

Practical policy-as-code



With [Open Policy Agent](#) and [Rönd](#)

Ciao! I'm...

Graziano Casto - Developer Relations @ Mia-Platform



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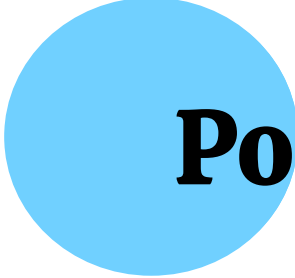
**What I talk about when I talk
about policy-as-code.**



What exactly policies are?

A policy is a set of rules that govern the behaviour of a software service.

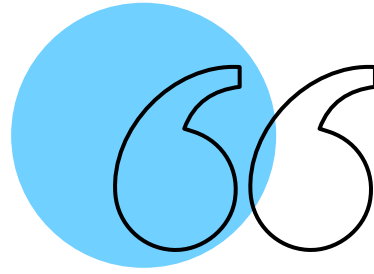
It simply describe invariants that must hold in a software system.



Policy !== Auth*

Authorization is a special kind of policy that often dictates which people or machine can run which action on which resources.

Authentication is how people or machines prove they are who they say they are.



Policy-as-code is an approach to policy management in which policies are defined, updated, and enforced using code.

Why PaC?

Visibility

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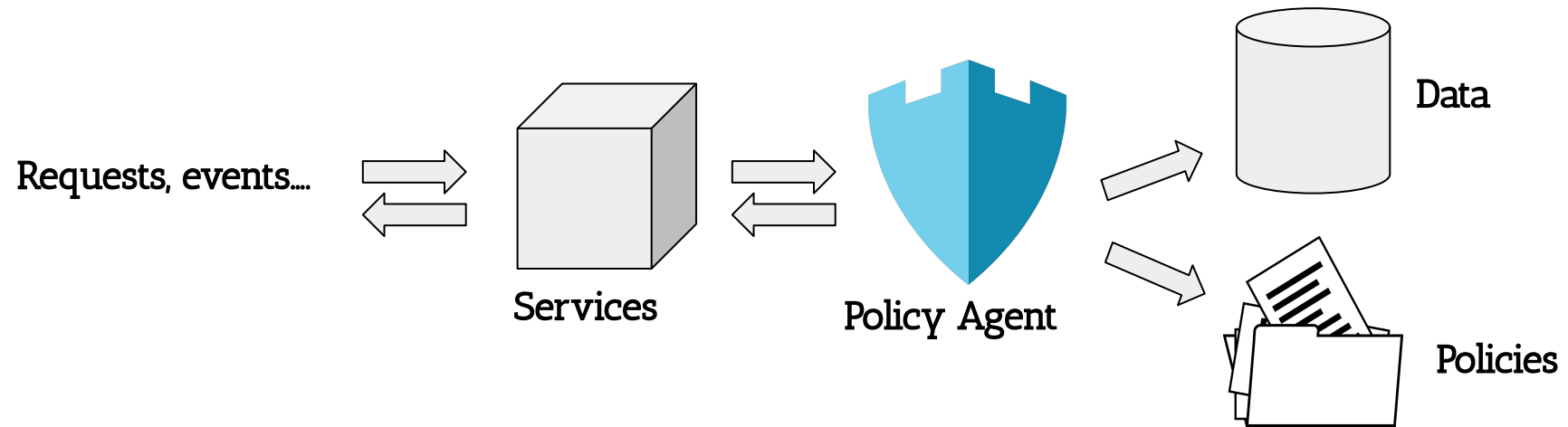
Accuracy

When teams define and manage policies using code, they avoid the risk of making configuration mistakes when managing a system manually.

Testing

When policies are written in code, it's easy to validate them using automated auditing tools.

Policy Decoupling





How to implement policy decoupling for API enforcement

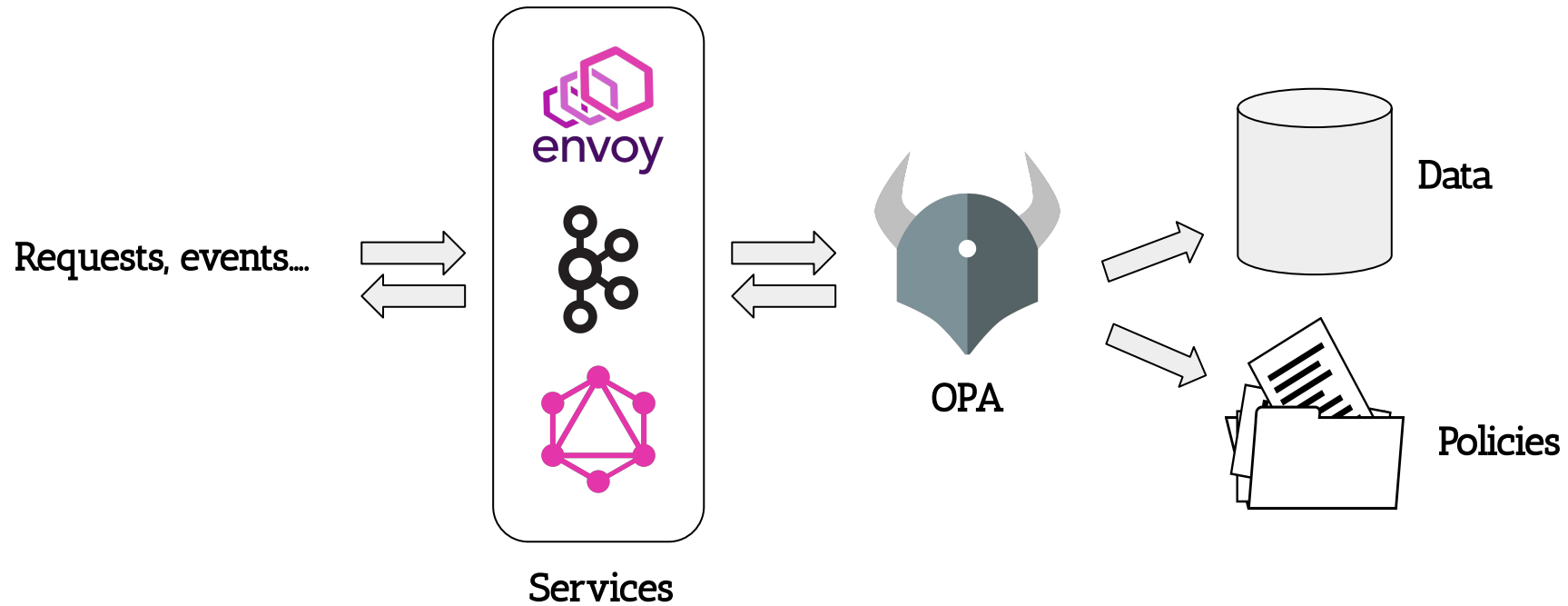
Open Policy Agent

Open Policy Agent (OPA) is an open-source CNCF graduated project.

It provides a high-level declarative language (Rego) that lets you specify policy as code and simple APIs to offload policy decision-making from your software.



Open Policy Agent Architecture





Securing APIs with OPA

```
package policies

default allow := false

# Allow users to get their own salaries.

allow if {
  input.method == "GET"
  input.path == ["finance", "salary", input.user]
}
```



Authentication approach

Role-based access control (RBAC) is a method of regulating access to a specific resource based on the roles of individual users within your organization.



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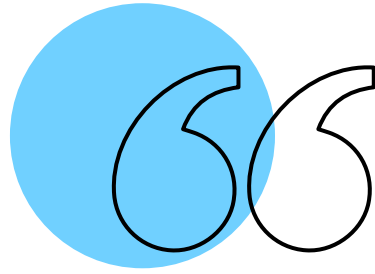
Attribute-based access control (ABAC) is another authorization method built on top of RBAC that allow you to define your security model also on user or request attribute.

Rönd

It's an open-source lightweight Kubernetes sidecar container that helps you protect your APIs with simple security policies.

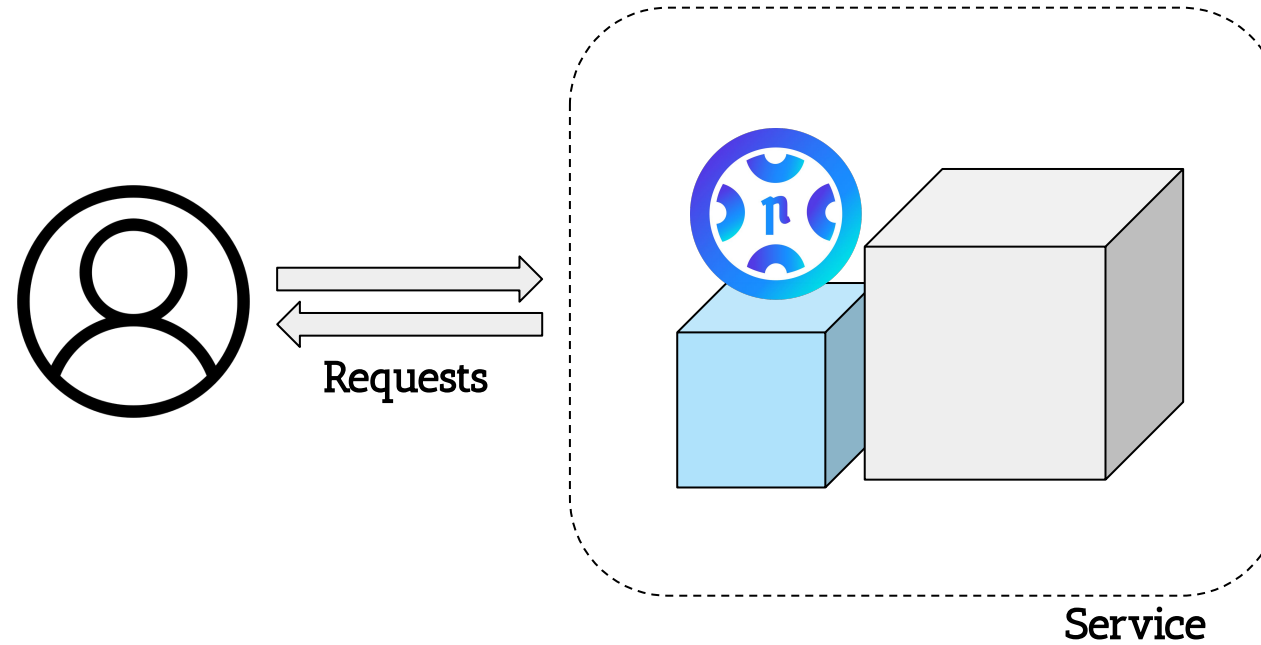
It uses OPA as security engine for validating authorization rules, and leverages Rego language for writing the security policies.



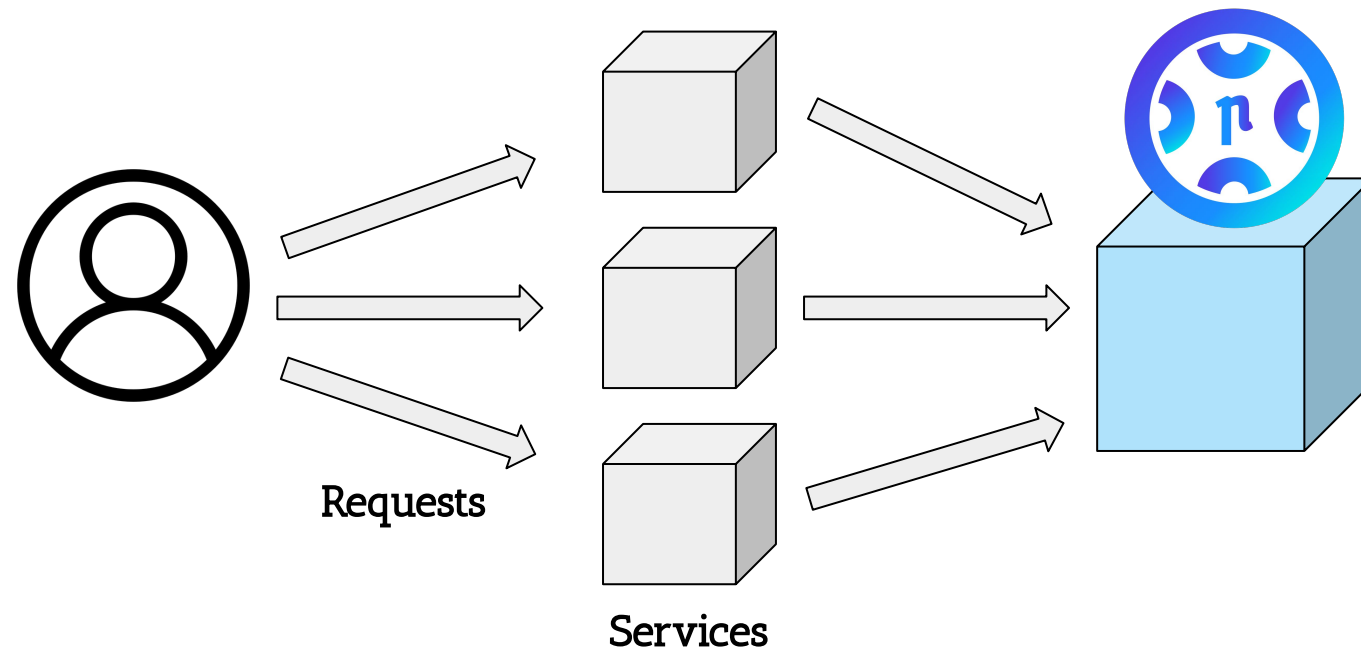


Rönd is an authorization mechanism, but it also natively allows you to build an RBAC **solution** by defining the concepts of **Roles**, **Permissions**, and **User Groups** as building blocks.

Run as sidecar container..



...or as a standalone service





Securing APIs with Rönd: a real world example

The APIs to secure

→ GET /store-info

All requests are accepted even if without an Authorization header.



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All requests are accepted even if without an Authorization header.

→ POST /receipt

Only authenticated requests are accepted.

Users with role *Salesman* can add only receipts for their store, *StoreManager* can add receipts on the entire chain.



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→ GET /receipt

Only authenticated requests are accepted.

Users with role *Salesman* can access the receipts without the payments and customer sensitive data, *StoreManager* can access the receipts also with payment and customer data..



How we get info about user roles?

```
import axios from 'axios';

const options = {
  method: 'GET',
  url: 'http://myawesomeservice/store-info',
  headers: {
    Authorization: 'eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJyYb2x1IjoiU2FsZXNtYW4iLCJzdG9yZXMlOi0lsxXX0.nYs1YVnFJ-2MmldTZw_kaevMfL5V-MdC26KPVv-kICo'
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try {
  const { data } = await axios.request(options);
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```



```
{
  "role": "Salesman",
  "stores": [1]
}
```

How Rönd configuration works

```
{
  "paths":{
    "/store-info":{
      "get":{
        "x-rond":{
          "requestFlow":{
            "policyName":"allow_all"
          }
        }
      }
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  }
}
```

routes.json

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```
package policies

allow_all {
  true
}
```

policies.rego

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Define a Rego complex policy

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  role := decoded_jwt["role"]
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Define a [Rego function](#) to check if the role of the user performing the request is the same required to perform the requested action.

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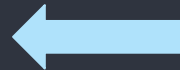
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try {
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  console.log(data);
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}
```

Define a [Rego function](#) to check if the user is assigned to the store which the request insists on.

```
user_belongs_to_store(required_store) {
  authorization_jwt := input.request.headers["Authorization"][0]
  decoded_jwt_data := io.jwt.decode(authorization_jwt)
  decoded_jwt := decoded_jwt_data[1]
  stores := decoded_jwt["stores"]
  some store in stores
  store == required_store
}
```

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user belongs to store(required store) {
  authorization_jwt := input.request.headers["Authorization"][0]
  decoded_jwt_data := io.jwt.decode(authorization_jwt)
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  url: 'http://myawsservice/receipt',
  headers: {Authorization:
'eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJyYb2xlIjoiU3RvcnVNYW5hZ2VYIiwic3RvcnVzIjpbMV19.jYcCyUjy-
oFaRg20fcZptDtIHow3UWbwZgbdAjfV3nc'},
  data: {
    store: 1,
    receipt_nbr: '0001-0001',
    date: '2024-01-02',
    total_price: 100,
    currency: 'EUR',
    items: [{product_code: 'EA-001', qty: 1, price: 100}],
    payment: [{payment_method: 'INSTANT_PAYMENT', amount: 100}]
  }
};
```

Define a [Rego function](#) to check if the user is assigned to the store which the request insists on.

```
{
  "role": "Salesman",
  "stores": [1]
}
```

```
user_belongs_to_store(required_store) {
  authorization_jwt := input.request.headers["Authorization"][0]
  decoded_jwt_data := io.jwt.decode(authorization_jwt)
  decoded_jwt := decoded_jwt_data[1]
  stores := decoded_jwt["stores"]
  some store in stores
  store == required_store
}
```


Define a Rego complex policy

```
{
  "paths": {
    "/store-info": {...},
    "/receipt": {
      "post": {
        "x-rond": {
          "requestFlow": {
            "policyName": "allow_create_new_receipt"
          }
        }
      },
      "get": {...}
    }
  }
}
```

Define a Rego complex policy

```
{
  "paths": {
    "/store-info": {...},
    "/receipt": {
      "post": {
        "x-rond": {
          "requestFlow": {
            "policyName": "allow_create_new_receipt"
          }
        }
      }
    },
    "get": {...}
  }
}
```

Define a Rego complex policy

```
{
  "paths": {
    "/store-info": {...},
    "/receipt": {
      "post": {
        "x-rond": {
          "requestFlow": {
            "policyName": "allow_create_new_receipt"
          }
        }
      }
    },
    "get": {...}
  }
}
```



```
package policies

user_has_role(required_role) {
  authorization_jwt := input.request.headers["Authorization"][0]
  decoded_jwt_data := io.jwt.decode(authorization_jwt)
  decoded_jwt := decoded_jwt_data[1]
  role := decoded_jwt["role"]
  role == required_role
}

user_belongs_to_store(required_store) {
  authorization_jwt := input.request.headers["Authorization"][0]
  decoded_jwt_data := io.jwt.decode(authorization_jwt)
  decoded_jwt := decoded_jwt_data[1]
  stores := decoded_jwt["stores"]
  some store in stores
  store == required_store
}

allow_create_new_receipt {
  user_has_role("StoreManager")
} {
  store := input.parsed_body.store
  user_belongs_to_store(store)
}
```

Define a Rego complex policy

```
{
  "paths": {
    "/store-info": {...},
    "/receipt": {
      "post": {
        "x-rond": {
          "requestFlow": {
            "policyName": "allow_create_new_receipt"
          }
        }
      },
      "get": {...}
    }
  }
}
```

```
package policies
```

```
user_has_role(required_role) {
  authorization_jwt := input.request.headers["Authorization"][0]
  decoded_jwt_data := io.jwt.decode(authorization_jwt)
  decoded_jwt := decoded_jwt_data[1]
  role := decoded_jwt["role"]
  role == required_role
}
```

```
user_belongs_to_store(required_store) {
  authorization_jwt := input.request.headers["Authorization"][0]
  decoded_jwt_data := io.jwt.decode(authorization_jwt)
  decoded_jwt := decoded_jwt_data[1]
  stores := decoded_jwt["stores"]
  some store in stores
  store == required_store
}
```

```
allow_create_new_receipt {
  user_has_role("StoreManager")
} {
  store := input.parsed_body.store
  user_belongs_to_store(store)
}
```

Define a Rego complex policy

```
{
  "paths": {
    "/store-info": {...},
    "/receipt": {
      "post": {
        "x-rond": {
          "requestFlow": {
            "policyName": "allow_create_new_receipt"
          }
        }
      },
      "get": {...}
    }
  }
}
```

```
package policies

user_has_role(required_role) {
  authorization_jwt := input.request.headers["Authorization"][0]
  decoded_jwt_data := io.jwt.decode(authorization_jwt)
  decoded_jwt := decoded_jwt_data[1]
  role := decoded_jwt["role"]
  role == required_role
}

user_belongs_to_store(required_store) {
  authorization_jwt := input.request.headers["Authorization"][0]
  decoded_jwt_data := io.jwt.decode(authorization_jwt)
  decoded_jwt := decoded_jwt_data[1]
  stores := decoded_jwt["stores"]
  some store in stores
  store == required_store
}

allow_create_new_receipt {
  user_has_role("StoreManager")
} {
  store := input.parsed_body.store
  user_belongs_to_store(store)
}
```

The APIs to secure

→ GET /store-info

All requests are accepted even if without an Authorization header.

→ POST /receipt

Only authenticated requests are accepted.

Users with role *Salesman* can add only receipts for their store, *StoreManager* can add receipts on the entire chain.

→ GET /receipt

Only authenticated requests are accepted.

Users with role *Salesman* can access the receipts without the payments and customer sensitive data, *StoreManager* can access the receipts also with payment and customer data..



Modify response with Rönd

```
import axios from 'axios';

const options = {
  method: 'GET',
  url: 'http://myawesomeservice/receipt',
  headers: {
    Authorization: 'eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJyYb2xlIjoieU2FsZXNtYW4iLCJzdG9yZXMlOi0lsxXX0.nYs1YVnFJ-2MmldTZw_kaevMfL5V-MdC26KPVv-kICo'
  }
};

try {
  const { data } = await axios.request(options);
  console.log(data);
} catch (error) {
  console.error(error);
}
```

Modify response with Rönd

```
import axios from 'axios';

const options = {
  method: 'GET',
  url: 'http://myawesomeservice/receipt',
  headers: {
    Authorization: 'eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJyYb2xlIjoiU2FsZXNtYW4iLCJzdG9yZ2MmldTZw_kaevMfL5V-MdC26KPVv-kICo'
  }
};

try {
  const { data } = await axios.request(options);
  console.log(data);
} catch (error) {
  console.error(error);
}
```

```
{
  "store": 1,
  "receipt_nbr": "0001-0001",
  "date": "2024-01-02",
  "total_price": 100.00,
  "currency": "EUR",
  "customer": {
    "name": "John",
    "last_name": "Doe",
    "birth_date": "1970-01-01",
    "vat_nbr": "45784578457",
    "email": "mario.rossi@gmail.com"
  },
  "items": [
    {
      "product_code": "EA-001",
      "qty": 1,
      "price": 100.00
    }
  ],
  "payments": [
    {
      "payment_method": "DIGITAL_PAYMENT",
      "amount": 100.00
    }
  ]
}
```


Modify response with Rönd

```
import axios from 'axios';

const options = {
  method: 'GET',
  url: 'http://myawesomeservice/receipt',
  headers: {
    Authorization: 'eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJyY2xlIjoiU2FsZXNtYW4iLCJzdG9yZSI6IjZMmldTZw_kaevMfL5V-MdC26KPVv-kICo'
  }
};

try {
  const { data } = await axios.request(options);
  console.log(data);
} catch (error) {
  console.error(error);
}
```

We have to remove *customer* and *payments* information from the response for *Salesman* users.

```
{
  "store": 1,
  "receipt_nbr": "0001-0001",
  "date": "2024-01-02",
  "total_price": 100.00,
  "currency": "EUR",
  "customer": {
    "name": "John",
    "last_name": "Doe",
    "birth_date": "1970-01-01",
    "vat_nbr": "45784578457",
    "email": "mario.rossi@gmail.com"
  },
  "items": [
    {
      "product_code": "EA-001",
      "qty": 1,
      "price": 100.00
    }
  ],
  "payments": [
    {
      "payment_method": "DIGITAL_PAYMENT",
      "amount": 100.00
    }
  ]
}
```

Modify response with Rõnd

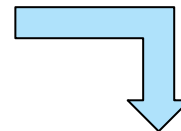
```
{
  "paths": {
    "/store-info": {...},
    "/receipt": {
      "post": {...},
      "get": {
        "x-rond": {
          "requestFlow": {
            "policyName": "allow_access_receipt",
          },
          "responseFlow": {
            "policyName": "protect_receipt_info"
          }
        }
      }
    }
  }
}
```

Modify response with Rönd

```
{
  "paths": {
    "/store-info": {...},
    "/receipt": {
      "post": {...},
      "get": {
        "x-rond": {
          "requestFlow": {
            "policyName": "allow_access_receipt",
          },
          "responseFlow": {
            "policyName": "protect_receipt_info"
          }
        }
      }
    }
  }
}
```

Modify response with Rönd

```
{
  "paths": {
    "/store-info": {...},
    "/receipt": {
      "post": {...},
      "get": {
        "x-rond": {
          "requestFlow": {
            "policyName": "allow_access_receipt",
          },
          "responseFlow": {
            "policyName": "protect_receipt_info"
          }
        }
      }
    }
  }
}
```



First of all check that the request is authenticated and that the user belongs to *StoreManager* of *Salesman* role.

```
allow_access_receipt {
  user_has_role("StoreManager")
} {
  user_has_role("Salesman")
}
```

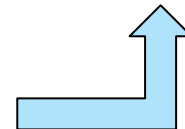
Modify response with Rõnd

```
{
  "paths": {
    "/store-info": {...},
    "/receipt": {
      "post": {...},
      "get": {
        "x-rond": {
          "requestFlow": {
            "policyName": "allow_access_receipt",
          },
          "responseFlow": {
            "policyName": "protect_receipt_info"
          }
        }
      }
    }
  }
}
```

Modify response with Rõnd

```
{
  "paths": {
    "/store-info": {...},
    "/receipt": {
      "post": {...},
      "get": {
        "x-rond": {
          "requestFlow": {
            "policyName": "allow_access_receipt",
          },
          "responseFlow": {
            "policyName": "protect_receipt_info"
          }
        }
      }
    }
  }
}
```

```
protect_receipt_info [response] {
  user_has_role("StoreManager")
  response := input.response.body
} {
  user_has_role("Salesman")
  receipt_response_list := input.response.body
  result := [new_item |
    item := receipt_response_list[_]
    new_item = object.remove(item, ["customer", "payments"])
  ]
  response := result
}
```



Based on the role of the user performing the request we filter the response to remove *customer* and *payments* object from the response in case the user is a *Salesman*.

Modify response with Röd

```
{
  "paths": {
    "/store-info": {...},
    "/receipt": {
      "post": {...},
      "get": {
        "x-rond": {
          "requestFlow": {
            "policyName": "allow_access_receipt",
          },
          "responseFlow": {
            "policyName": "protect_receipt_info"
          }
        }
      }
    }
  }
}
```

```
protect_receipt_info [response] {
  user_has_role("StoreManager")
  response := input.response.body
} {
  user_has_role("Salesman")
  receipt_response_list := input.response.body
  result := [new_item |
    item := receipt_response_list[_]
    new_item = object.remove(item, ["customer", "payments"])
  ]
  response := result
}
```

Modify response with Rõnd

```
{
  "paths": {
    "/store-info": {...},
    "/receipt": {
      "post": {...},
      "get": {
        "x-rond": {
          "requestFlow": {
            "policyName": "allow_access_receipt",
          },
          "responseFlow": {
            "policyName": "protect_receipt_info"
          }
        }
      }
    }
  }
}
```

```
protect_receipt_info [response] {
  user_has_role("StoreManager")
  response := input.response.body
} {
  user_has_role("Salesman")
  receipt_response_list := input.response.body
  result := [new_item |
    item := receipt_response_list[_]
    new_item = object.remove(item, ["customer", "payments"])
  ]
  response := result
}
```



That's all!

Key session takeaways



01 PaC: your swiss knife for policy management

That's all!

Key session takeaways

01 PaC: your swiss knife for policy management

02 Open Policy Agent: the tool for policy decoupling

That's all!

Key session takeaways

01 PaC: your swiss knife for policy management

02 Open Policy Agent: the tool for policy decoupling

03 Rönd: implement your RBAC architecture with ease

Q&A Time

Feel free to ask any
question now or reach me
around the conference to
have a chat!

[Leave your feedback here! →](#)



<https://bit.ly/feedback-graz>

Grazie!

Graziano Casto

 graziano.casto@mia-platform.eu

 [@castograziano](https://www.linkedin.com/company/castograziano)

 castograziano.com



<https://bit.ly/feedback-graz>