ACM ICN 2020 Tutorial:

Practical NDN Application Development and Seamless Deployment

Name Tree Schema Code Example

September 29, Zoom, Earth, Solar System, Milky Way

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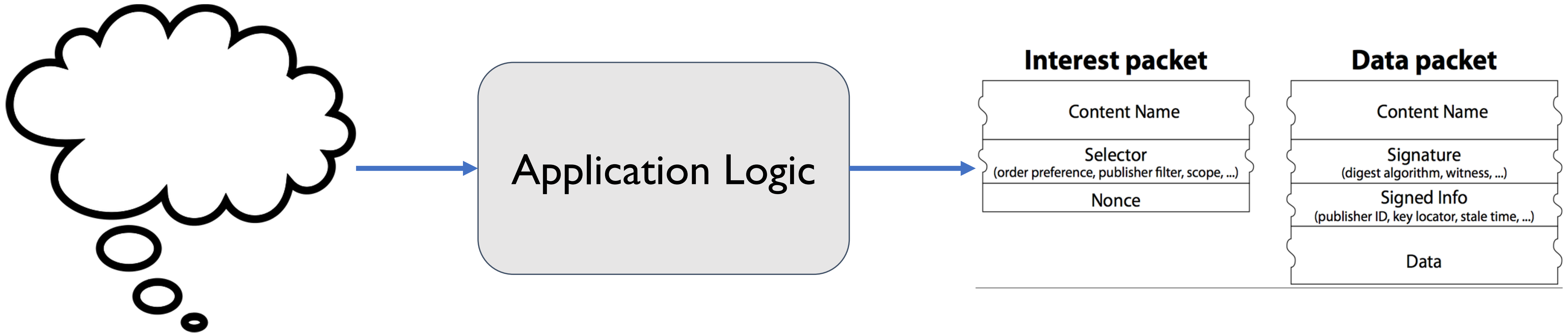
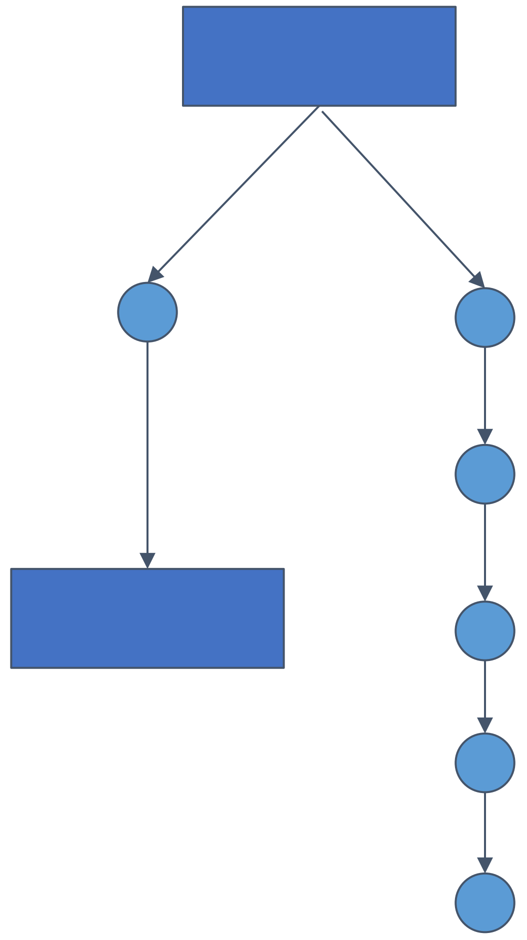
Why NDN App Development Is Hard?


Application Logic
Interest packet
Content Name
Selector
(order preference, publisher filter, scope, ...)
Nonce
Data packet
Content Name
Signature
(digest algorithm, witness, ...)
Signed Info
(publisher ID, key locator, stale time, ...)
Data

Need a systematic way!

A Less Painful Start



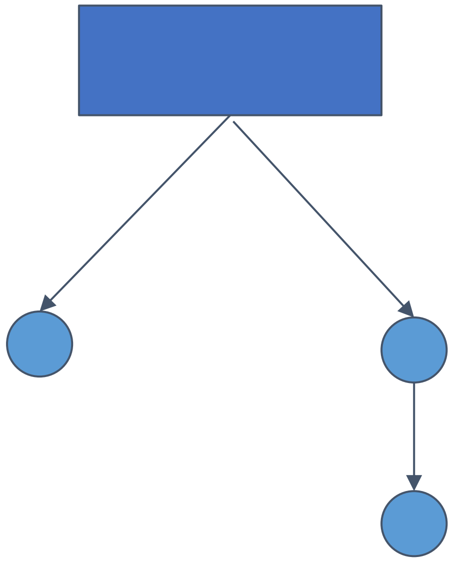
python-ndn

https://github.com/named-data/python-ndn

Name Tree Schema

CNL concept, different design

Our Goal



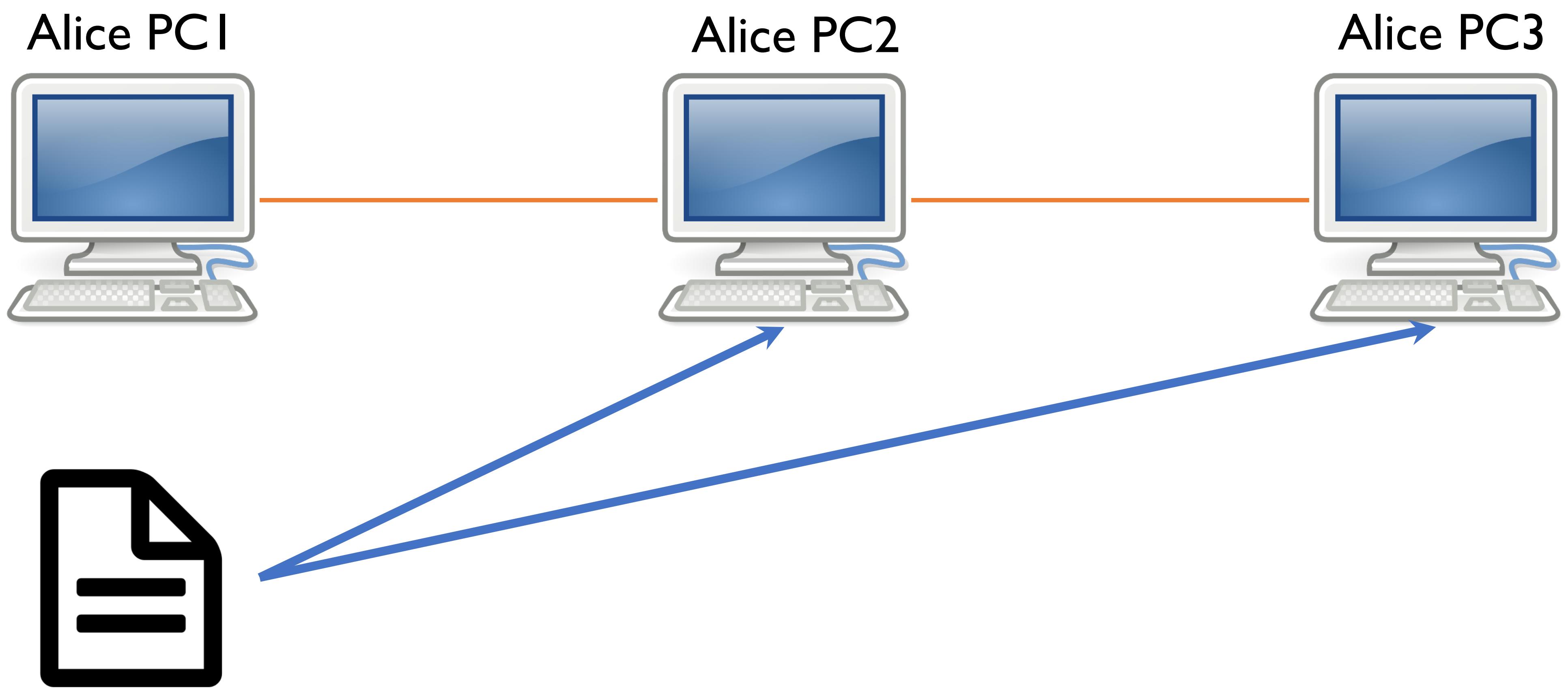
=

```
$(function(){cards();});
$(window).on('resize', function(){cards();});
function cards(){
    var width = $(window).width();
    if(width < 750){
        cardssmallscreen();
    }else{
        cardsbigscreen();
    }
}
function cardssmallscreen(){
    var cards = $('.card').length;
    var height = 0;
    var card2 = 2;
```

The structure of
Application Namespace

The structure of
Program Code

Example Scenario: File Sharing

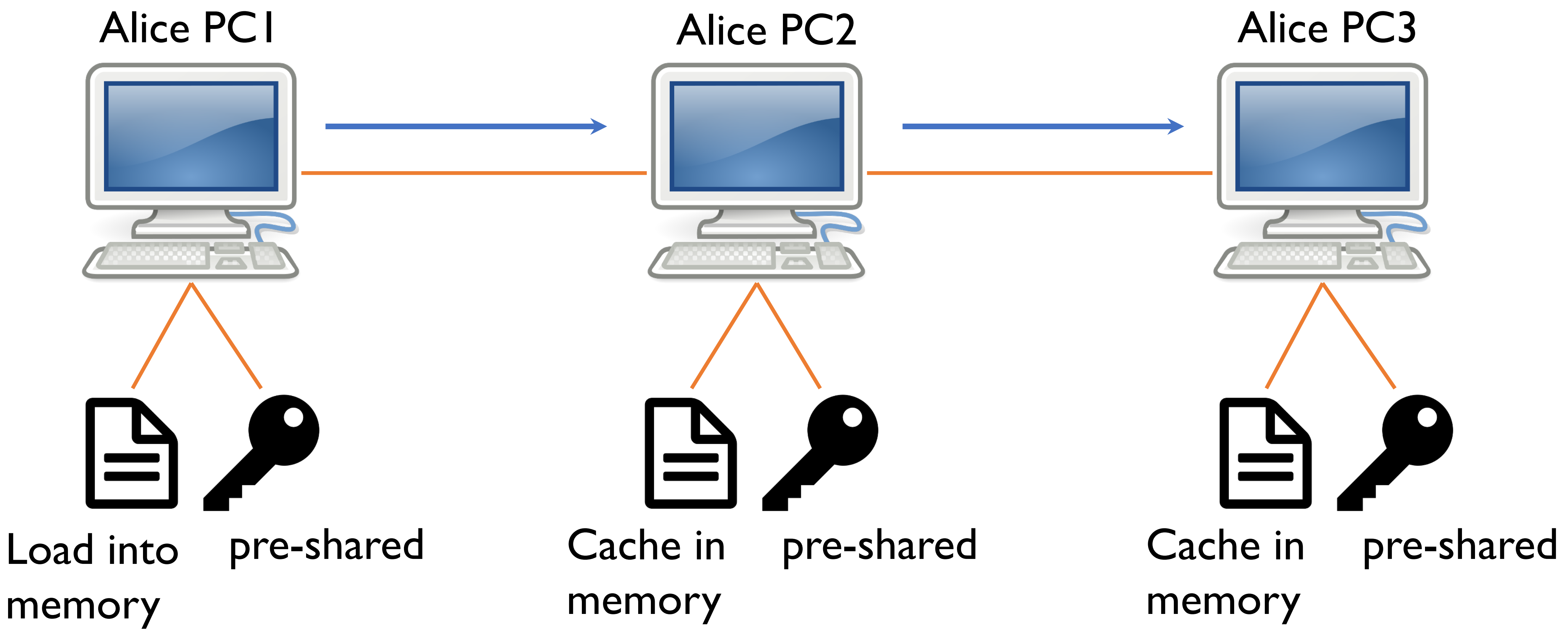


Scenario

- Alice wants to share a file among her computers.
- She can use her key as the trust anchor.
    - /Alice/KEY/%29i%D5%CE%C8A%CE%0F/self/%FD%00%00%01n%10%8E%D1%F6
- The file may be large, so segmentation is needed.
    - RDR can be used here
        - https://redmine.named-data.net/projects/ndn-tlv/wiki/RDR
- RDR handles version discovery and segmentation.
    - A metadata packet contains the latest version number
    - The content is segmented
    - Let’s use it as a black box, so no more details now.

Note: RDR is designed for versioned data. File sharing does not necessarily need it.

Overall Design

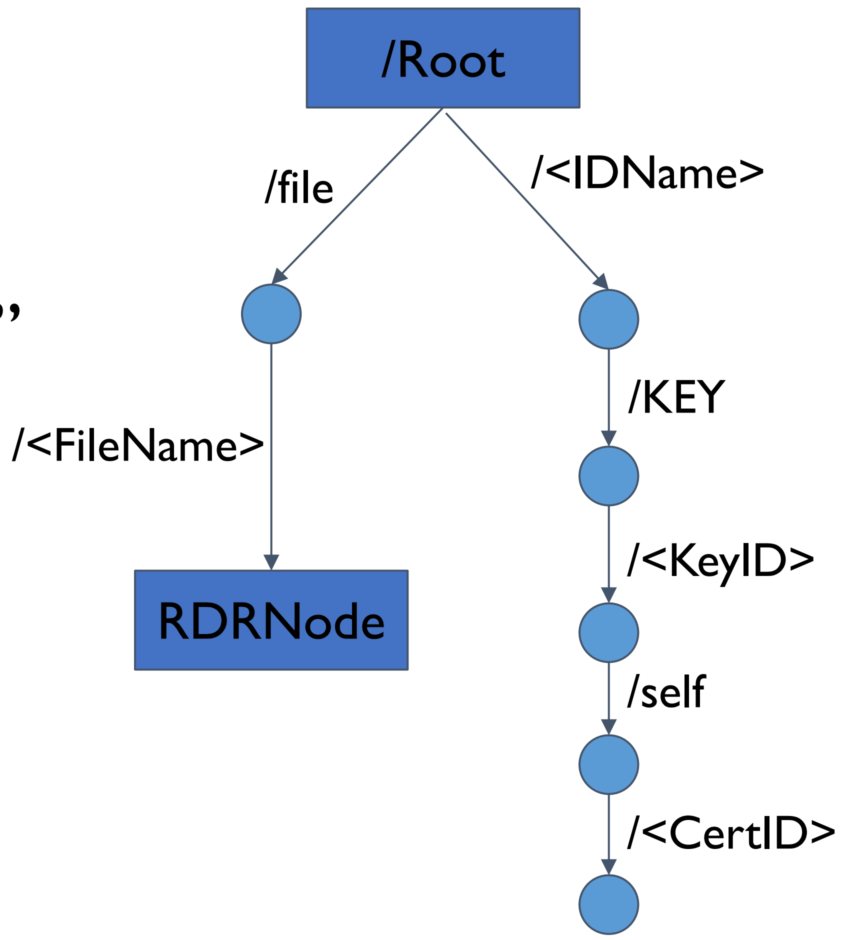


Namespace Schema Design

- A file object handled by RDR
  - Named "/file/<FileName>"
- Alice's key and certificate
  - Named "/Alice/KEY/<KeyID>/self/<CertID>"

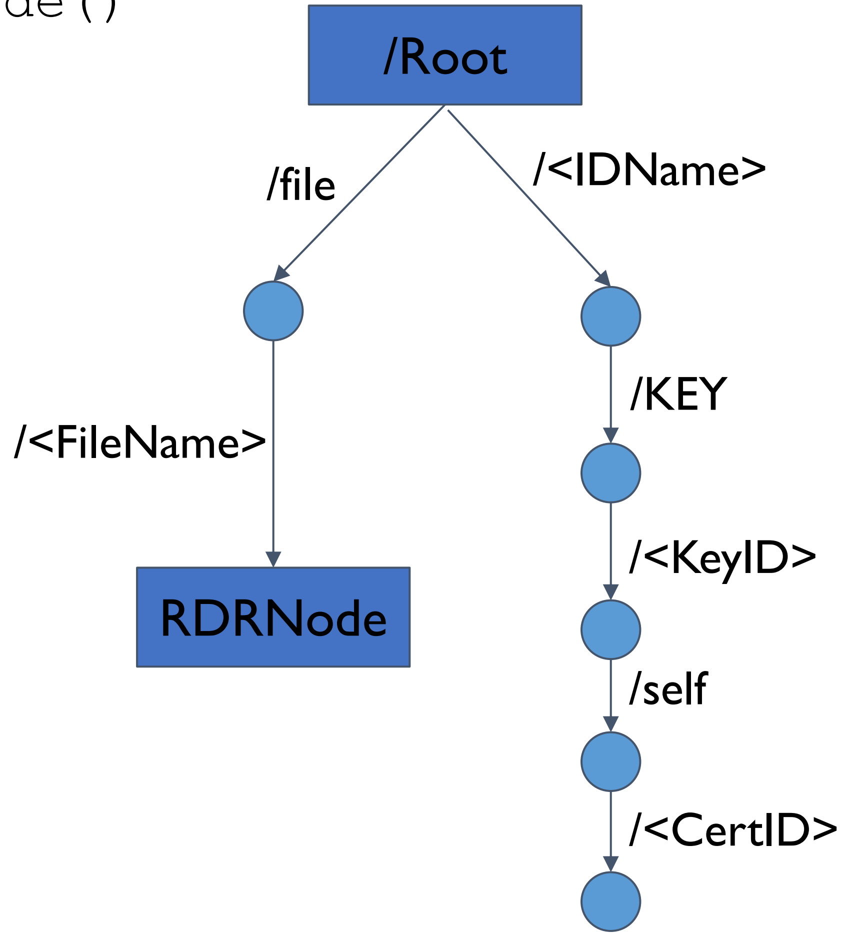
<...> are variables

Real names will be like "/file/foo.txt"



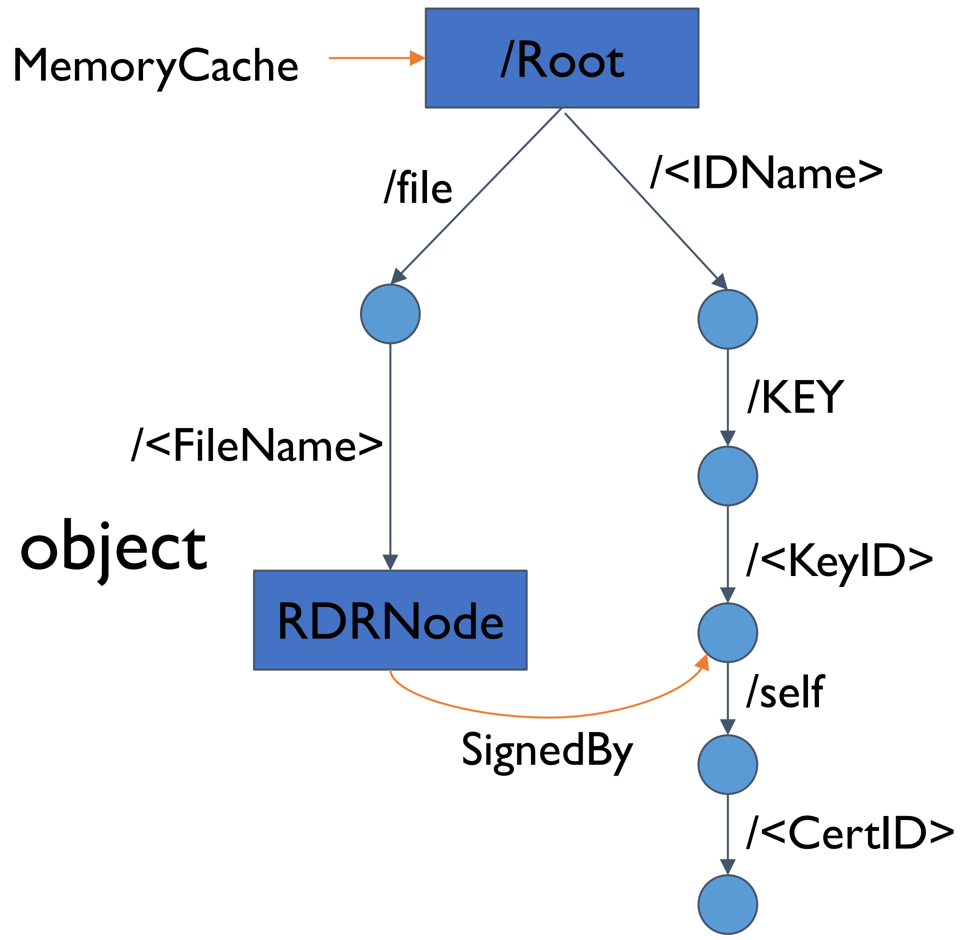
Namespace Schema Design

```
root = Node()
root['/<IDName>/KEY/<KeyID>/self/<CertID>'] = Node()
root['/file/<FileName>'] = RDRNode()
```



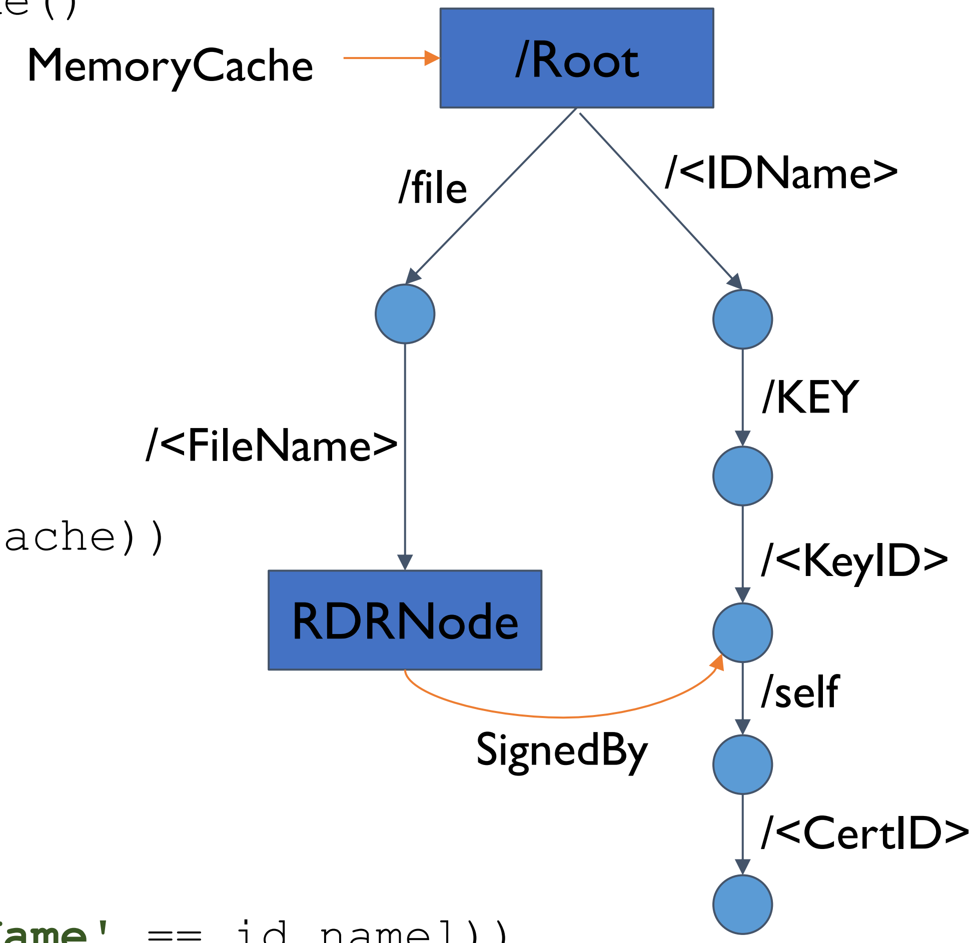
Policies

- A file object handled by RDR
  - All data stored in memory
  - Must be signed by Alice's key
- Alice's key and certificate
  - Preloaded and stored in memory
  - Can share the same storage with the file object



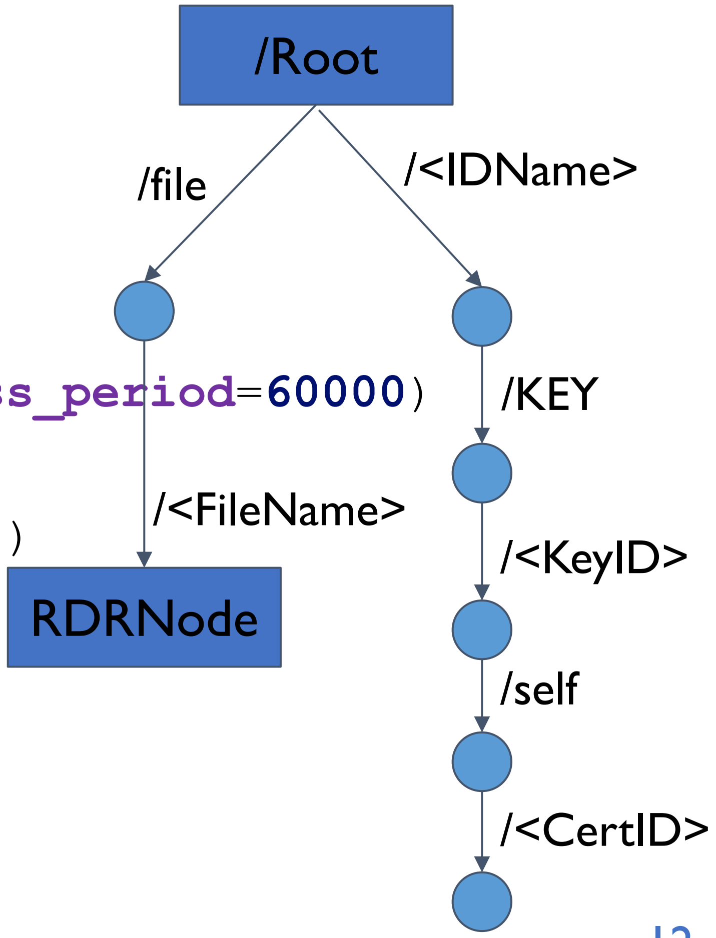
Policies

```
root = Node()
root['/<IDName>/KEY/<KeyID>/self/<CertID>'] = Node()
root['/file/<FileName>'] = RDRNode()


id_name = Name.Component.get_value(
    app.keychain.default_identity().name[0])

cache = MemoryCache()

root.set_policy(policy.Cache, MemoryCachePolicy(cache))

root['/file/<FileName>'].set_policy(

    policy.DataValidator,

    SignedBy(root['/<IDName>/KEY/<KeyID>'],

             subject_to=lambda _, vars: vars['IDName' == id_name]))
```

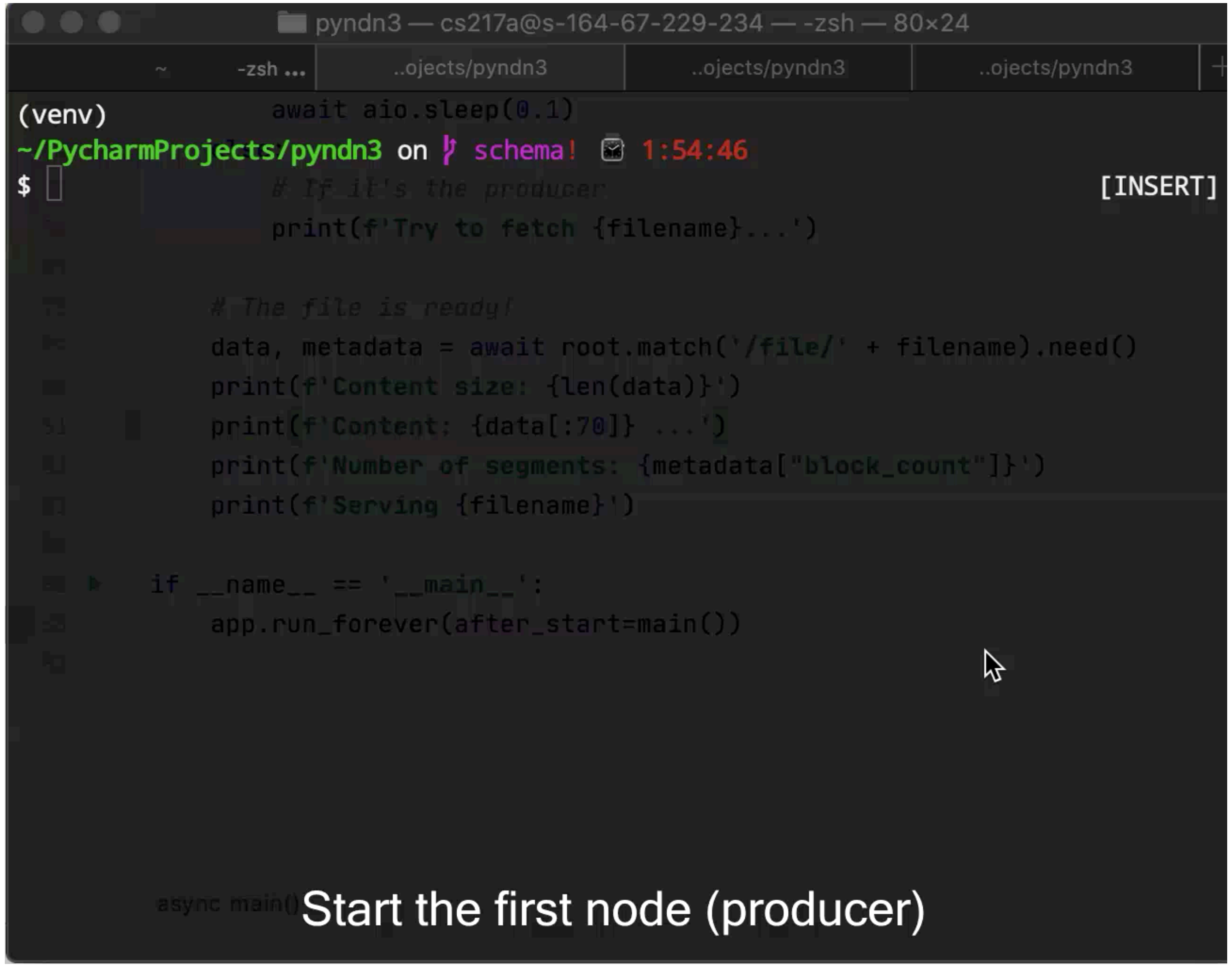


We Are Almost Done!

```
# Store the certificate
cert = app.keychain.default_identity().default_key().default_cert()
await cache.save(Name.normalize(cert.name), cert.data)

# Attach the tree to the face
await root.attach(app, '/')

# If it runs as a producer, provide file
await root.match('/file/' + filename).provide(data, freshness_period=60000)
# If it runs as a consumer, require the file
data, metadata = await root.match('/file/' + filename).need()
```



Demo

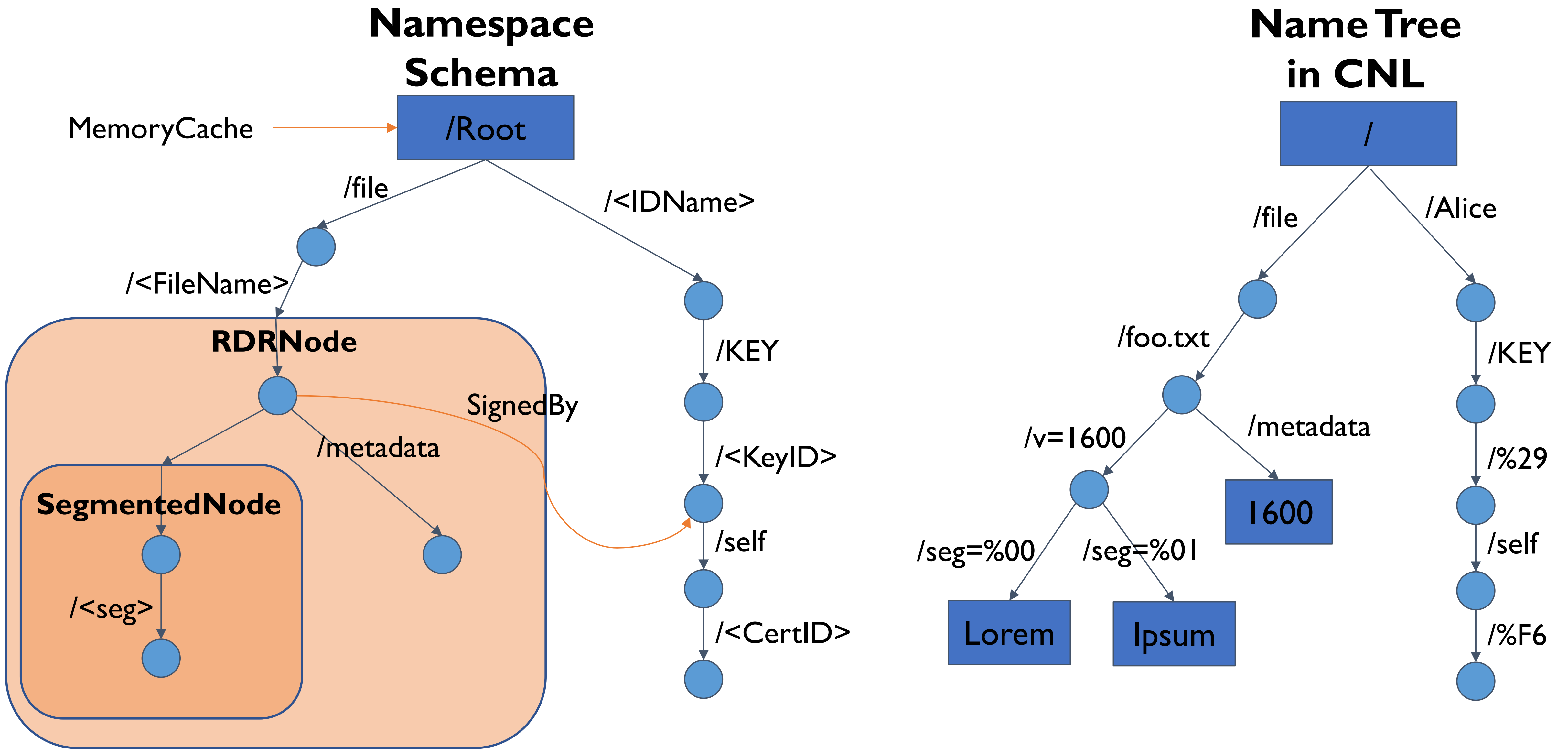


```
(venv)      await aio.sleep(0.1)
~/PycharmProjects/pyndn3 on schema! 1:54:46
$                                                   [INSERT]
            # If it's the producer
            print(f'Try to fetch {filename}...')

        # The file is ready!
        data, metadata = await root.match('/file/' + filename).need()
        print(f'Content size: {len(data)}')
        print(f'Content: {data[:70]} ...')
        print(f'Number of segments: {metadata["block_count"]}')
        print(f'Serving {filename}')

if __name__ == '__main__':
    app.run_forever(after_start=main())
```

async main()

Start the first node (producer)

But How It Works?



Summary

- Application namespace = Code structure
- A framework that all different libraries can be integrated into
  - Custom nodes are subtrees / substructures
  - Policies as filters / annotations
- Tutorial (with code) is online
  - https://python-ndn.readthedocs.io/en/latest/src/schema/ex1.html

- Future Work
  - Sync (CNL's functionality)
  - Repo (in-network storage)
  - Serialization of the schema tree