Blockchain Development
Week: 3
Title: Access Control

Dr Ian Mitchell

Middlesex University,
Dept. of Computer Science,
London

October 14, 2019

Lecture Aims

Aims

Apply and develop Access Control strategies for blockchain.

Lecture Objectives

Knowledge

- Implement Blockchain ACL
- Role-based access control
- Atribute based access control
- Apply different strategies of access control
- Control the authorisation of Participant's access to assets

Skills

Develop and implement access control for blockchain applications

Role-Based Access Control (RBAC)

- Academics, Students, Admin, Management, External
- All have different access to Systems
- M:N relationships between users and rights
- users cannot pass access permissions on to other users
- form of mandatory access control
- not multilevel

RBAC

A means of restricting access to objects based on the sensitivity of the information contained within the objects and the formal authorisation of subjects to access information of such sensitivity [1]

RBAC

- What is a Role?
- Set of transactions performed for access
- Transactions are allocated roles by SysAdmin
- Membership of a role
- Academics, Students, Admin, Management, External

Exam paper: Do's and Don'ts [3]

- Module Leader writes exam paper.
- Internal moderator reviews exam paper.
- External Examiner checks process
- Module Leader responds
- Administrator signs-off
- Students complete exam

RBAC

- What is a Role?
- Set of transactions performed for access
- Transactions are allocated roles by SysAdmin
- Membership of a role
- Academics, Students, Admin, Management, External
- **Role Explosion**

Exam paper: Do's and Don'ts [3]

- Module leader reviews submitted paper.
- Internal moderator submitting paper.
- External Examiner accessing incorrect papers
- Admin author paper
- Students views paper

Attribute-Based Access Control

- Protect objects
- Unauthorised operations
- ACL & RBAC
- Complex boolean rule set
- Rule set evaluates attribute
- Extensible Access Control Mark-up Language (XACML)

Attribute-Based Access Control

- Protect objects
- Unauthorised operations
- ACL & RBAC
- Complex boolean rule set
- Rule set evaluates attribute
- Extensible Access Control Mark-up Language (XACML)

Definition

An access control method where subject requests to perform operations on objects are granted or denied based on assigned attributes of the subject, assigned attributes of the object, environment conditions, and a set of policiesthat are specified in terms of those attributes and conditions.

Vincent C. Hu *et al* [2]

Attribute-Based Access Control

- Protect objects
- Unauthorised operations
- ACL & RBAC
- Complex boolean rule set
- Rule set evaluates attribute
- Extensible Access Control Mark-up Language (XACML)
- **Attributes**
- **Subject**
- **Object**
- **Operation**
- **Policy**
- **Environment**

Definition

An access control method where subject requests to perform operations on objects are granted or denied based on assigned attributes of the subject, assigned attributes of the object, environment conditions, and a set of policiesthat are specified in terms of those attributes and conditions.

Vincent C. Hu *et al* [2]

Hyperledger - Access Control Language

Review

- Permissioned blockchain
- Membership Services Provider (MSP)
- Fabric Certificate Authority (FCA)
- FCA issues Enrollment Certificates (e-certs)
- The e-cert is used as a signature
- user must register for e-cert
- Composer has BNA files
- Composer has cards

Attribute-based Access Control (ABAC)

- Fabric supports ABAC
- access control based on the attributes associated with the user identity
- Assets
- Participants
- Transactions
- Events
- Business Networks

  A business network is a collection of participants and assets that undergo a life cycle described by transactions. Events occur when transactions complete.

Access Control Language

Components

- Resources
  - namespace: org.example.*
  - namespace(recursive):org.example.**
  - Class in a ns: org.example.className
  - Instance of a class: org.example.className#ID
- operation
- participant
- transaction
- condition
- action

Access Control Language, ACL

Simple Rules

- Rules
- users
- permission
- create
- read
- update
- delete
- evaluated in order, first rule that matches is executed

Listing

```
1 rule {
2   description:
3   participant:
4   operation:
5   resource:
6   action:
7 }
8
```

Listing

```
1 rule ruleName {
2   description:" a brief descript of the rule"
3   participant:"namespace.participant"
4   operation:
5   resource:
6   action:
7 }
8
```

ACL

Listing

```
1 rule ruleName {
2   description:" a brief descript of the rule"
3   participant:"namespace.participant"
4   operation:ALL,CREATE,DELETE,READ,UPDATE
5   resource:"namespace.Asset"
6   action:ALLOW,DENY
7 }
8
```

Access Control Language, ACL

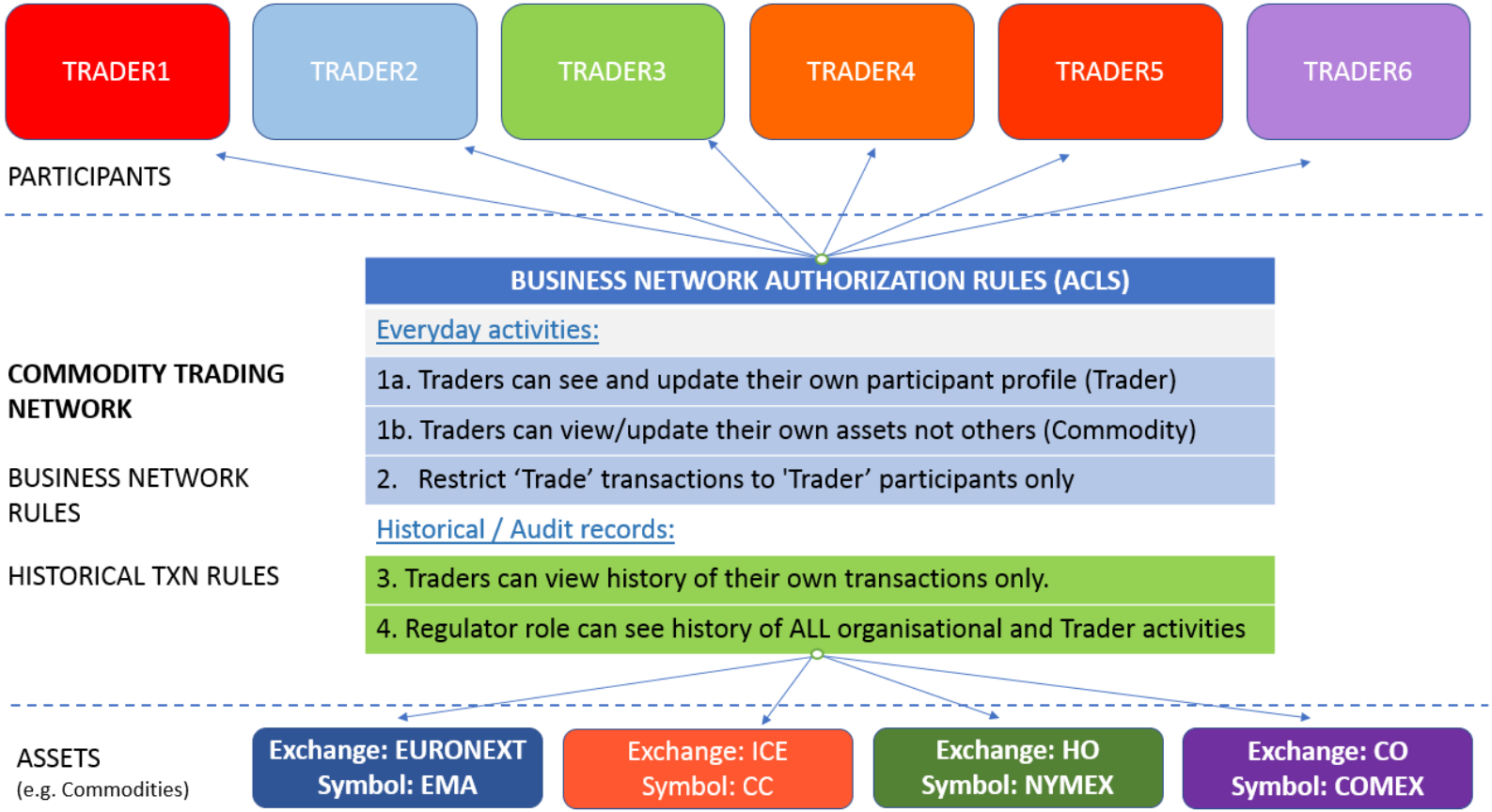
Conditional Rules

- Rules
- Trader example
- trader 1: current owner / seller
- trader 2: new owner / buyer
- only an owner of an asset should be able to sell it

Listing

```
1 rule ownerOnlyAccess{
2   description: "Owners get full access and
        the right to sell"
3   participant(p): "org.example.trading.
        Trader"
4   operation: ALL
5   resource(r): "org.example.trading.
        Commodity"
6   condition: (p==r.owner)
7   action:ALLOW
8  }
9
```

Case Study - Trader Network



Rule Implementation

Trader Network

- Rules are generic and allow all access
- Add 6 traders to the network
- Add more commodities to the network
- Look at rules
- Remove this rule
- keep the admin rules (on next slide)

Listing

```
17      description: "Allow all participants
          access to all resources"
18      participant: "ANY"
19      operation: ALL
20      resource: "org.example.trading.*"
21      action: ALLOW
22  }
23  */
```

Trader Network I

Permissions.acl

```
24 rule traderSeeThemselvesOnly{
25   description: "Trader can only see themselves"
26   participant(p):"org.example.trader.Trader"
27   operation: READ, UPDATE
28   resource(r): "org.example.trader.Trader"
29   condition: (p.getIdentifier() == r.getIdentifier())
30   action: ALLOW
31   }
32 rule traderUpdateReadTheirCommodities{
33   description: "trader can see/sell/update their own commodities"
34   participant(p): "org.example.trader.Trader"
35   operation: ALL
36   resource(r): "org.example.trader.Commodity"
37   condition: (p.getIdentifier()==r.owner.getIdentifier())
38   action: ALLOW
39 }
40 rule traderToSubmitTX{
41   description:"Enable Traders to trade, submit transactions"
42   participant:"org.example.trader.Trader"
43   operation:ALL
44   resource:"org.example.trader.Trade"
45   action: ALLOW
46   }
47
48 rule SystemACL {
49     description:  "System ACL to permit all access"
50     participant: "org.hyperledger.composer.system.Participant"
51     operation: ALL
```

Trader Network II

Permissions.acl

```
52      resource: "org.hyperledger.composer.system.**"
53      action: ALLOW
54  }
55
56  rule NetworkAdminUser {
57      description: "Grant business network administrators full access to user resources"
58      participant: "org.hyperledger.composer.system.NetworkAdmin"
59      operation: ALL
60      resource: "**"
61      action: ALLOW
62  }
63
64  rule NetworkAdminSystem {
65      description: "Grant business network administrators full access to system resources"
66      participant: "org.hyperledger.composer.system.NetworkAdmin"
67      operation: ALL
68      resource: "org.hyperledger.composer.system.**"
69      action: ALLOW
70  }
```

Rule

Traders can only see themselves

- If we have six traders, should traders be able to see each other?
- So here is a rule that allows traders to see themselves only
- This is a condition.
- The solution slightly abuses the resource
- A resource does not have to be an asset, it can also be a participant
- Condition is when the identifiers are equal allow updates and reads

```
1 rule traderSeeThemselvesOnly{
2   description: "Trader can only see
        themselves"
3   participant(p):"org.example.trader.
        Trader"
4   operation: READ, UPDATE
5   resource(r): "org.example.trader.Trader"
6   condition: (p.getIdentifier() == r.
        getIdentifier())
7   action: ALLOW
8   }
9
```

Rule

Traders can only trade assets they own

- You should not be able to trade something you don't own
- rule is to allow traders to only sell assets they own
- This is a more traditional condition
- participant: trader
- resource: commodity (asset)
- condition: traderID == owner ID

```
1 rule traderUpdateReadTheirCommodities{
2   description: "trader can see/sell/update
        their own commodities"
3   participant(p): "org.example.trader.
      Trader"
4   operation: ALL
5   resource(r): "org.example.trader.
      Commodity"
6   condition: (p.getIdentifier()==r.owner.
      getIdentifier())
7   action: ALLOW
8 }
9
```

Rule

Traders To Submit Transactions

- allow access to transaction, trade
- participant: trader
- resource: trade (transaction)
- condition: none
- action: allow
- operation: all

```
1 rule traderToSubmitTX{
2   description:"Enable Traders to trade,
        submit transactions"
3   participant:"org.example.trader.Trader"
4   operation:ALL
5   resource:"org.example.trader.Trade"
6   action: ALLOW
7   }
8
```

Summary

- Top-to-bottom evaluation
- most specific to least specific
- As soon as participant, operation and resource match then subsequent rules are not executed
- If no ACL rule fires then AC is denied

References I

[1] David F Ferraiolo et al. "Proposed NIST standard for role-based access control". In: *ACM Transactions on Information and System Security (TISSEC)* 4.3 (2001), pp. 224–274.

[2] Vincent C. Hu et al. "Guide to Attribute Based Access Control (ABAC) Definition and Considerations". In: Computer Security SP 800-162 (2014).

[3] I. Mitchell and S. Hara. "BMAR - blockchain for medication administration records". In: *Blockchain and Clinical Trial - Securing Patient Data*. Advanced Sciences and Technologies for Security Applications (2019). Ed. by H. Jahankhani.

Web Resources

- `http://hyperledger.org`