Metadata Synchronization Protocol for a Decentralized Network of Data Providers

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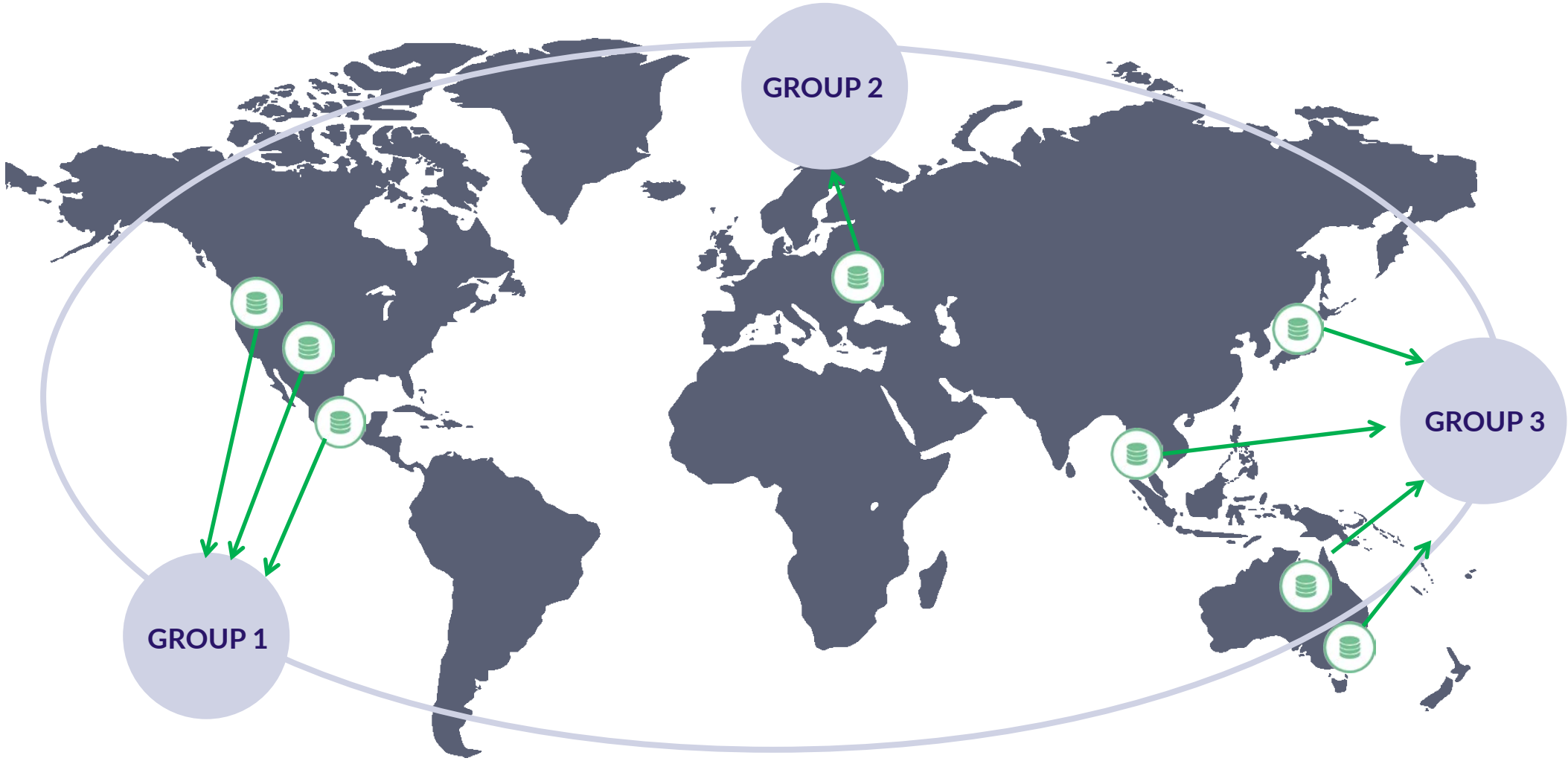
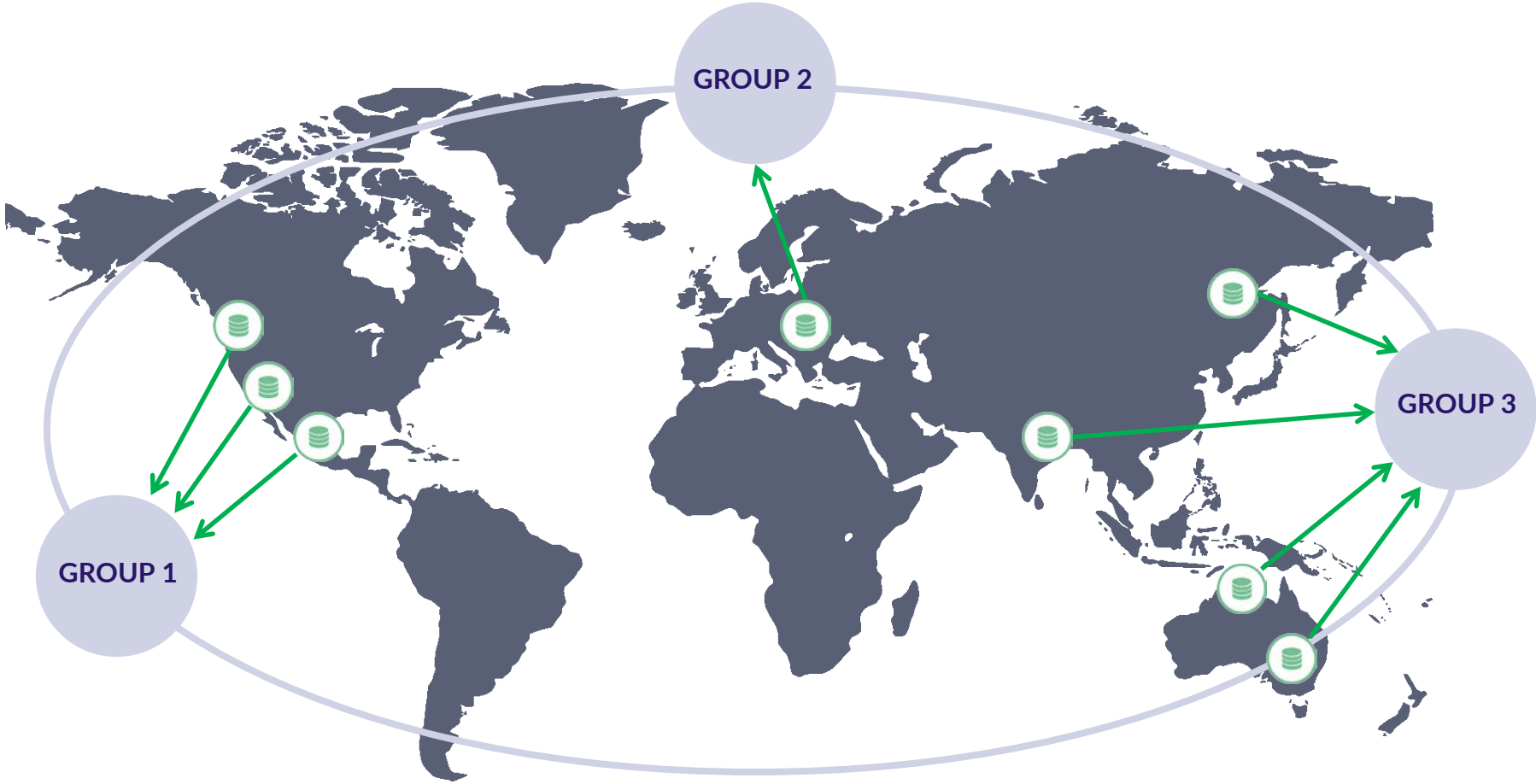
AGENDA

1. Global data access for modern science
2. Challenges of global data access
3. Metadata synchronization protocol - requirements
4. **Proposed concept of metadata synchronization protocol**
5. Conclusions

GLOBAL DATA ACCESS FOR MODERN SCIENCE

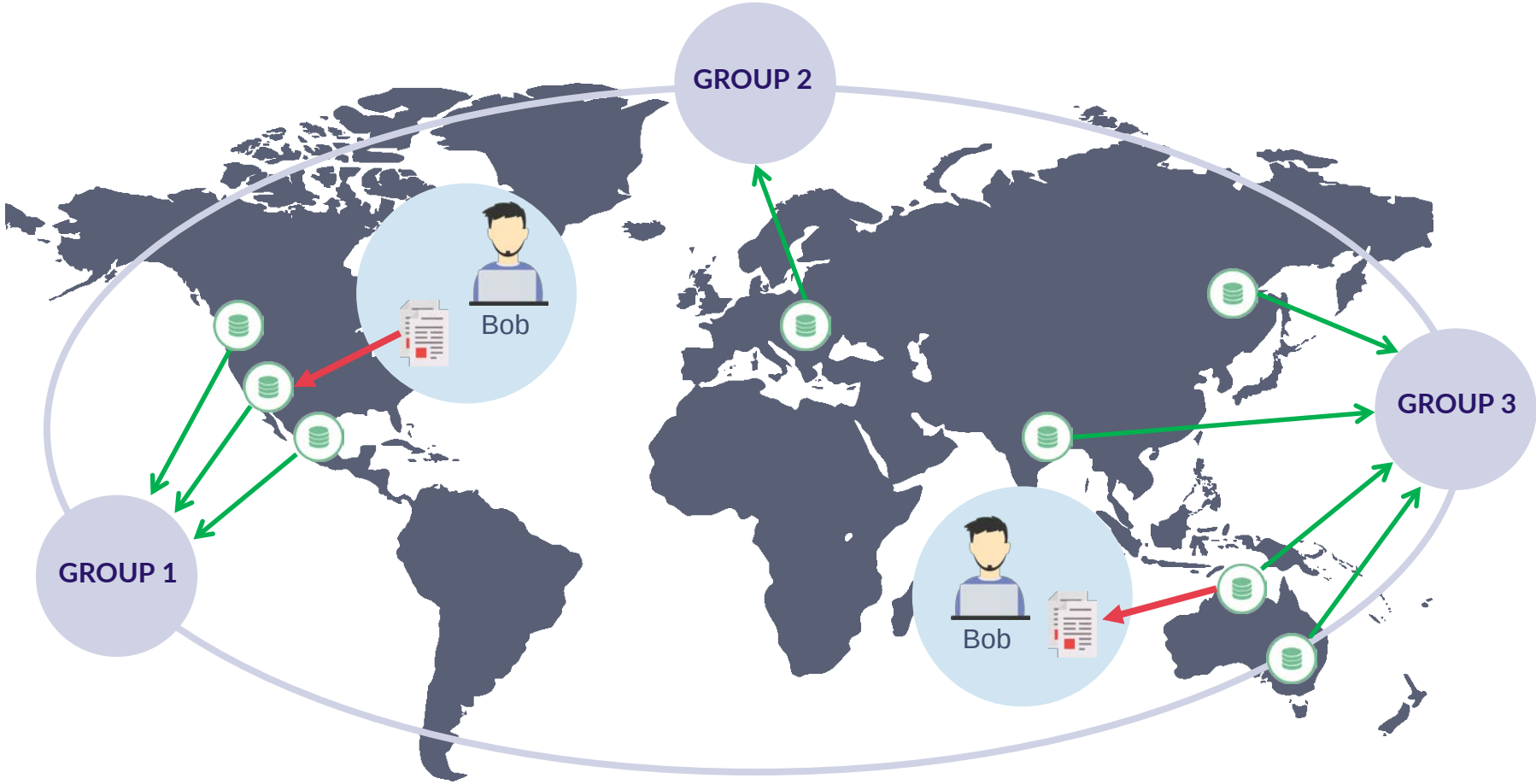


CHALLENGES OF GLOBAL DATA ACCESS



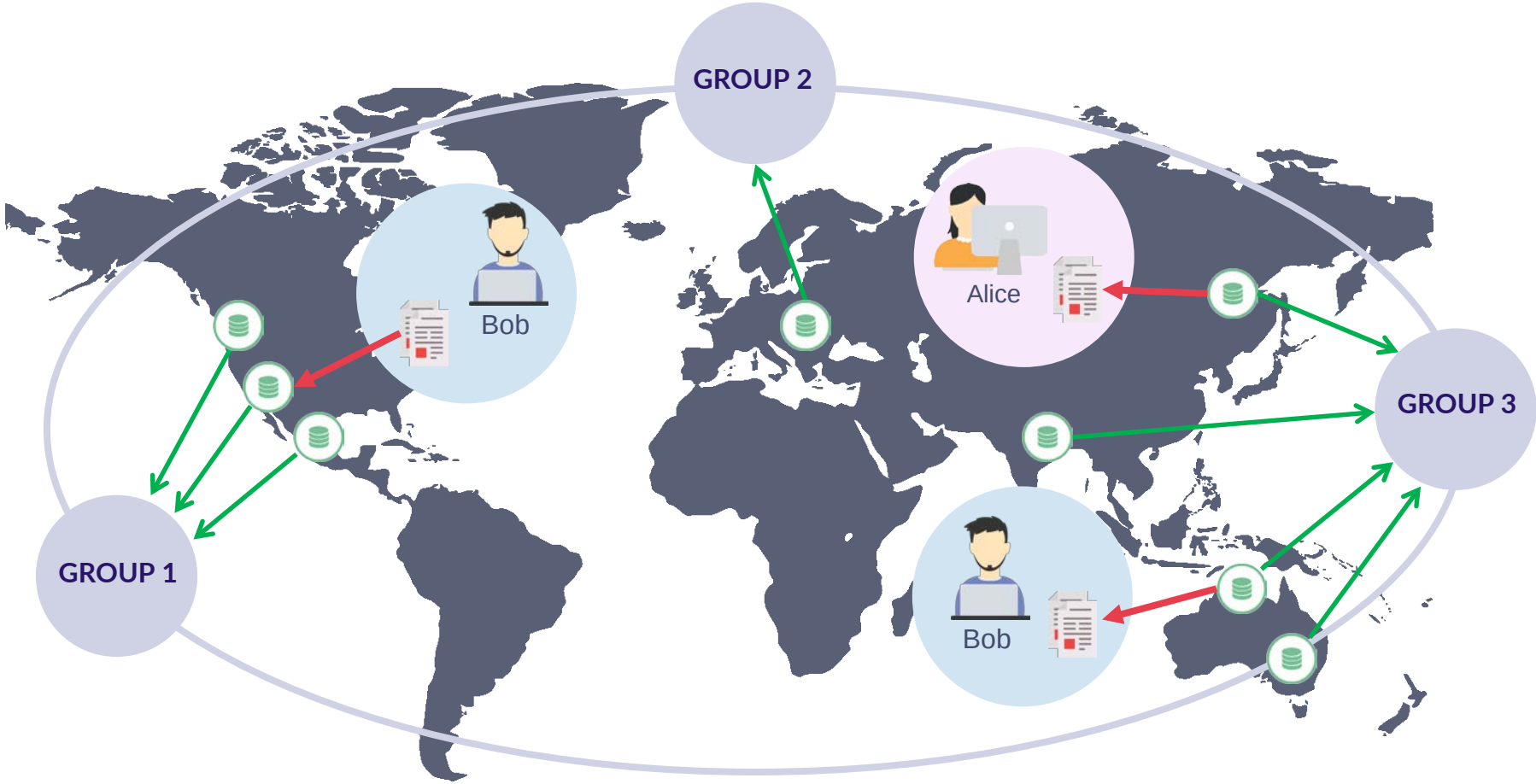
CHALLENGES OF GLOBAL DATA ACCESS

- Transparent data access



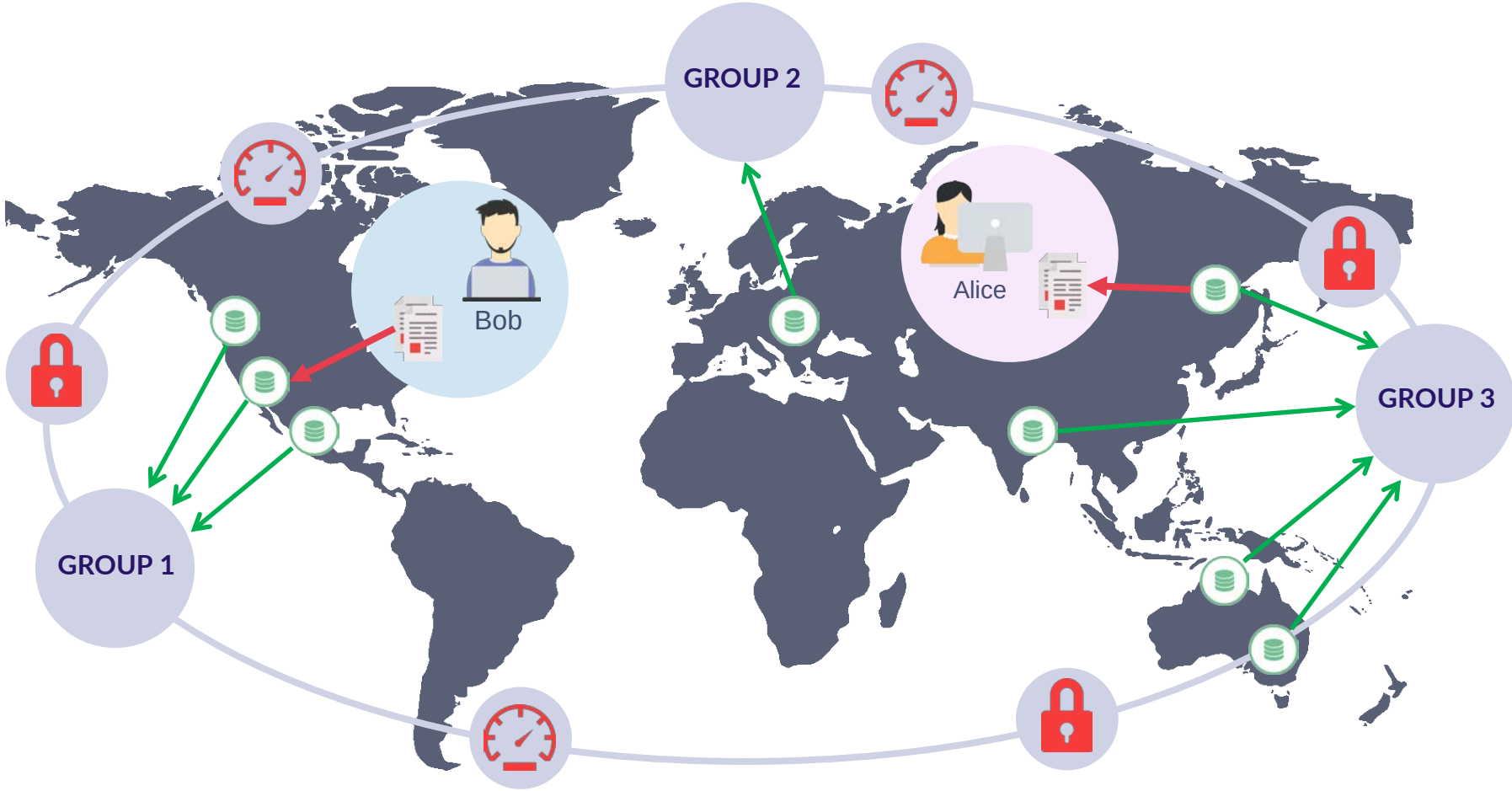
CHALLENGES OF GLOBAL DATA ACCESS

- Transparent data access
- Cross-border collaboration



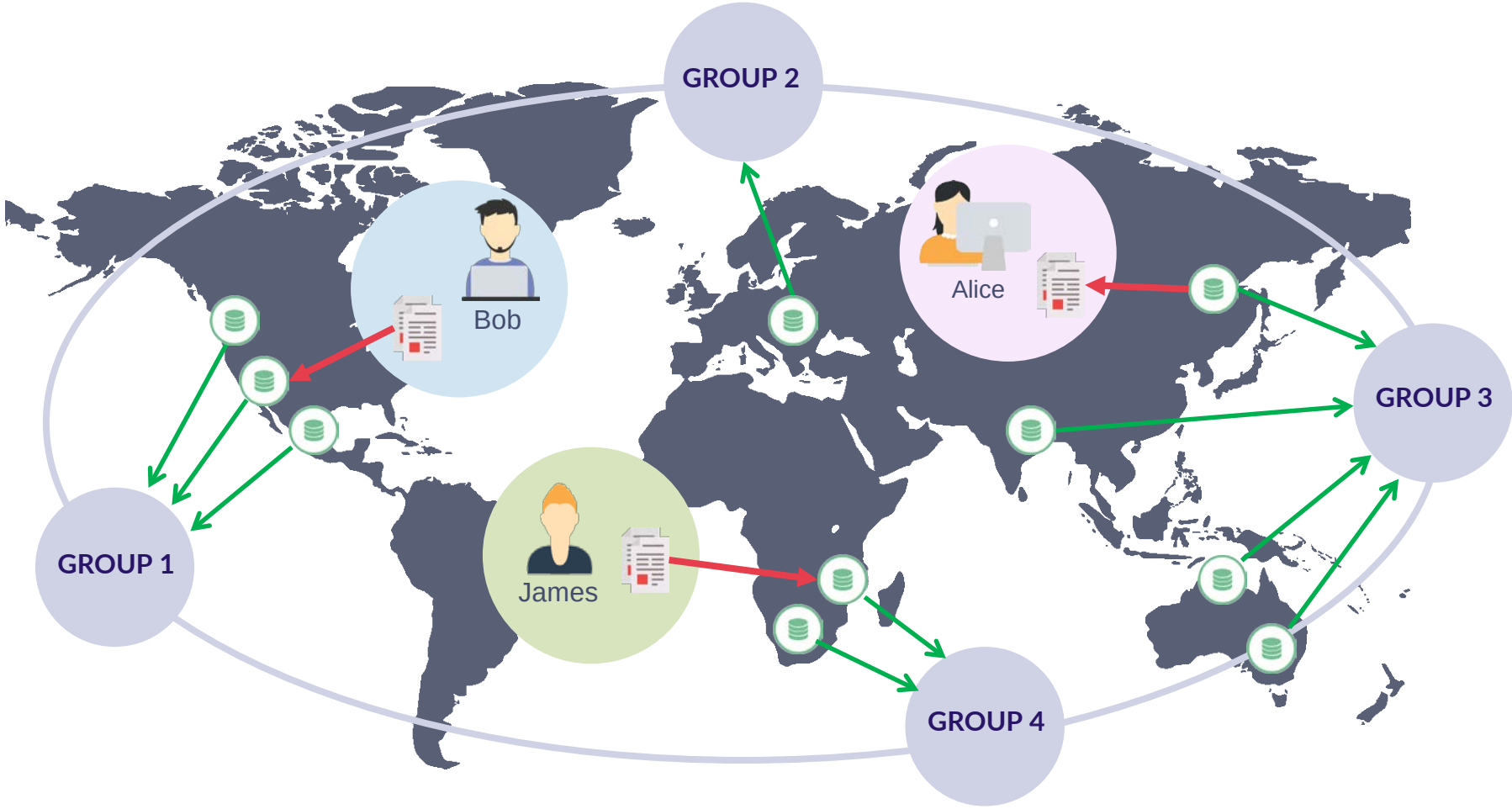
CHALLENGES OF GLOBAL DATA ACCESS

- Transparent data access
- Cross-border collaboration
- Security & efficiency



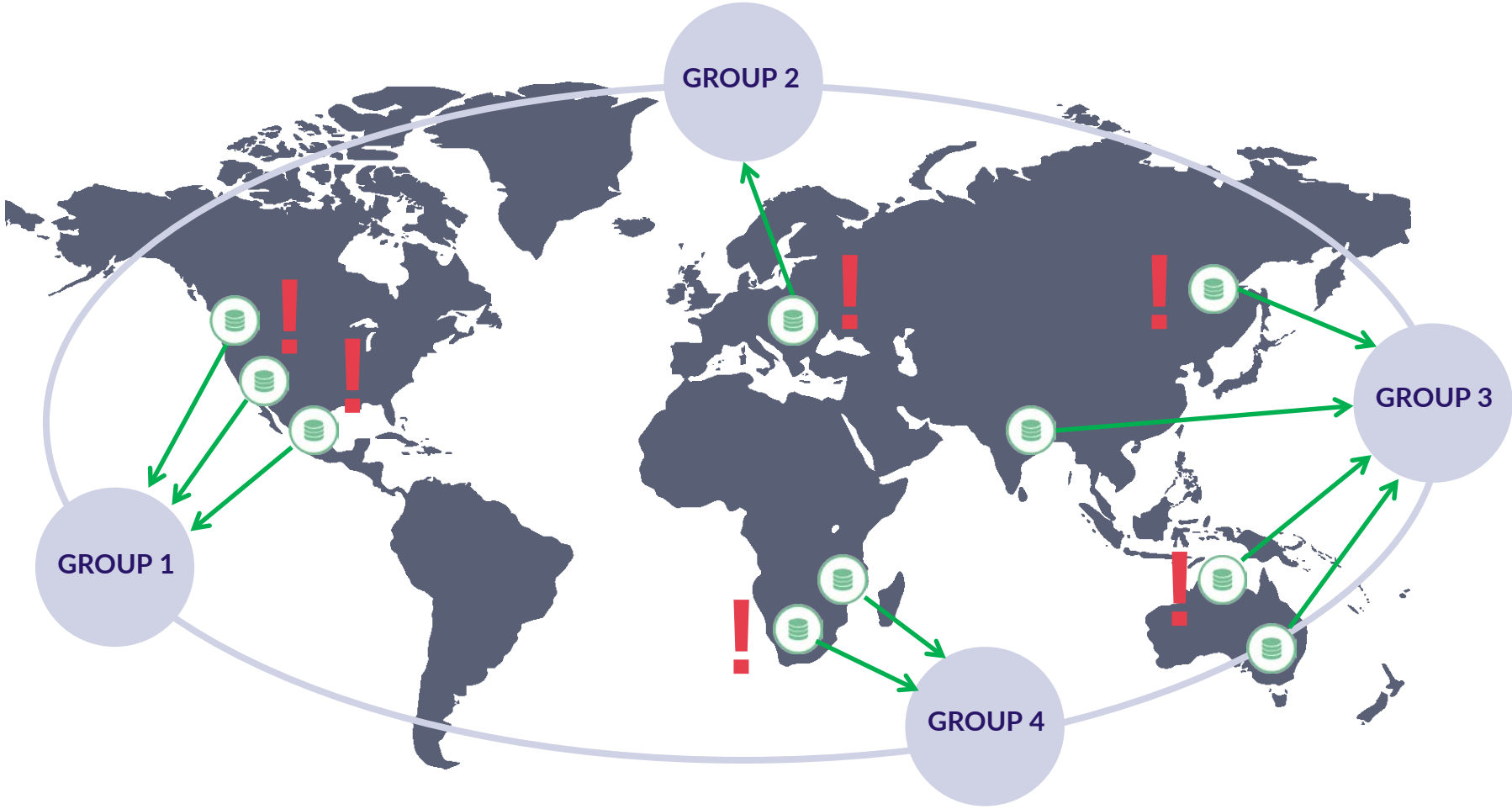
CHALLENGES OF GLOBAL DATA ACCESS

- Transparent data access
- Cross-border collaboration
- Security & efficiency
- Openness of the network



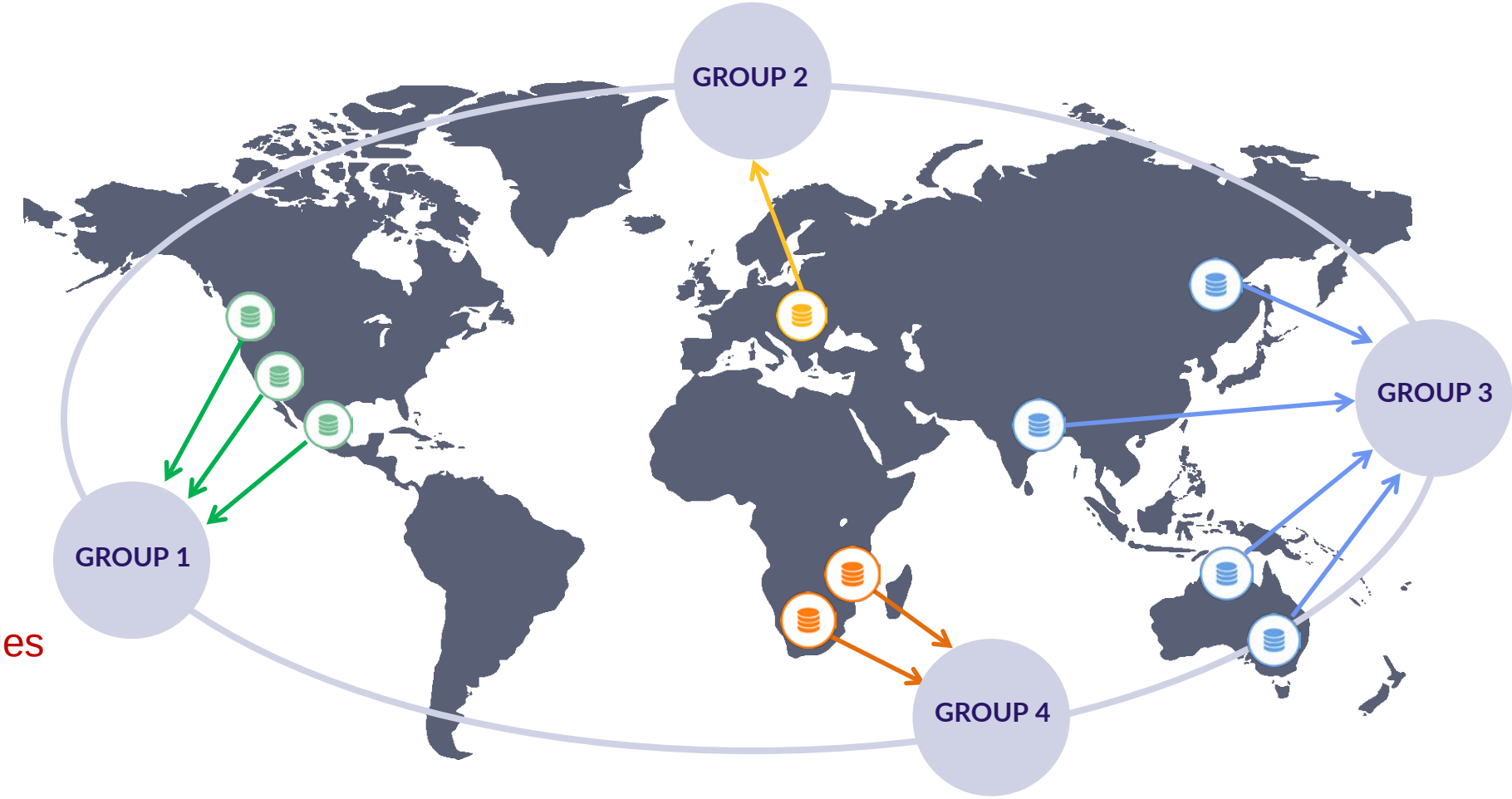
CHALLENGES OF GLOBAL DATA ACCESS

- Transparent data access
- Cross-border collaboration
- Security & efficiency
- Openness of the network
- Autonomy (lack of trust)



CHALLENGES OF GLOBAL DATA ACCESS

- Transparent data access
- Cross-border collaboration
- Security & efficiency
- Openness of the network
- Autonomy (lack of trust)
- Reflecting existing hierarchies



METADATA SYNCHRONIZATION PROTOCOL

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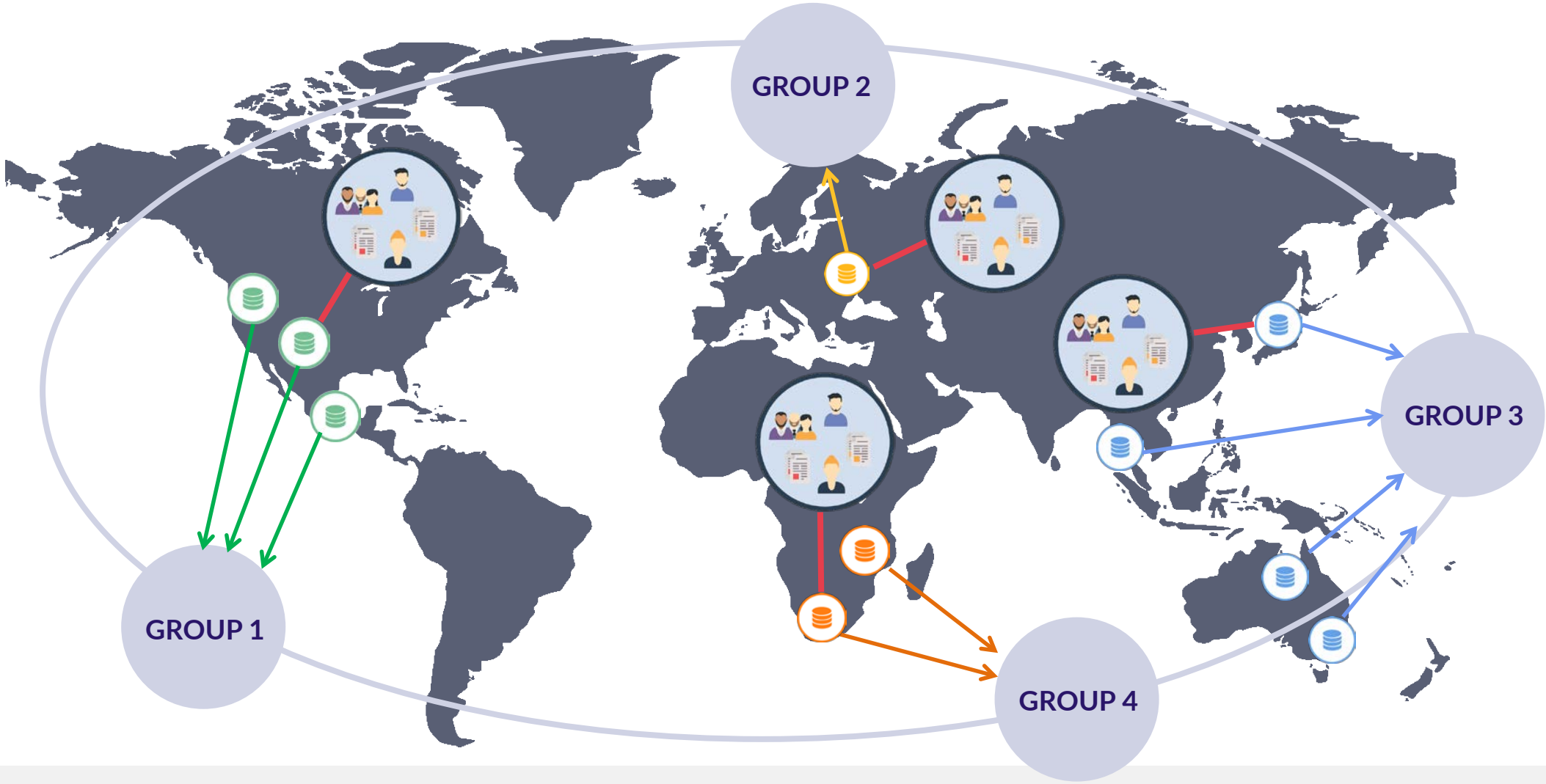


METADATA SYNCHRONIZATION - REQUIREMENTS

- Decentralized (retaining autonomy)
- Globally consistent
- Scalable – hundreds of providers
- Secure – decentralized AAI*
- Location discovery mechanisms

** AAI – authentication and authorization infrastructure*

Proposed solution

Metadata synchronization protocol

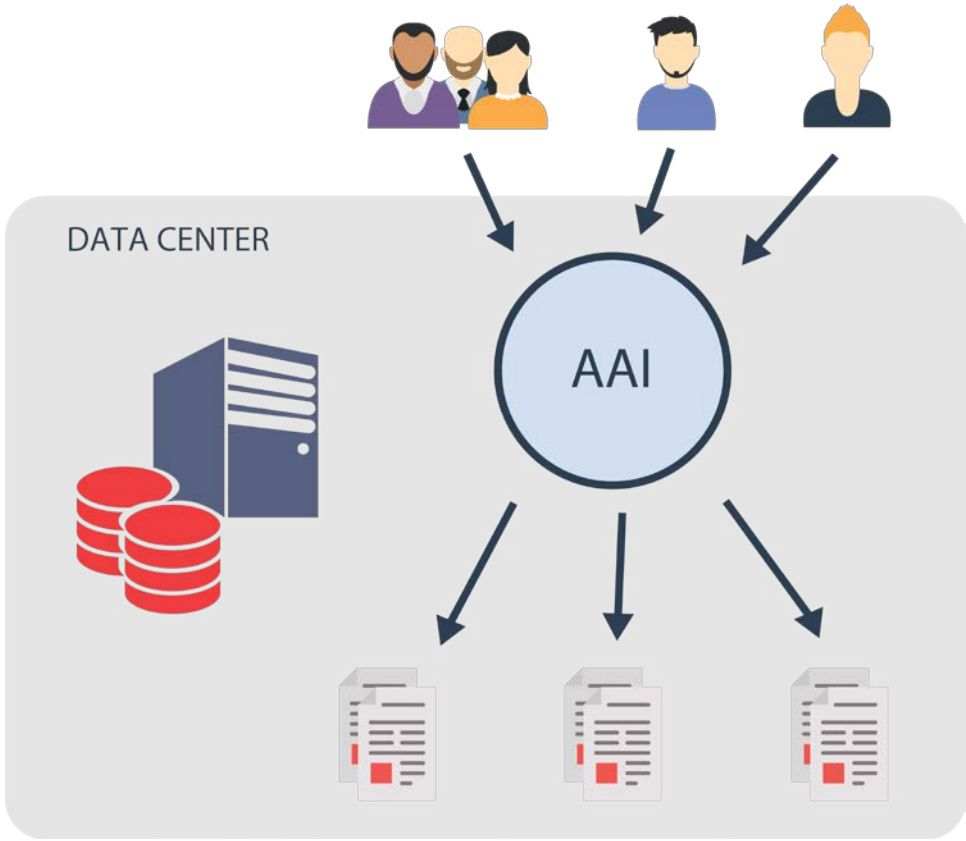
based on

hybrid, multi-tier architecture

PROPOSED SOLUTION – PROVIDER SCOPE

Provider service – basic building block

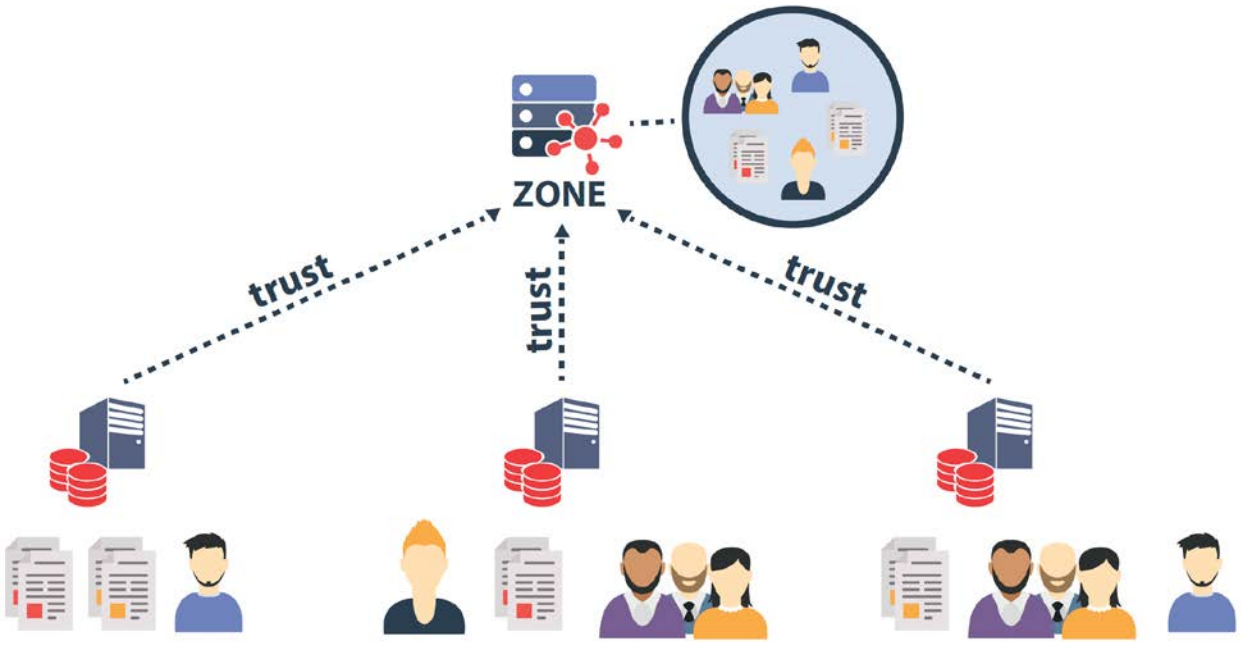
- Gathers knowledge using metadata sync
- Manages data on underlying storages



AAI – Authentication and Authorization Infrastructure

PROPOSED SOLUTION – ZONE SCOPE

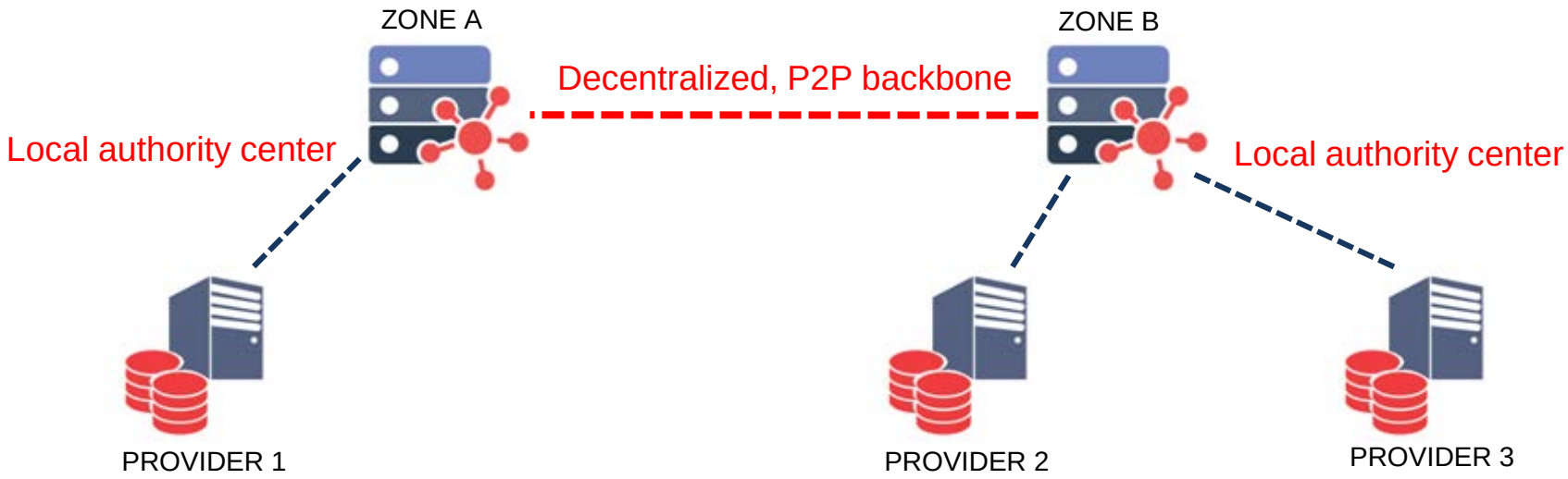
Zone service – oversees a group of providers



- Gathers and serves metadata
- Trusted authority & mediator
- AuthN & AuthZ center
- Macaroon based tokens
- Reflects existing hierarchies

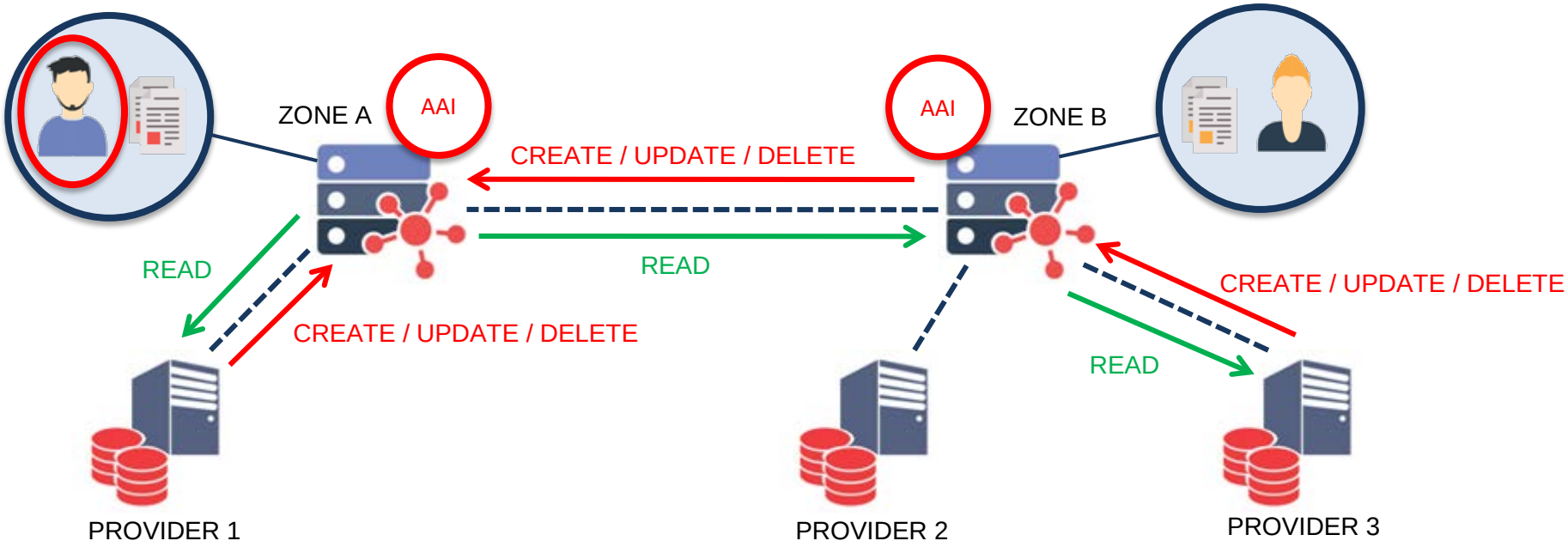
PROPOSED SOLUTION – GLOBAL SCOPE

Cooperation between *Zones* – hybrid architecture



PROPOSED SOLUTION – METADATA SYNC

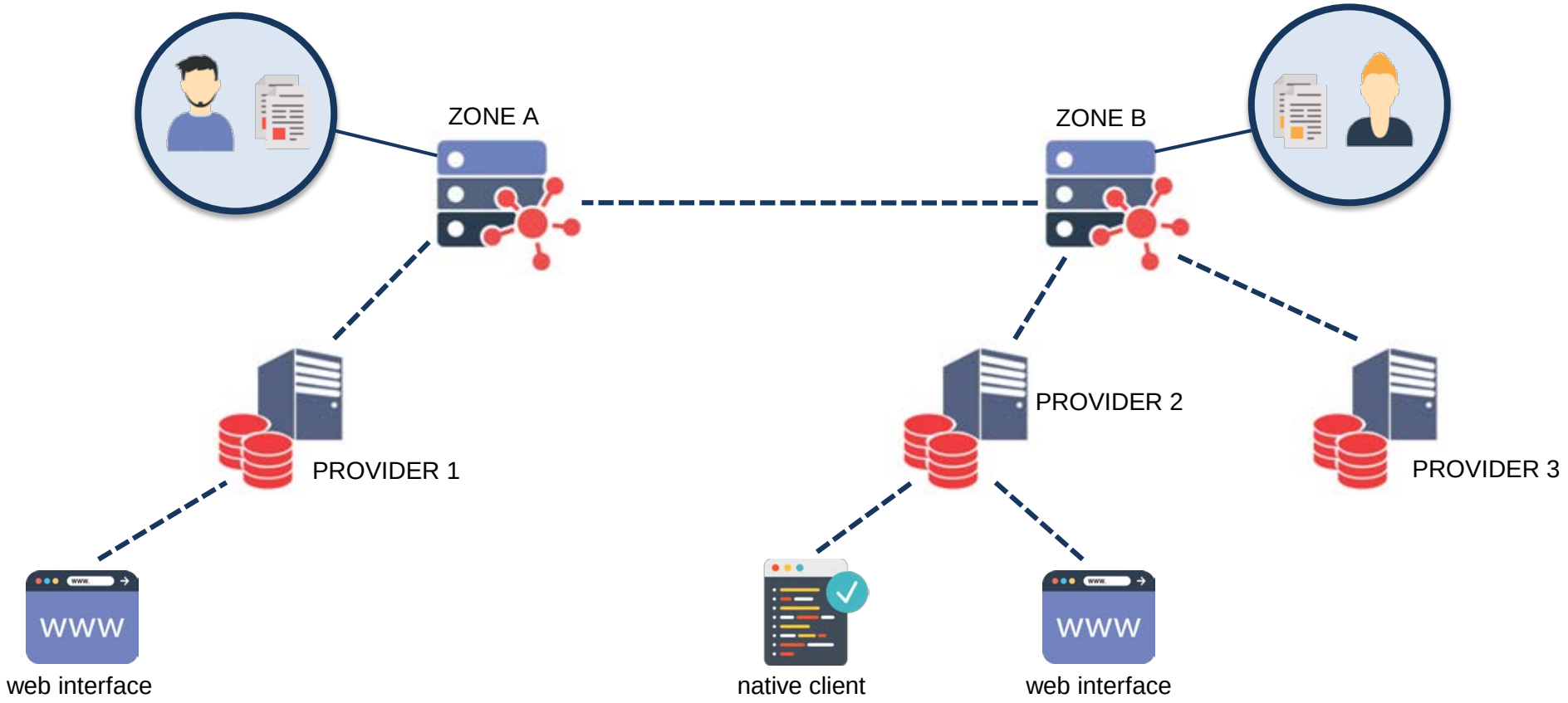
Metadata handled by the *Zone* of origin – local **AuthN & AuthZ** center



- No concurrent modification conflicts
- Metadata sync overheads evenly distributed

PROPOSED SOLUTION – METADATA SYNC

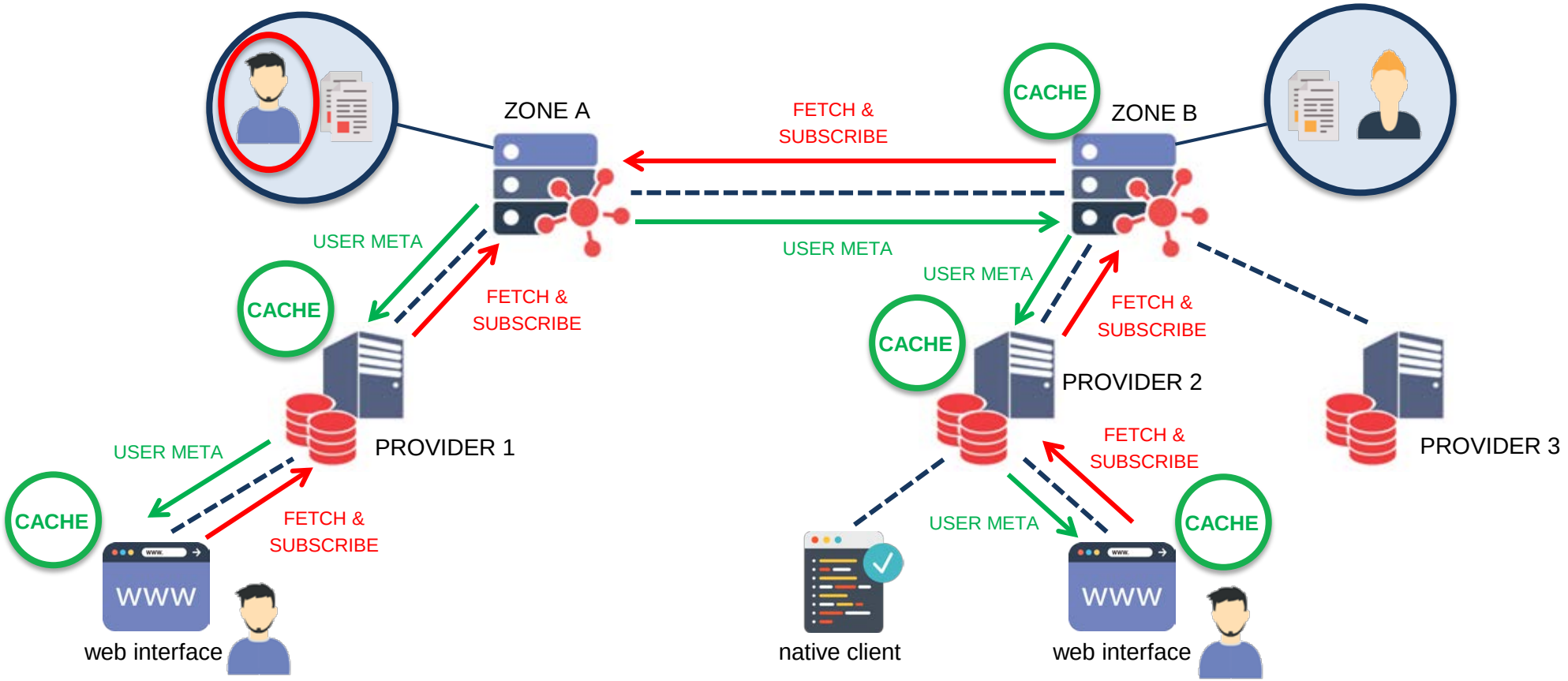
Multi-tier client-server architecture



PROPOSED SOLUTION – METADATA SYNC

Publish / subscribe and multi-tier caching

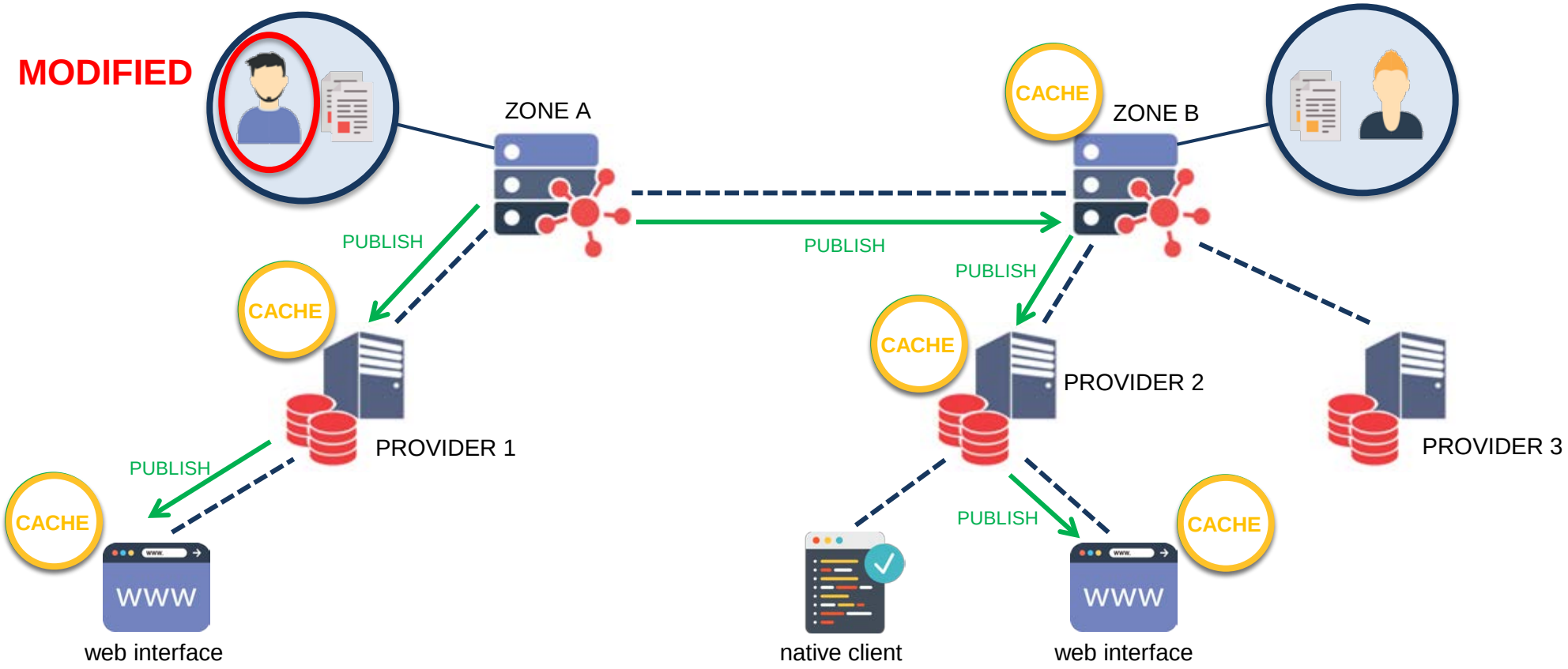
Vast performance improvement



PROPOSED SOLUTION – METADATA SYNC

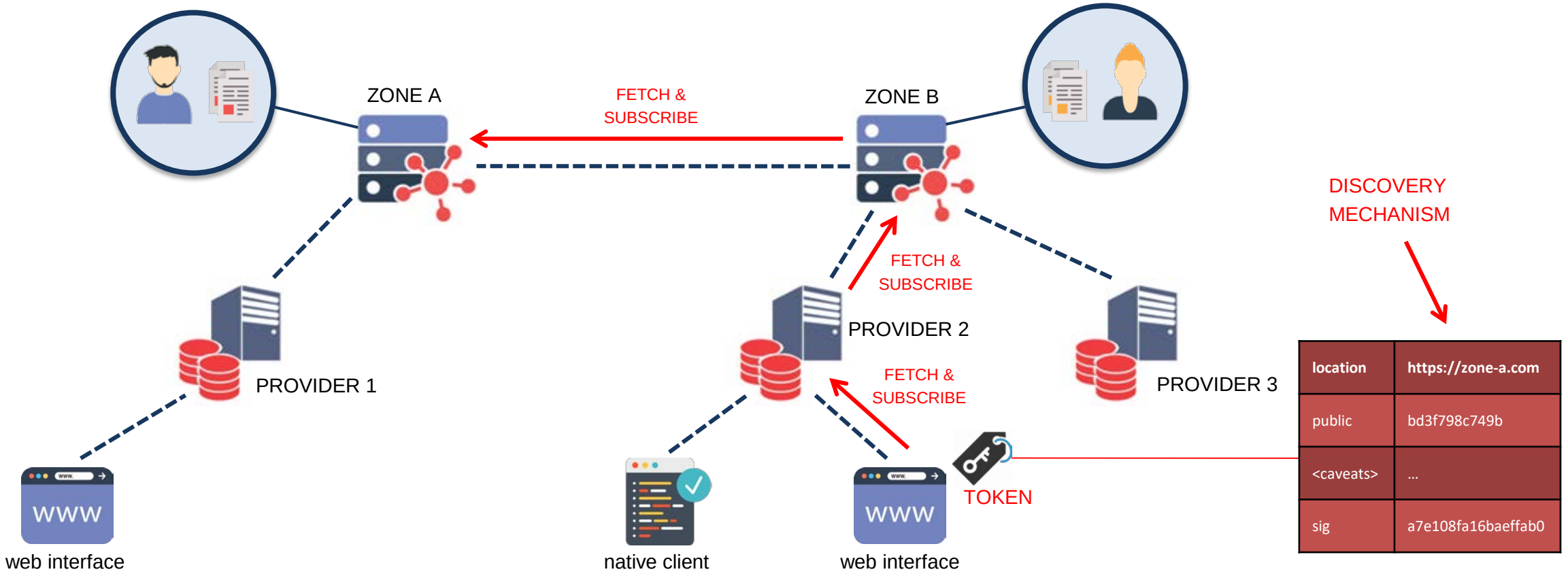
Publish / subscribe and multi-tier caching

Eventual consistency

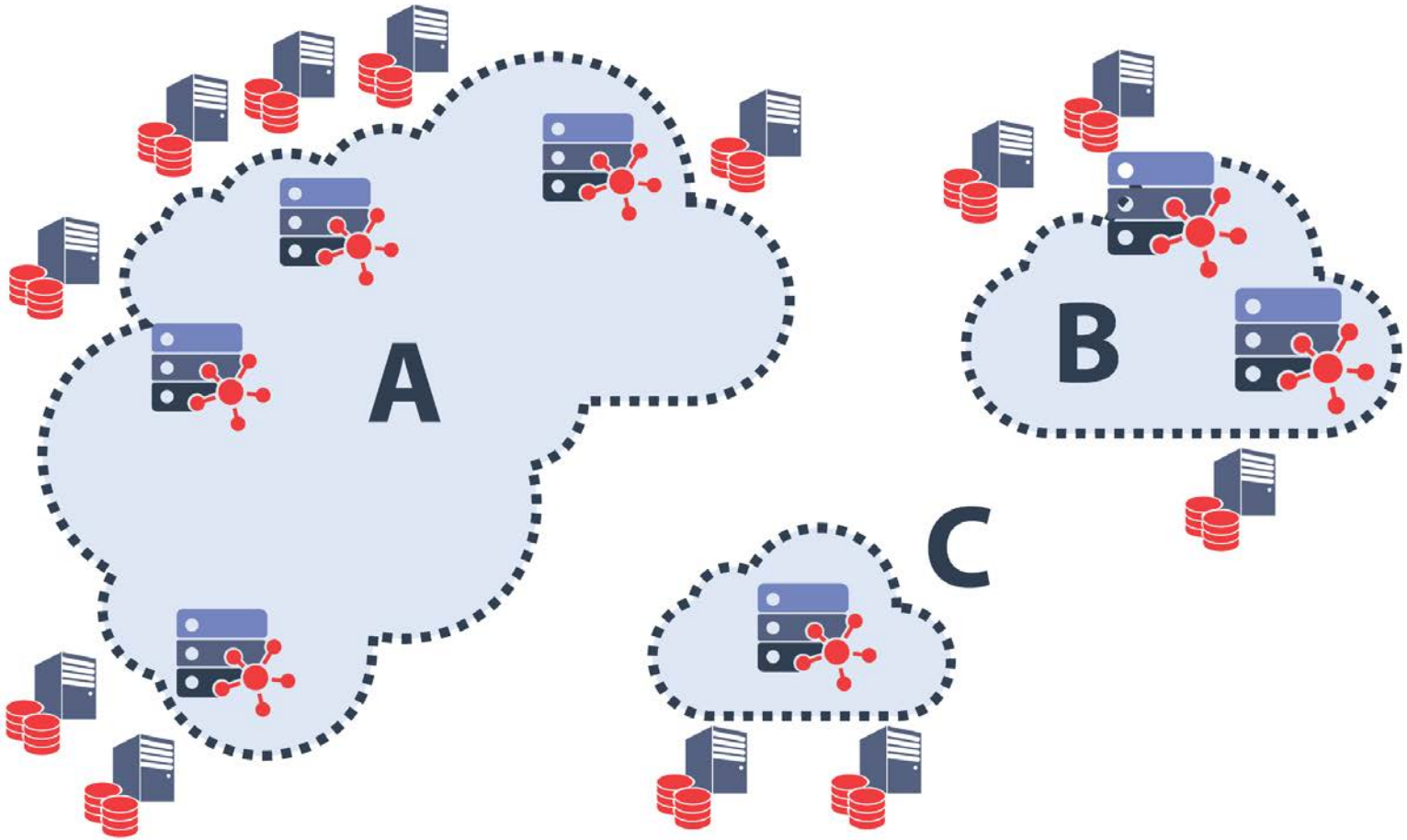


PROPOSED SOLUTION – AAI

Macaroon-based decentralized authorization



Proposed solution – zone mode

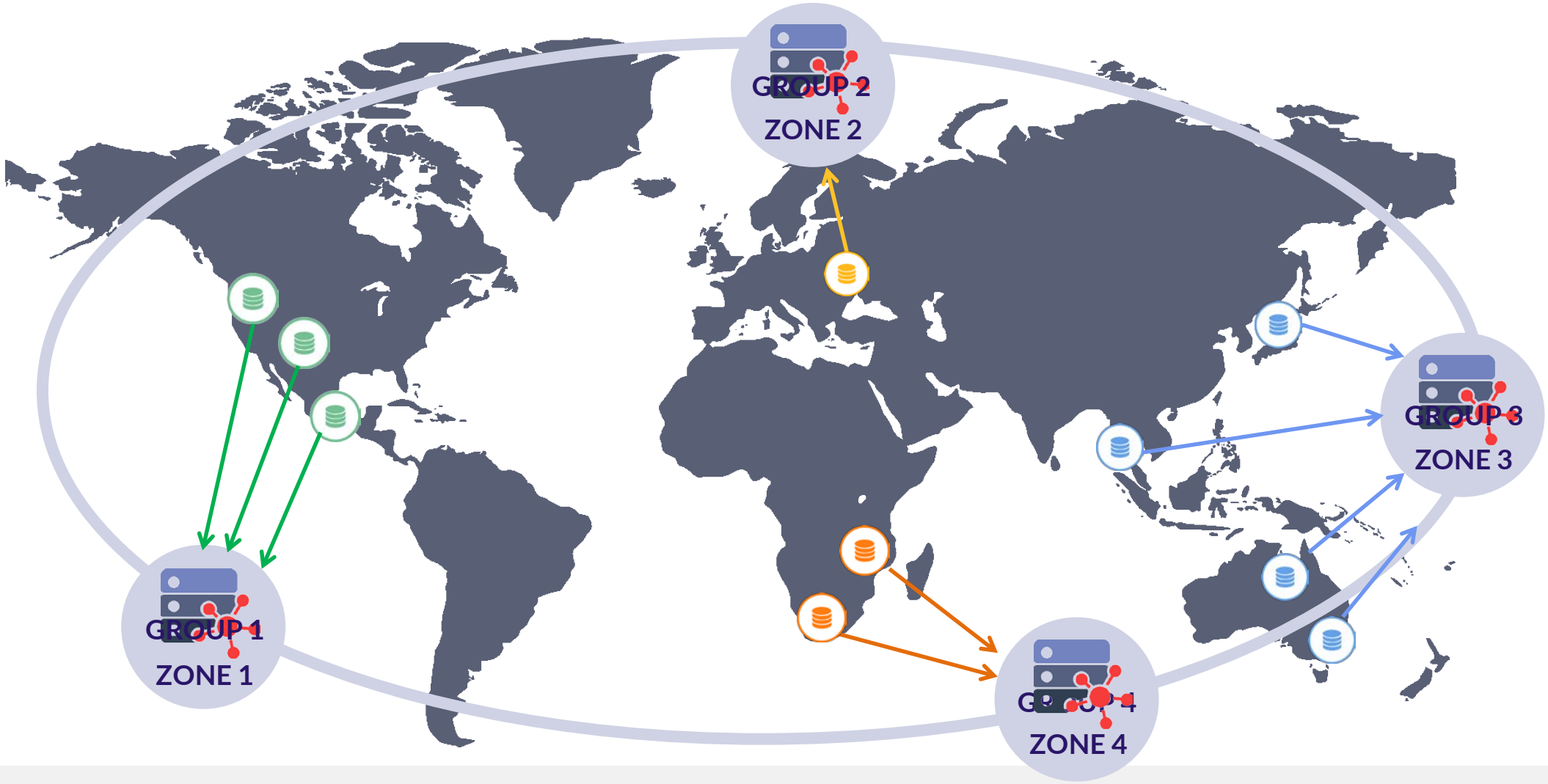


A) Open

B) Restricted

C) Isolated

METADATA SYNC PROTOCOL IN GLOBAL DATA ACCESS



CONCLUSIONS

- Global data access can be achieved by creating a decentralized network of data providers
- We propose a **metadata synchronization protocol** for such network, based on **hybdrid, multi-tier architecture** with **P2P backbone**
- Proposed concept is being implemented in **Onedata**, a distributed virtual file system

- ✔ Zone service acting as central authority and SP server
- ✔ Synchronization Protocol (SP) for single zone scope
- ✔ Macaroon based AAI for single zone scope
- ✔ Data provider service employing the SP
- 🚧 Cross Zone cooperation support
- 🚧 Sync protocol supporting global, cross zone scale

Onezone

Oneprovider

THANK YOU

https://onedata.org

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