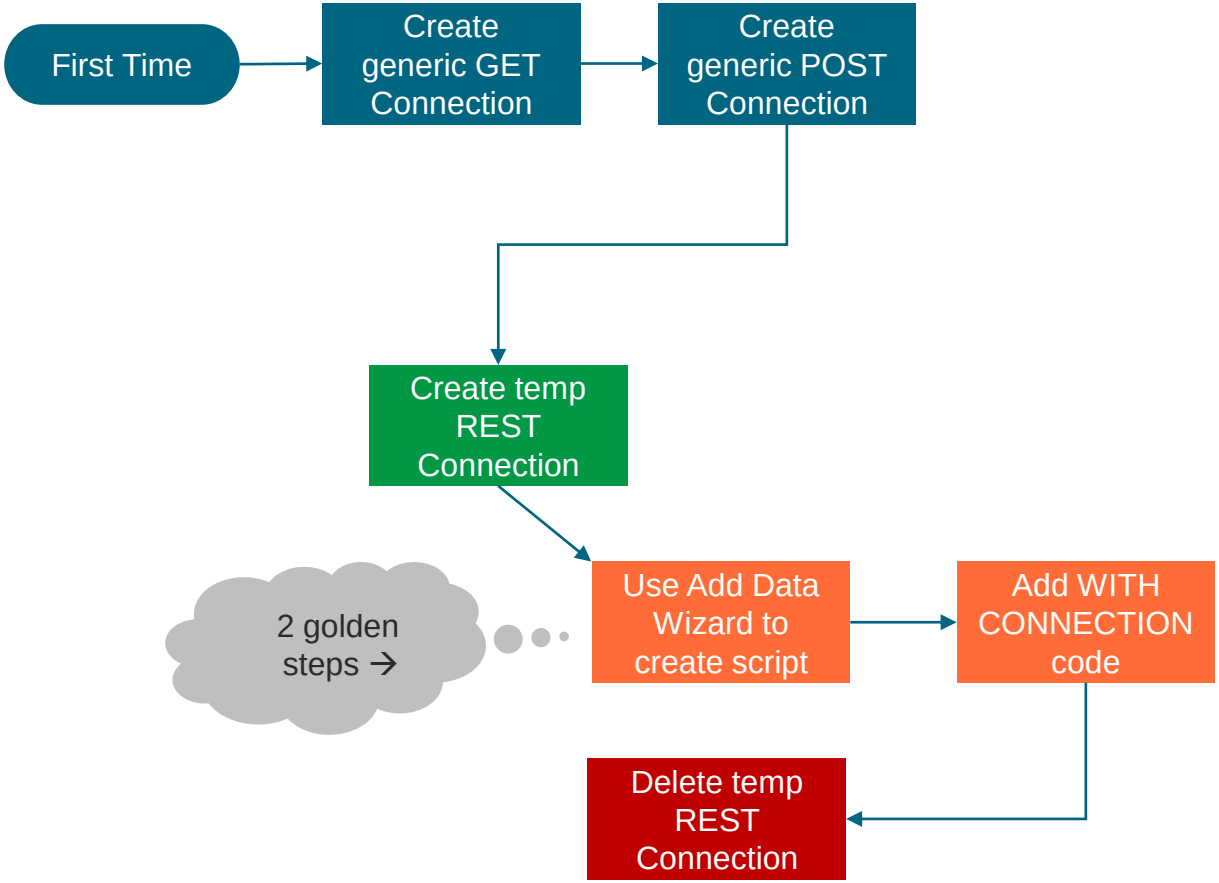
Select Data wizard



+ Scripting

POST → GET → GET → GET → ...

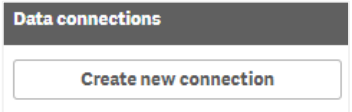
Workflow for working with REST Connector



Set up 2 placeholder REST-connections

- A **GET** request (https://postman-echo.com/get)
- A **POST** request (https://postman-echo.com/post)
- Leave the settings empty for Query-strings, Http-Heades, Body
  - you will <u>later</u> parameterize all those with script
- Why two requests?
  - You cannot parameterize the http-method itself (GET/POST) with script
  - The http-method will come from this script line just before the SELECT ...

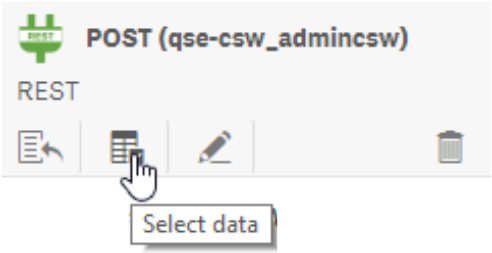
```
LIB CONNECT TO 'get_connection';
LIB CONNECT TO 'post_connection';
```



Note:

The „Create New Connection“ dialog can only be safed when there was a proper REST response


```
SQL SELECT
    "__KEY_root",
    "rootfield",
    (SELECT
        "id",
        "name",
        "__FK_data"
    FROM "data" FK "__FK_data")
FROM JSON (wrap on) "root" PK "__KEY_root"
```



Use Add Data Wizard to create script

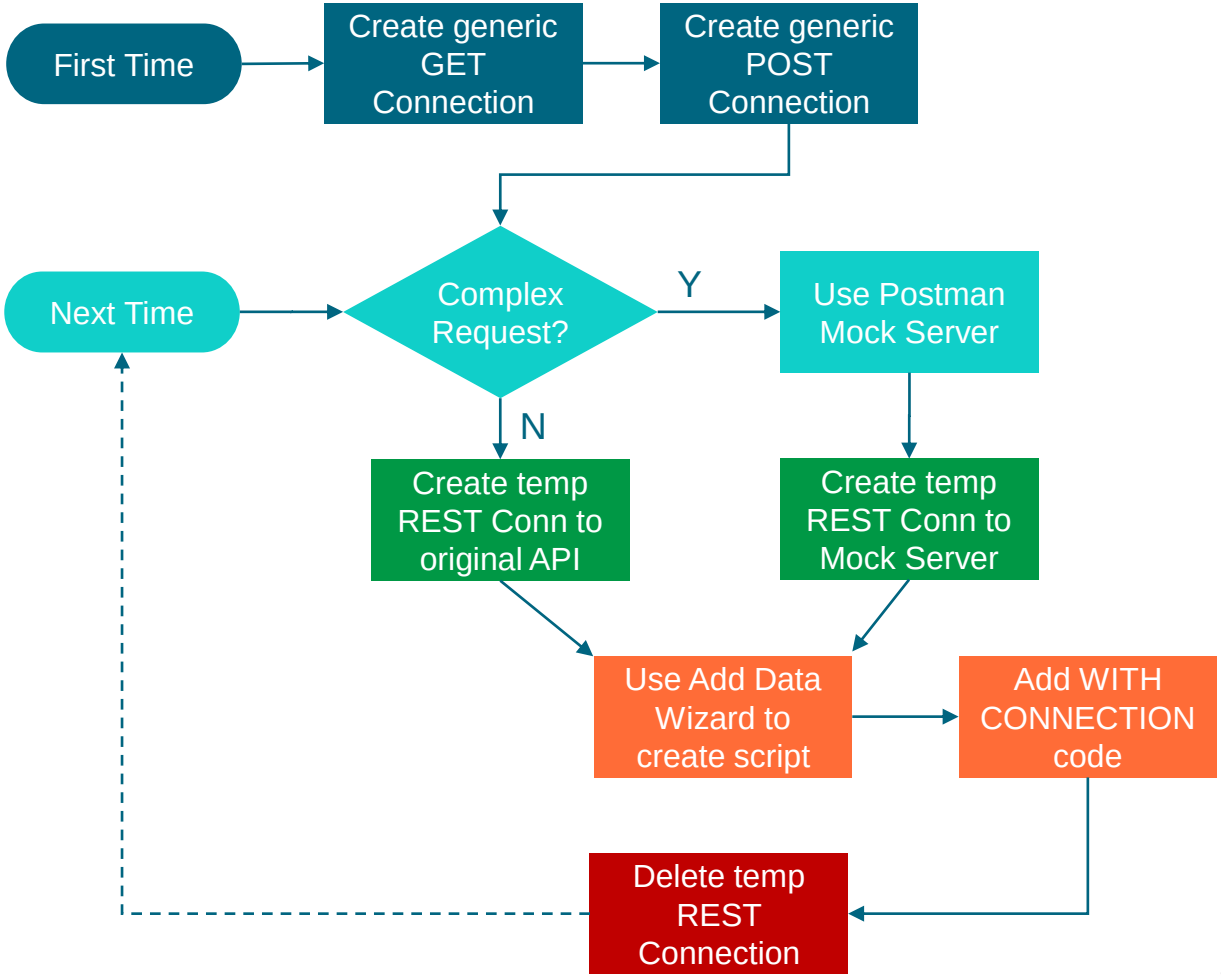
Add WITH CONNECTION code

```
WITH CONNECTION (
    URL "$(vBaseAPIurl)/users/$(vAPIuserId)"
    ,QUERY "tenent" "qliktrainees"
    ,HTTPHEADER "Content-Type" "application/json"
    ,HTTPHEADER "Authorization" "Bearer $(vToken)"
    //,HTTPHEADER "X-HTTP-Method-Override" "PUT",
    ,HTTPHEADER "cookie" "$(vCookie)"
    ,BODY "{""path"":""$(vAttribute)""}"
);
```

Insert all API parameters

2 golden steps

Workflow for working with REST Connector



Some Qlik Script Tricks

Request and use bearer token,
ISO-Date handling, Transposing Data, Paging

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Receiving an access token

And use it as bearer authentication in subsequent calls

1) Get the token

```
LIB CONNECT TO 'REST POST Request';
Authentication:
SQL SELECT
    "access_token",
    "token_type",
    "expires_in",
    "expiration_time",
    "error_message"
FROM JSON (wrap on) "root"
WITH CONNECTION (
    URL "$(vBaseAPIurl)/api/Authentication"
    ,QUERY "username" "#####"
    ,QUERY "password" "#####"
);

LET vToken = FieldValue('access_token', 1);
DROP TABLE Authentication;
TRACE New Token is $(vToken);
```

1

2) Use the token

```
LIB CONNECT TO 'REST GET Request';

RestConnectorMasterTable:
SQL SELECT
    ...
FROM JSON (wrap on) "root"
WITH CONNECTION (
    URL "$(vBaseAPIurl)/api/endpoint"
    ,HTTPHEADER "Authorization" "Bearer $(vToken)"
    ...
);
```

2

Even better: Try the old token first, get a new only if the old doesn‘t work anymore
→ https://github.com/ChristofSchwarz/qs_script_rest_api/blob/master/sub_try_request.md

Transposing Arrays

If data is returned in an array matrix like this instead of key-value pairs ...


```
{
    "range": "'Form responses 1'!A1:S125",
    "majorDimension": "ROWS",
    "values": [
        [
            "Timestamp",
            "Passenger",
            "From Airport",
            "To Airport",
            "Date",
            "Operator",
            "Aircraft Type",
            "Flight-Number",
            "Reason for Travel",
            "Company/Private",
            "Travel Class",
            "",
            "Comment"
        ],
        [
            "18/12/2018 16:24:57",
            "Christof",
            "VIE",
            "STR",
            "18/12/2018 16:30:00",
            "Eurowings",
            "A319",
            "",
            "PDS Software & PDS",
            "Company",
            "Economy"
        ],
        [
            "18/12/2018 18:27:02",
            "Christof",
            "Str"
```

Transposing Arrays

... the imported result will have two fields, an „array row“ autoid and a value ...

But what you want is ...

__KEY_values		@Value
1	1	Passenger
1	1	From Airport
1	1	To Airport
1	1	Date
1	1	Operator
2	2	Christof
2	2	VIE
2	2	STR
2	2	18/12/2018 16:30:00
2	2	Eurowings
3	3	Christof
3	3	Str
3	3	Bre
3	3	18/12/2018 18:40:00
3	3	Eurowings
	4	Vie
	4	Christof
	4	Ham

Transposing Arrays

1	1	1	1	1
2	2	2	2	2
3	3	3	3	3

But what you want is ...

this where each element of an array row is are transposed into a column (field) in Qlik.

__KEY_values	@Value
1	Passenger
1	From Airport
1	To Airport
1	Date
1	Operator
2	Christof
2	VIE
2	STR
2	18/12/2018 16:30:00
2	Eurowings
3	Christof
3	Str
3	Bre
3	18/12/2018 18:40:00
3	Eurowings
4	Vie
4	Christof
4	Ham

Transposing Arrays

1	1
1	2
1	3
1	4
1	5
2	1
2	2
2	3
2	4
3	1
3	2
3	3
3	4
3	5

- Introduce a row autoid __X which
  - restarts at 1 and
  - increments when the main key is the same as above

```
RestConnectorMasterTable:
LOAD *,
    If(Len(__FK_values_u0)
        ,If(Peek('__FK_values_u0')=__FK_values_u0, Peek('__X')+1, 1)
        ) AS __X,
;
SQL SELECT
    "__KEY_root",
    (SELECT
        "__FK_values",
        "__KEY_values",
        (SELECT
            "@Value",
            "__FK_values_u0"
        FROM "values" FK "__FK_values_u0" ArrayValueAlias "@Value")
    FROM "values" PK "__KEY_values" FK "__FK_values")
FROM JSON (wrap on) "root" PK "__KEY_root"
WITH CONNECTION (  ...
```

Transposing Arrays

1	2	3	4	5
1	1	1	1	1
2	2	2	2	
3	3	3	3	3

- Use Generic Load to achieve this transpose

```
GENERIC LOAD
    __FK_values_u0, __X, @Value
RESIDENT RestConnectorMasterTable
WHERE __FK_values_u0 > 0;

DROP TABLE RestConnectorMasterTable;
```

Transposing Arrays

1	2	3	4	5
1	1	1	1	1
2	2	2	2	
3	3	3	3	3

- Use Generic Load to achieve this transpose

If the field names are not part of the response ...

```
__FieldNames:
MAPPING LOAD * INLINE [
    1, Timestamp
    2, Passenger
    3, From Airport
    4, To Airport
    5, Date
    6, Operator
    7, Aircraft Type
] (no labels);

GENERIC LOAD
       __FK_values_u0, ApplyMap('__FieldNames', __X), @Value
RESIDENT RestConnectorMasterTable
WHERE __FK_values_u0 > 0;

DROP TABLE RestConnectorMasterTable;
```

Script Snippets → https://github.com/ChristofSchwarz/qs_script_rest_api/blob/master/transposing.md

Transposing Arrays

1	2	3	4	5
1	1	1	1	1
2	2	2	2	
3	3	3	3	3

- Use Generic Load to achieve this transpose

If the field names are in block 1 of the response

```
__FieldNames:
MAPPING LOAD __X, @Value
RESIDENT RestConnectorMasterTable
WHERE __FK_values_u0 = 1 AND Len(@Value);
```

Script Snippets → https://github.com/ChristofSchwarz/qs_script_rest_api/blob/master/transposing.md

```
GENERIC LOAD
       __FK_values_u0, ApplyMap('__FieldNames', __X), @Value
RESIDENT RestConnectorMasterTable
WHERE __FK_values_u0 > 1;

DROP TABLE RestConnectorMasterTable;
```

Date handling

Reading ISO dates

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
`Field` →	2	0	1	8	-	1	1	-	0	1	T	1	4	:	3	2	:	5	1	.	1	2	3	Z
`Left(Field,10)`	2	0	1	8	-	1	1	-	0	1														
`Mid(Field,12,8)`												1	4	:	3	2	:	5	1					
`Mid(Field,12,12)`												1	4	:	3	2	:	5	1	.	1	2	3	

Date handling

Reading ISO dates

```
                                 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
        Field →                  2 0 1 8 - 1 1 - 0 1 T 1 4 : 3 2 : 5 1 . 1 2 3 Z
Date#( Left(Field,10) ,'         Y Y Y Y - M M - D D ' )
Time#( Mid(Field,12,8)                                , ' h h : m m : s s ' )
Time#( Mid(Field,12,12)                               , ' h h : m m : s s . f f f ' )
```

All together:

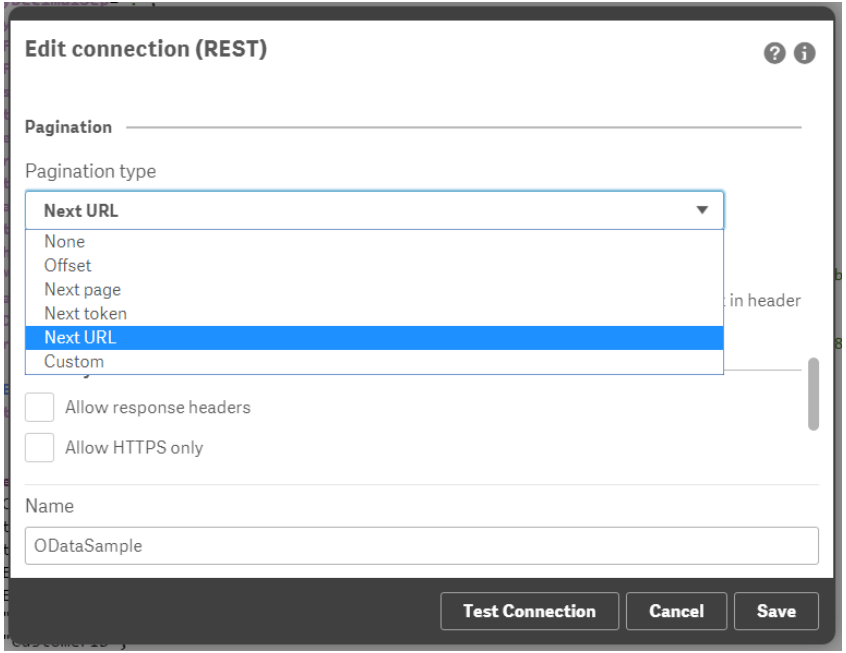
```
Timestamp(
    Date#(Left(Field,10) ,'YYYY-MM-DD’)) + Time#(Mid(Field,12,8),'hh:mm:ss’)
,'$(TimestampFormat)') AS Field
```

Code Snippet → https://github.com/ChristofSchwarz/qs_script_rest_api/blob/master/date_field_processing.md

Paging with REST APIs

Built-in paging types

- There are some paging strategies supported with no coding, e.g.
  - BestBuy
  - Facebook
  - Google Analytics
- REST Connector and Pagination Video (M. Tarallo) https://youtu.be/QICT55_712I



→ https://help.qlik.com/en-US/connectors/Subsystems/REST_connector_help/Content/Connectors_REST/Create-REST-connection/Pagination-scenarios.htm

Paging

Example

- Works out of the box.

GET https://schenck-sims.adamos-dev.com/measurement/measurements

Params | Authorization | Headers (8) | Body | Pre-request Script | Tests

Query Params

KEY	VALUE
Key	Value

Body | Cookies | Headers (6) | Test Results

Pretty | Raw | Preview | JSON


```
1  {
   "next": "https://schenck-sims.adamos-dev.com/measurement/measurements?pageSize=5&currentPage=2",
   "self": "https://schenck-sims.adamos-dev.com/measurement/measurements?pageSize=5&currentPage=1",
4  "statistics": {
5      "totalPages": 1433630,
6      "currentPage": 1,
7      "pageSize": 5
8  },
9  "measurements": [
10     {
11         "self": "https://schenck-sims.adamos-dev.com/measurement/measurements/8134601",
12         "time": "2019-03-14T00:00:00.819Z",
13         "id": "8134601",
14         "source": {
15             "self": "https://schenck-sims.adamos-dev.com/inventory/managedObjects/107",
16             "id": "107"
17         },
18         "type": "csd_sim_Universal1",
19         "Status": {
20             "csd_Status": {
21                 "value": 2
22             }
```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Paging

Example

- Does not work out of the box
- Dropped querystring “$format”
- Relative url

GET https://services.odata.org/V3/Northwind/Northwind.svc/Orders?$expand=Order_Details&$format=json

Pretty Raw Preview JSON


```
7288                "Quantity": 40,
7289                "Discount": 0
7290            },
7291            {
7292                "OrderID": 10447,
7293                "ProductID": 65,
7294                "UnitPrice": "16.8000",
7295                "Quantity": 35,
7296                "Discount": 0
7297            },
7298            {
7299                "OrderID": 10447,
7300                "ProductID": 71,
7301                "UnitPrice": "17.2000",
7302                "Quantity": 2,
7303                "Discount": 0
7304            }
7305        ],
7306        "OrderID": 10447,
7307        "CustomerID": "RICAR",
7308        "EmployeeID": 4,
7309        "OrderDate": "1997-02-14T00:00:00",
7310        "RequiredDate": "1997-03-14T00:00:00",
7311        "ShippedDate": "1997-03-07T00:00:00",
7312        "ShipVia": 2,
7313        "Freight": "68.6600",
7314        "ShipName": "Ricardo Adocicados",
7315        "ShipAddress": "Av. Copacabana, 267",
7316        "ShipCity": "Rio de Janeiro",
7317        "ShipRegion": "RJ",
            "ShipPostalCode": "02389-890",
            "ShipCountry": "Brazil"
7320    }
7321 ],
7322 "odata.nextLink": "../../Northwind/Northwind.svc/Orders?$expand=Order_Details&$skiptoken=10447"
7323 }
```


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Tricks for Paging

OData

Key generation strategy

Current record

1. Set Key Generation strategy to „Current Record“
2. Get the first data page with the REST Connector Wizard
   - (If missing add "odata.nextLink“)
   - Add WITH CONNECTION (...) as always
3. Put all the blocks into a DO-WHILE loop
   - Create variable skiptoken before the loop
   - Add $skiptoken to „WITH CONNECTION“ block
4. Parse the „$skiptoken“ argument from odata.nextLink field

Code Snippets:
https://github.com/ChristofSchwarz/qs_script_rest_api/blob/master/odata.md

Sampe Data:
https://services.odata.org/V3/Northwind/Northwind.svc/Orders?$expand=Order_Details&$format=json

```
LET skiptoken = '';
DO

  RestConnectorMasterTable:
  SQL SELECT
      "odata.metadata",
      "odata.nextLink",
      "__KEY_root",
      ...
      FROM "value" PK "__KEY_value" FK "__FK_value")
  FROM JSON (wrap on) "root" PK "__KEY_root"
  WITH CONNECTION ( QUERY "$skiptoken" "$(skiptoken)" );

  ... Other tables like „values“ and „root“

  nextLink: LOAD Only(odata.nextLink) RESIDENT 'RestConnectorMasterTable';
  LET nextlink = FieldValue('Only(odata.nextLink)', 1);
  DROP TABLE nextLink;
  LET skiptoken = TextBetween(nextlink & '&', '$skiptoken=', '&');
  WHEN Len(nextlink) TRACE [nextLink $skiptoken=$(skiptoken)];

  DROP TABLE RestConnectorMasterTable;

LOOP WHILE Len(nextlink)
```

IoT topics: All together

Advanced Scripting Skills

- How much data do have to load at once? → ODAG? QABDI?
- Can previous data be stored to get delta? → QVD
- Json structures of multiple API calls may differ but should be treated like one → CONCATENATE LOAD
- Data is cut off due to max page size → DO WHILE loops
- Series of sensor values are insufficient to answer business questions → post processing and enrich with flags, duration → RESIDENT LOAD
- Put the heavy-lifting into script

More resources

Help

- https://help.qlik.com/en-US/connectors/Subsystems/REST_connector_help/Content/Connectors_REST/Create-REST-connection/Create-REST-connection.htm

Code Snippets

- https://github.com/ChristofSchwarz/qs_script_rest_api
- https://github.com/ChristofSchwarz/qs_script_rest_api/blob/master/transposing.md

Videos

- REST Connector Deluxe (C. Schwarz) https://youtu.be/7m9ZejlzkkY
- Qlik and REST (M. Tarallo) https://youtu.be/ibCACdF_tPo
- REST Connector and Pagination (M. Tarallo) https://youtu.be/QlCT55_712I
- Google Sheet API with Qlik Script (C. Schwarz) https://youtu.be/l9sk-v_PTf8

Latest version of this presentation

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Thank You