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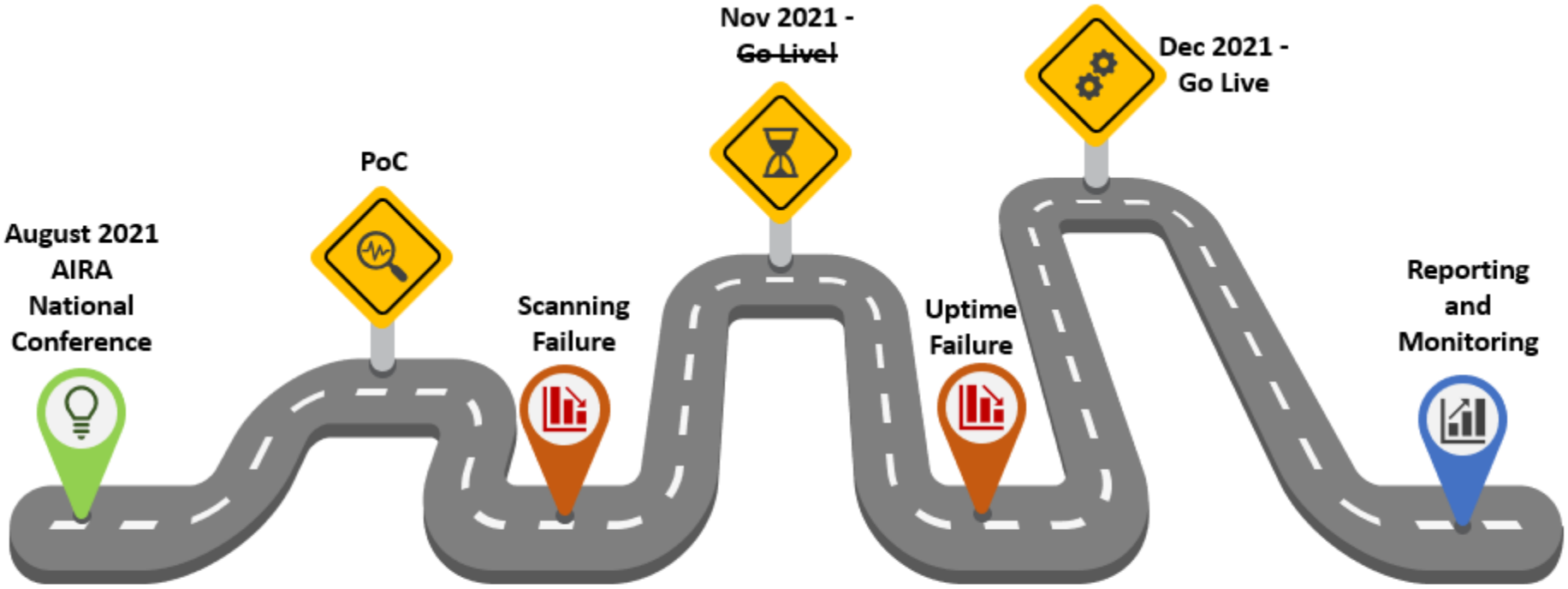
Lessons Learned Implementing SMART Health Cards

Kevin Snow, Chief Architect
AIRA National Meeting
April 2022

Our Journey!



Milestones

Represents significant milestones in the process of going live with a central Smart Health Card service.

Events

Events along the way that steered the direction of the project.

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Discovery

- ❑ **Who** is involved
- ❑ **What** will this look like
- ❑ **Where and When -** Consumer perspective
- ❑ **Why** do we need this
- ❑ **How** does it work

Who is involved

AIRA
AMERICAN IMMUNIZATION REGISTRY ASSOCIATION

VCI™

CommonHealth

HL7® FHIR®

Excelsior Pass
Excelsior Pass Plus

19 Jurisdictions

Microsoft

Add to Apple Wallet

G Pay

What will this look like

Add to Apple Wallet

COVID-19 Vaccination Record

WEB IZ

Please keep this record card, which includes medical information about the vaccines you have received.

Por favor, guarde esta tarjeta de registro, que incluye información médica sobre las vacunas que ha recibido.

SIMPSON	BART	M	
Last Name	First Name	Middle Name	Generation

01/01/1999	1054756
Date of birth	Patient number (medical record or IIS record number)

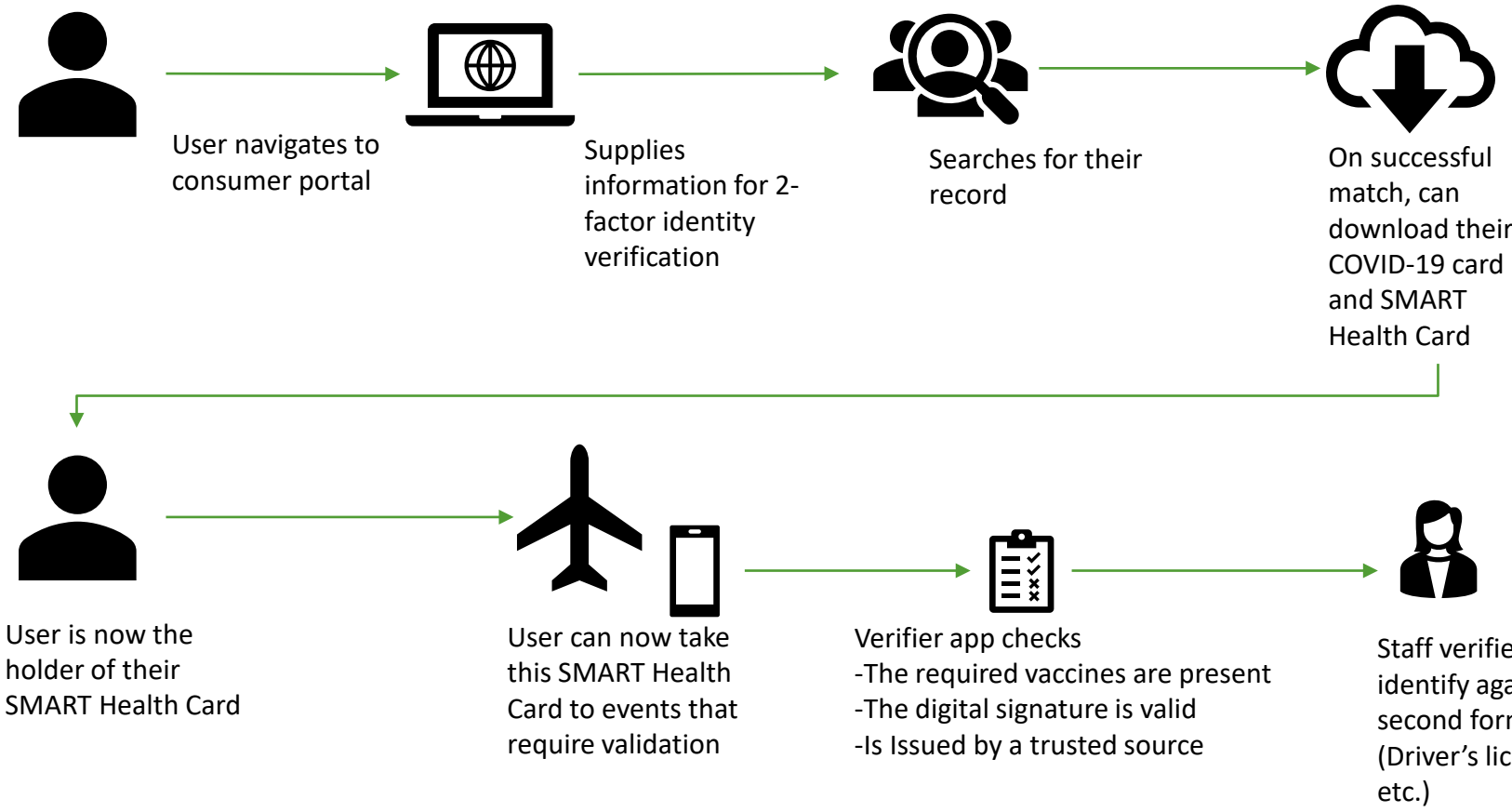
Vaccine	Product Name / Manufacturer Lot Number	Date	Administering Clinic
1st Dose COVID-19	COVID-19 mRNA (PFR)	09/01/2021	PARENT RECORD (PROLD)
2nd Dose COVID-19	COVID-19 mRNA (PFR)	09/22/2021	PARENT RECORD (PROLD)

SMART®

Digital COVID-19 Vaccination Record

- **This SMART Health Card is a Digital COVID-19 Vaccination Record (https://smarthealth.cards/)**
- **Keep a copy or share this with a trusted organization by letting them scan the 2D barcode (QR code) on your paper or phone screen**
- **Downloaded/Printed on 3/29/2022 at 3:28:22PM**
- **You may not misuse, modify, alter, amend or remove any of the content on this card. Misuse of this card in any way is expressly prohibited and may constitute a criminal offense punishable by imprisonment.**

Where and When – Consumer Perspective

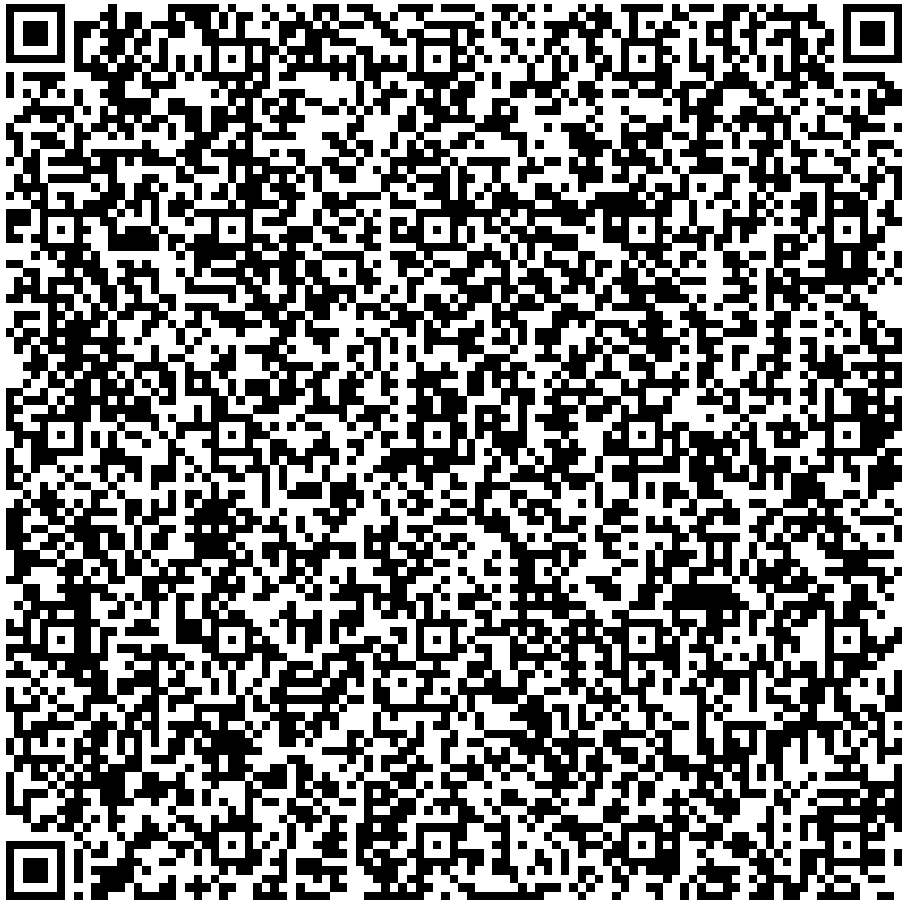


Why do we need this

- ❑ Digital Version of Paper Records
- ❑ Consumer can persist test results and vaccine records
- ❑ Digital signatures to ensure the integrity of the records
- ❑ Trusted issuers to confirm from an authorized source

How to verify a SMART Health Card - Verifier Portal

- https://demo-portals.smarthealth.cards/VerifierPortal.html



Steps to Verify a QR Code

	Internet Required Step	Verification Step
1. Get QR Code Value		
2. Decode Numeric (sch:/567629….)		
3. Decode Compact Jws		
4. Extract Public Key URL		
5. Download Issuer Public Key	☑	
6. Verify Issuer in Trusted Issuer Directory	☑	☑
7. Verify Signature		☑
8. Extract FHIR Bundle		
9. Verify vaccine requirements are met		☑

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Review

06 Reporting & Monitoring

We will need to be able to report on the volume of QR codes generated, access to the Issuer URL, how and where the QR codes are used with-in the jurisdiction. Additionally, we need to monitor for any problems.

05 19 Jurisdictions

These steps need to be repeated across 19 jurisdictions. In addition, jurisdictions often have multiple environments such as Production, QA, Test.

04 Registration

We need to go through a registration process in order to be listed as a Trusted Issuer. Each jurisdiction needs to sign a legal agreement and submit a form identifying themselves, their Issuer URL, and that they passed the QA process.

01 Scanner & App

You need more that just a scanner. You need a validator application installed that can interpret and validate the contents of the SMART Health Card

02 Public Issuer URL

We will need to host our public keys in a publically accessible web site. This site needs to be available 24/7. This site needs to be kept up to date with a list of all the valid public keys used over time. *Requires CORS enabled and at least TLS 1.2.*

03 Certificate Management

We will need to use ECC certificates. Issuers SHOULD generate new signing keys at least annually.

Solution

1. American Samoa
2. CNMI
3. Colorado
4. Connecticut
5. Delaware
6. FSM
7. GUAM
...
19. South Carolina

{api}

Central SMART Health Card Service

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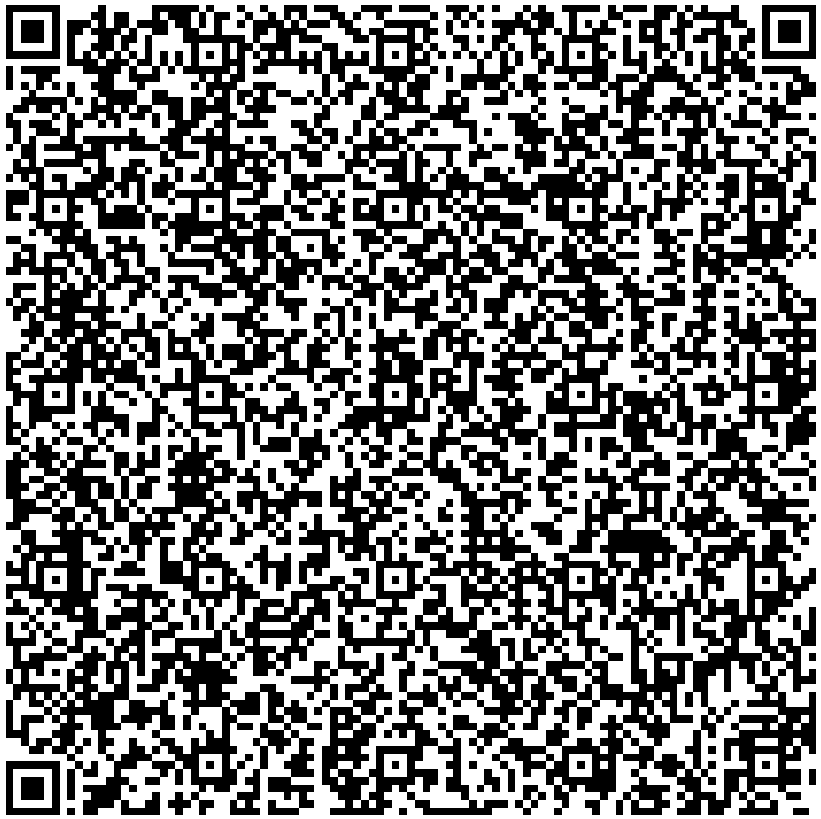
Proof of Concept Tools

Scanning Problem!

Our first QR Code

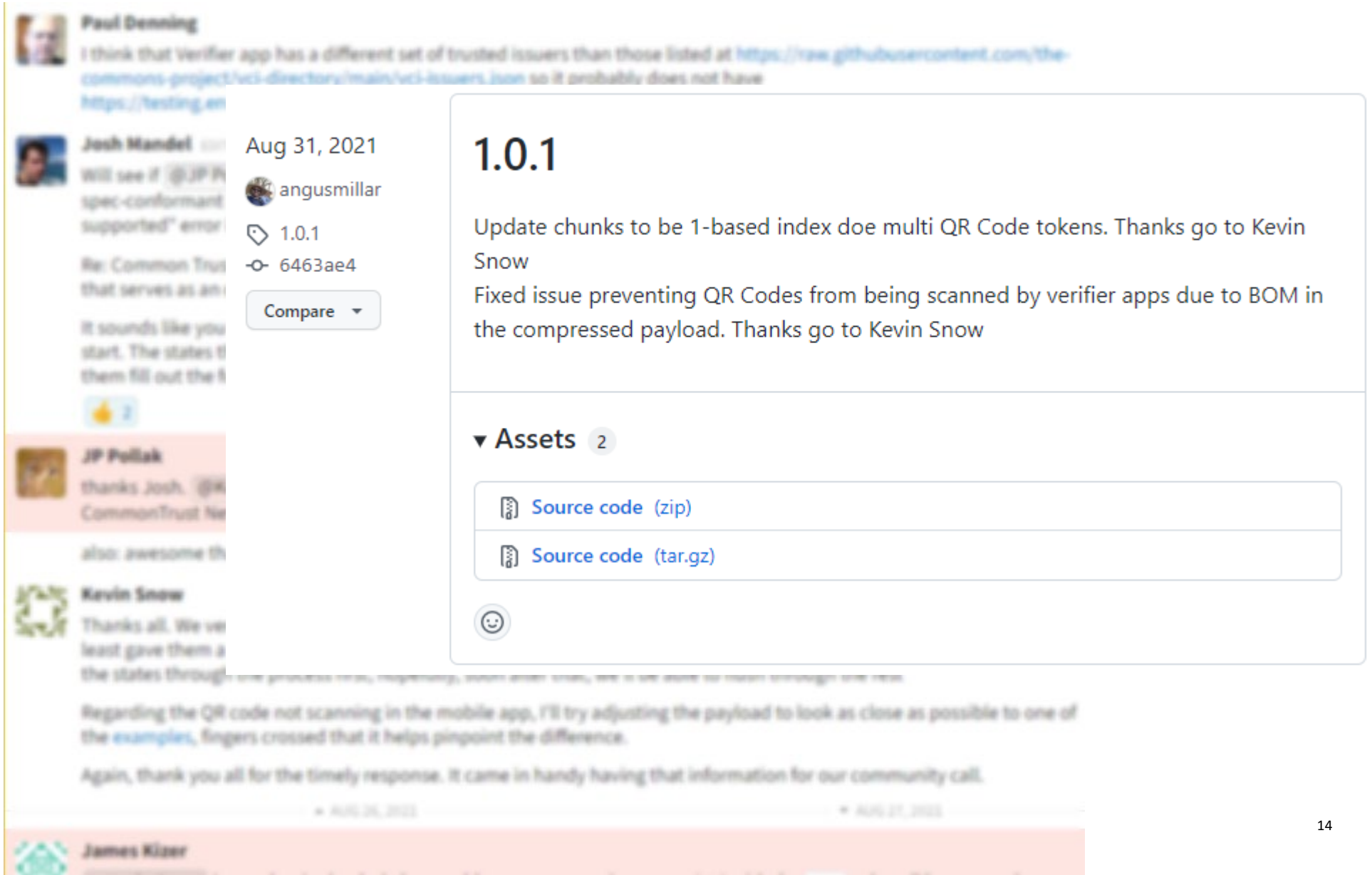
Includes BOM



QR Code after changes

Excludes BOM

Getting help from and contributing back to the open-source community



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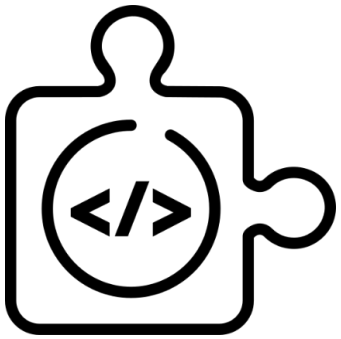
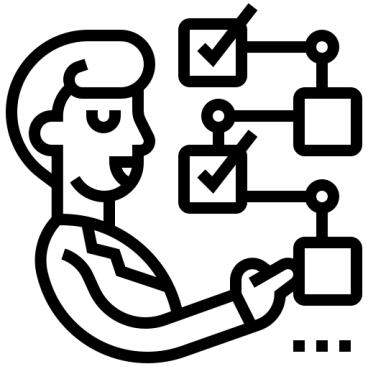
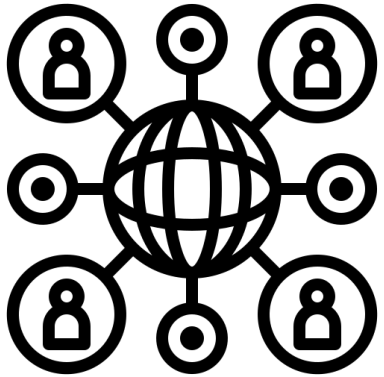
Testing as a First-Class Citizen



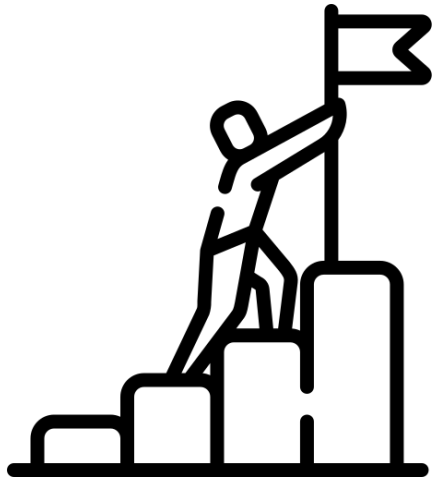
Unit Tests



Integration Tests



Endpoint Tests

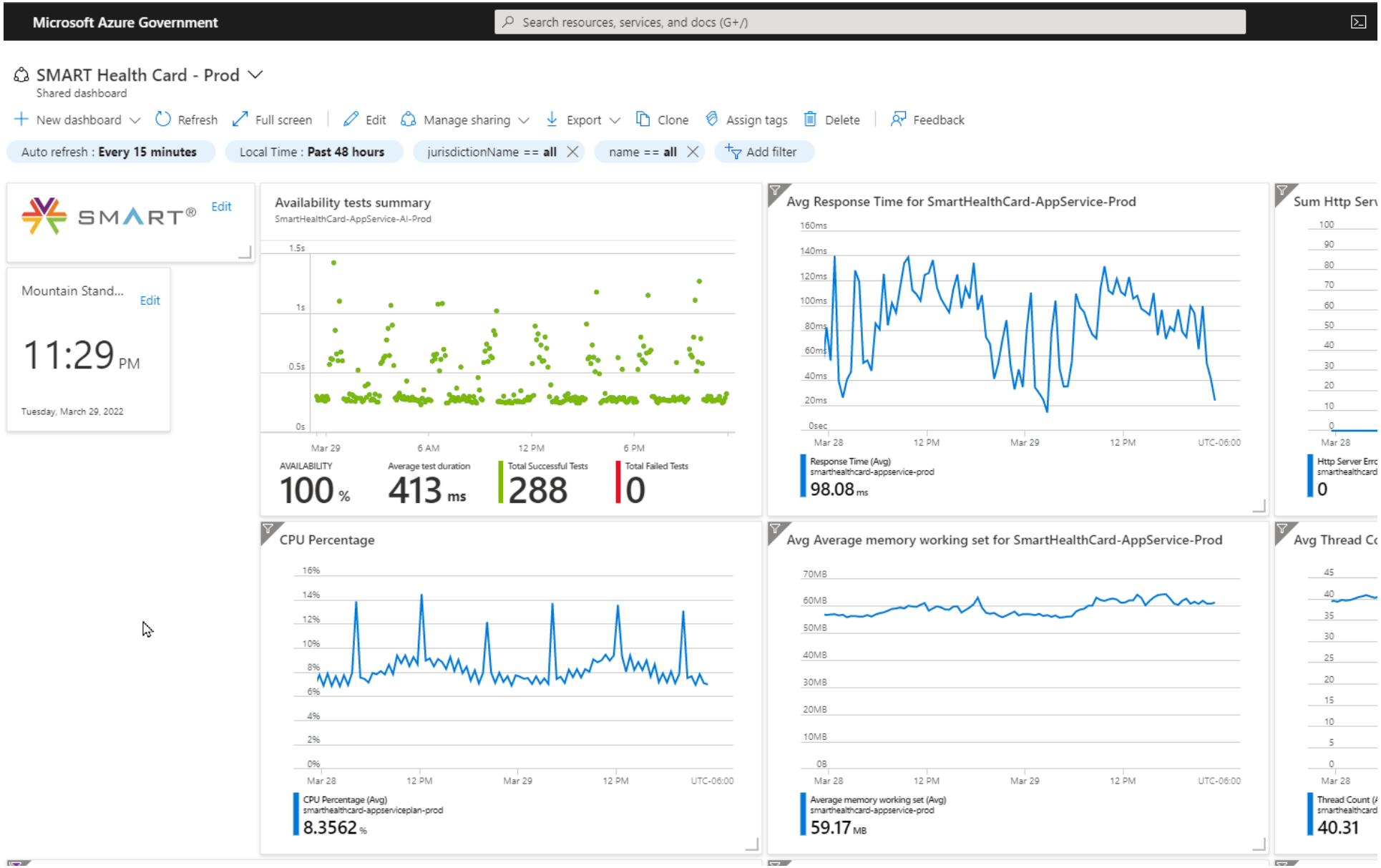


Load Tests

images: Flaticon.com

Logging as a First-Class Citizen

Monitoring and Alerting



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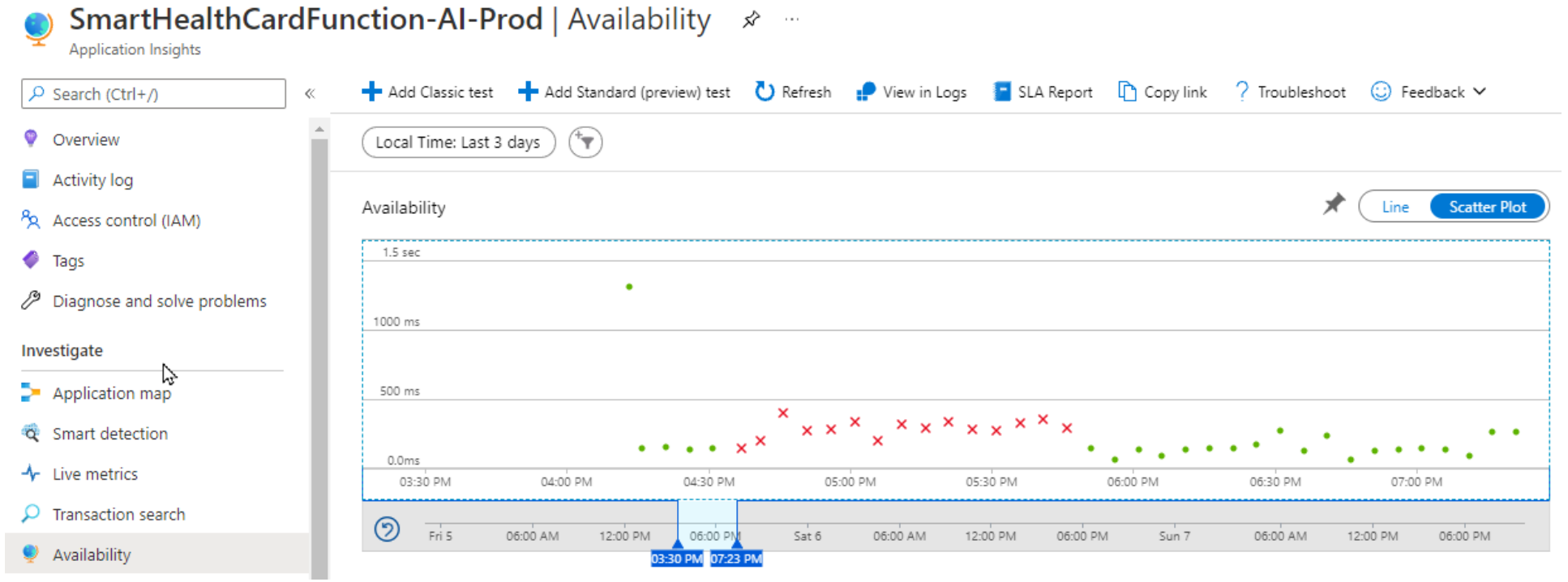
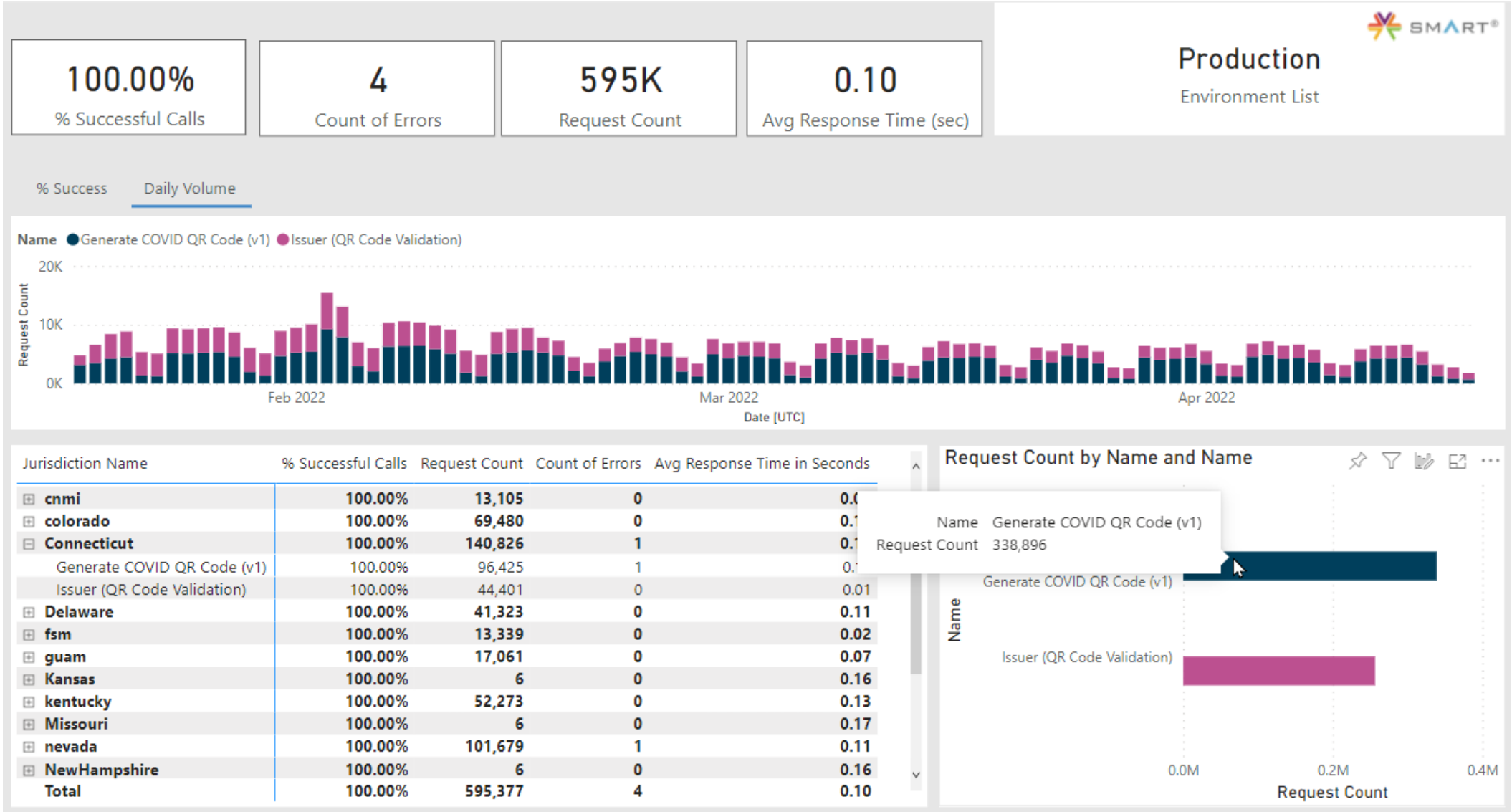
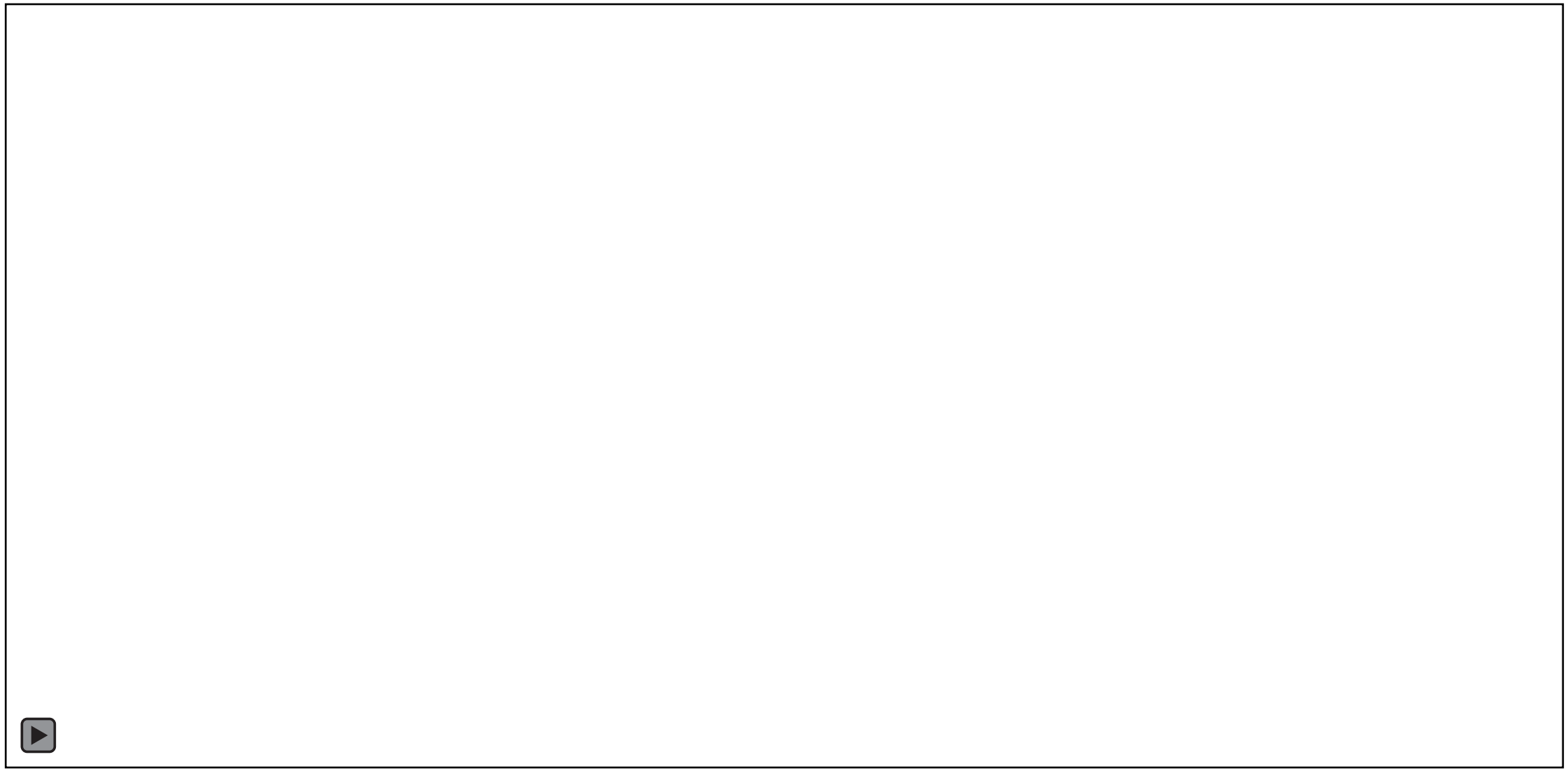
Go Live!


SmartHealthCardFunction-AI-Prod | Availability
Application Insights
Search (Ctrl+/)
Overview
Activity log
Access control (IAM)
Tags
Diagnose and solve problems
Investigate
Application map
Smart detection
Live metrics
Transaction search
Availability
Add Classic test
Add Standard (preview) test
Refresh
View in Logs
SLA Report
Copy link
Troubleshoot
Feedback
Local Time: Last 3 days
Availability
Line
Scatter Plot
1.5 sec
1000 ms
500 ms
0.0ms
03:30 PM
04:00 PM
04:30 PM
05:00 PM
05:30 PM
06:00 PM
06:30 PM
07:00 PM
Fri 5
06:00 AM
12:00 PM
06:00 PM
Sat 6
06:00 AM
12:00 PM
06:00 PM
Sun 7
06:00 AM
12:00 PM
06:00 PM
03:30 PM
07:23 PM

Reporting


100.00%
% Successful Calls
4
Count of Errors
595K
Request Count
0.10
Avg Response Time (sec)
SMART
Production
Environment List
% Success
Daily Volume
Name Generate COVID QR Code (v1) Issuer (QR Code Validation)
20K
10K
0K
Request Count
Feb 2022
Mar 2022
Apr 2022
Date [UTC]
Jurisdiction Name
% Successful Calls
Request Count
Count of Errors
Avg Response Time in Seconds
cnmi 100.00% 13,105 0
colorado 100.00% 69,480 0
Connecticut 100.00% 140,826 1
Generate COVID QR Code (v1) 100.00% 96,425 1
Issuer (QR Code Validation) 100.00% 44,401 0 0.01
Delaware 100.00% 41,323 0 0.11
fsm 100.00% 13,339 0 0.02
guam 100.00% 17,061 0 0.07
Kansas 100.00% 6 0 0.16
kentucky 100.00% 52,273 0 0.13
Missouri 100.00% 6 0 0.17
nevada 100.00% 101,679 1 0.11
NewHampshire 100.00% 6 0 0.16
Total 100.00% 595,377 4 0.10
Request Count by Name and Name
Name Generate COVID QR Code (v1)
Request Count 338,896
Generate COVID QR Code (v1)
Issuer (QR Code Validation)
Name
0.0M
0.2M
0.4M
Request Count

Explore Map – Where is the Issuer URL being accessed (video)



Appendix

- Learning Resources
- Proof of Concept Tools (Explained)
- Sample API Request and Response
- Clean Architecture for the Pivot (Explained)
- Explore Map (Gif)

Learning Resources

- ❑VCI.org
  - SMART Health Card Implementation Guide
    - https://smarthealth.cards/en/
  - Technical Specification
    - https://spec.smarthealth.cards/
  - SMART Health Card Cards: Vaccination & Testing
    - https://build.fhir.org/ig/HL7/fhir-shc-vaccination-ig/
- ❑Verifier Portal
  - https://demo-portals.smarthealth.cards/VerifierPortal.html
- ❑SMART Health Cards Dev Tools
  - https://github.com/smart-on-fhir/health-cards-dev-tools

Proof of Concept Tools (Explained)

We are using an open-source library to help with generating SMART Health Cards

This is a serverless Function as a Service (FaaS) offering.

Runs at a low consumption cost and can scale up to 200 instances.

Each instance can generate 5 SMART Health Cards per second.

Key vaults

Secure location to store secrets and certificates.

Works with ECC Certificates.

Capable of auto-renewing certificates on an annual basis.

Sample API Request and Response

Request

Headers

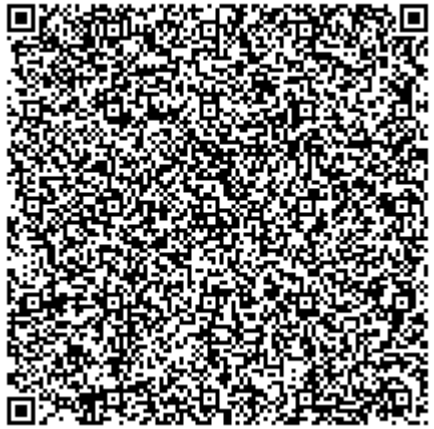
```
POST https://{{baseURL}}/delaware/api/v1/immunization/covid/qrcode
Content-Type:application/json
Authorization:Bearer {{accessToken}}
X-Request-ID:e34121ae-4cd9-4484-b293-2bc736090971
```

Body

```
{
    "Patient": {
        "FirstName": "Bartholomew",
        "MiddleName": "JoJo",
        "LastName": "Simpson",
        "DateOfBirth": "1990-02-23T00:00:00"
    },
    "Immunizations": [{
        "Cvx": "207",
        "AdministrationDate": "2021-01-01T00:00:00",
        "LotNumber": "000001-20characters",
        "Performer": "ABC General Hospital - This is 50 Characters Long"
    },
    {
        "Cvx": "207",
        "AdministrationDate": "2021-01-29T00:00:00",
        "LotNumber": "000002-20characters",
        "Performer": "ABC General Hospital - This is 50 Characters Long"
    }]
}
```

Response

```
content-length:4881
content-type:image/jpeg
x-shc-value: shc:/567629595326546034602925407728043360287
...
```

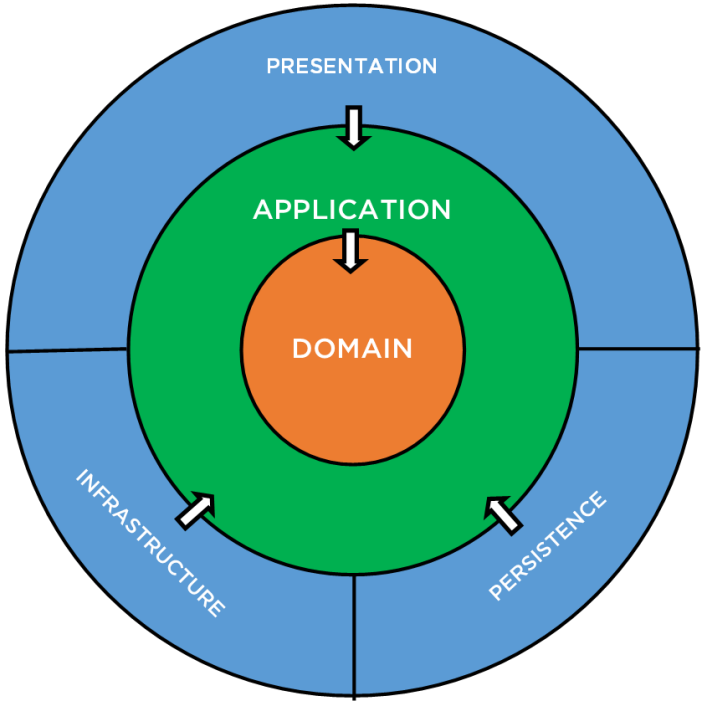


Clean Architecture for the Pivot (Explained)

Clean Architecture is what allowed is to quickly pivot from out previous presentation tier (FaaS) and switch to PaaS

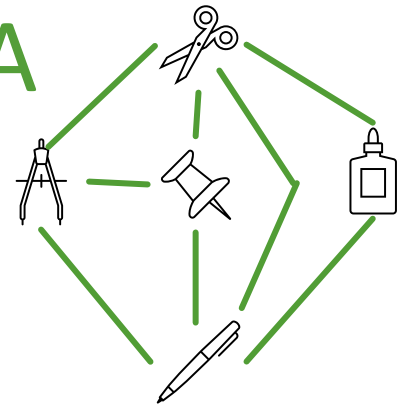
Clean Architecture is a collection of organizing principles so that is easy to understand and easy to change as the project grows.

This allows the business to adapt to changing technology and interfaces



Exercise: If you need to replace the scissors with a knife. Would be it easier in A or B?

A



B

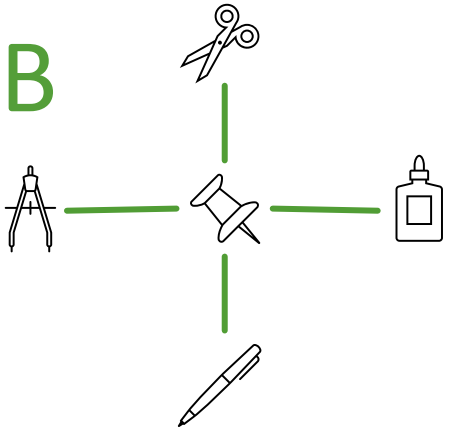


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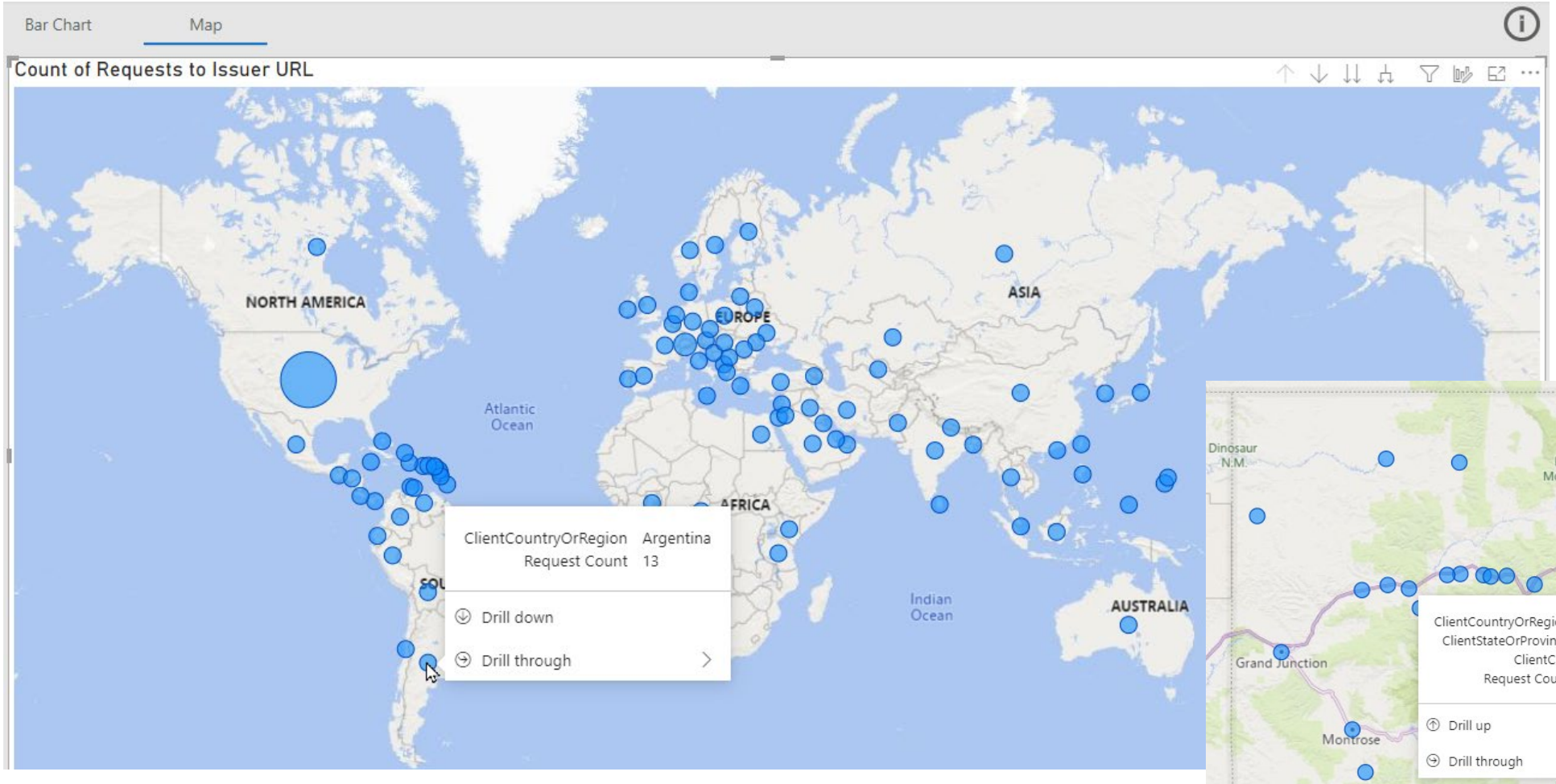
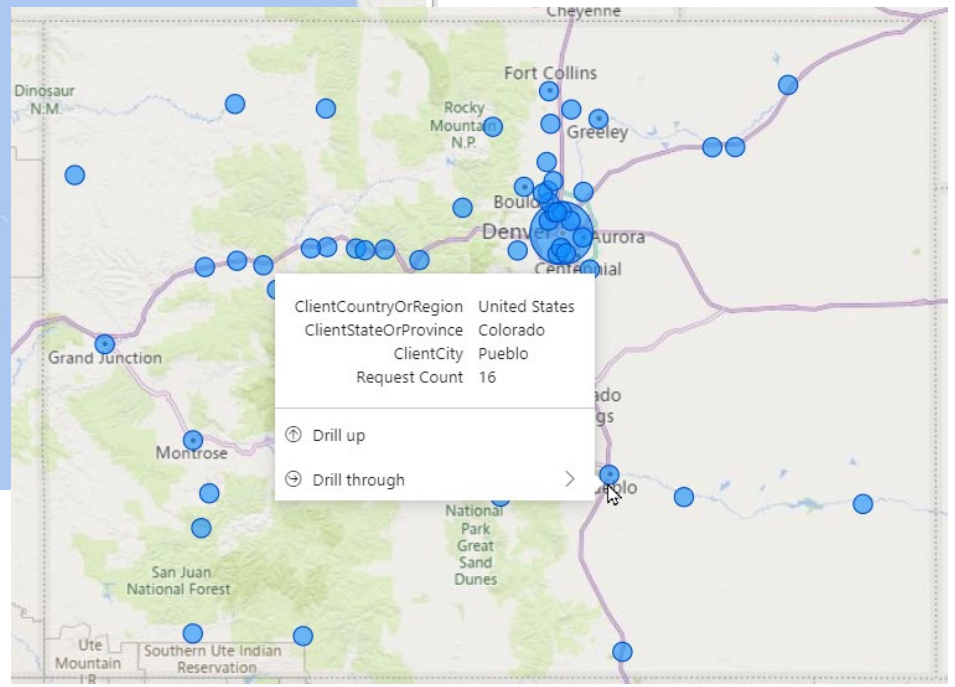
image: https://netsharpdev.com/2019/12/04/clean-architecture/

Explore Map – Where is the Issuer URL being accessed (image)





- Map view allows you to zoom into requests throughout the world
- You can drill-down and view specific request

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