1. 链码

```
// chaincode/go/test1/test.go -> 对应链码名testcc
package main
import {
}
type Test struct{
}
func (t* Test)Init();
func (t* Test)Invoke(); // 业务逻辑1
func main(){

}
// chaincode/go/test2/test1.go -> 链码名: testcc1
package main
import {
}
type Test struct{
}
func (t* Test)Init();
func (t* Test)Invoke(); // 业务逻辑2
func main(){

}
// 安装流程
- 安装test1目录中的链码
- 安装test2目录中的链码
```

背书策略

```
# 指定背书策略
peer chaincode instantiate -o oraderer.test.com:7050 -C mychannel -n mycc –v 1.0 -c '{"Args":["init", "a", "100", "b", "200"]}' -P "AND ('OrgGoMSP.member', 'OrgCppMSP.member')"
# 调用
# 调用示例
$ peer chaincode invoke -o orderer.itcast.com:7050  -C mychannel -n testcc --tls true --cafile /opt/gopath/src/github.com/hyperledger/fabric/peer/crypto/ordererOrganizations/itcast.com/orderers/orderer.itcast.com/msp/tlscacerts/tlsca.itcast.com-cert.pem --peerAddresses peer0.orggo.itcast.com:7051 --tlsRootCertFiles /opt/gopath/src/github.com/hyperledger/fabric/peer/crypto/peerOrganizations/orggo.itcast.com/peers/peer0.orggo.itcast.com/tls/ca.crt --peerAddresses peer0.orgcpp.itcast.com:7051 --tlsRootCertFiles /opt/gopath/src/github.com/hyperledger/fabric/peer/crypto/peerOrganizations/orgcpp.itcast.com/peers/peer0.orgcpp.itcast.com/tls/ca.crt -c '{"Args":["invoke","a","b","10"]}'

AND("org1.member", "org2.member")
OR("org1.member", "org2.member")
AND("org3.member", OR("org1.member", "org2.member"))
```

main函数编写

```
func main() {
    // SimpleChaincode 自定义 的结构体
    err := shim.Start(new(SimpleChaincode)) // 最重要的一句话
    if err != nil {
    fmt.Printf("Error starting Simple chaincode: %s", err)
    }
}
如果要自定义函数,函数格式
func (t* xxx) funcName(stub shim.ChaincodeStubInterface, args []string) pb.Response {
}
```

2. Fabric 账号

2.1 Fabric账号

- **Fabric账号**

> 1. 账号是什么?
>
>   Fabric中的账号实际上是根据PKI规范生成的一组证书和秘钥文件
>
> 2. fabric中账号的作用
>   - 保证记录在区块链中的数据具有不可逆、不可篡改
>   - Fabric中每条交易都会加上发起者的标签（签名证书），同时用发起人的私钥进行加密
>   - 如果交易需要其他组织的节点提供背书功能，那么背书节点也会在交易中加入自己的签名

```
# Fabric中的完整账号结构
```

```
.
├── Admin@orggo.itcast.com
│   ├── msp
│   │   ├── admincerts
│   │   │   └── Admin@orggo.itcast.com-cert.pem
│   │   ├── cacerts
│   │   │   └── ca.orggo.itcast.com-cert.pem
│   │   ├── keystore
│   │   │   └── a2f15f92d1b1733a9a901aa4e6fa6d5910248a967b13a00521ba26068a2bc592_sk
│   │   ├── signcerts
│   │   │   └── Admin@orggo.itcast.com-cert.pem
│   │   └── tlscacerts
│   │       └── tlsca.orggo.itcast.com-cert.pem
│   └── tls
│       ├── ca.crt
│       ├── client.crt
│       └── client.key
├── User1@orggo.itcast.com
│   ├── msp
│   │   ├── admincerts
│   │   │   └── User1@orggo.itcast.com-cert.pem
│   │   ├── cacerts
│   │   │   └── ca.orggo.itcast.com-cert.pem
│   │   ├── keystore
│   │   │   └── 889f0029925920dcff610239140bda797e102cda8072a89e2f46c4798bdb5c1d_sk
│   │   ├── signcerts
│   │   │   └── User1@orggo.itcast.com-cert.pem
│   │   └── tlscacerts
│   │       └── tlsca.orggo.itcast.com-cert.pem
│   └── tls
│       ├── ca.crt
│       ├── client.crt
│       └── client.key
```

- msp文件夹中内容中主要存放签名用的证书文件和加密用的私钥文件。
  - admincerts：管理员证书。
  - cacerts：根CA服务器的证书。
  - keystore：节点或者账号的私钥。
  - signcerts：符合x.509的节点或者用户证书文件。
  - tlscacerts：TLS根CA的证书。
- tls 文件夹中存放加密通信相关的证书文件。

2.2 什么地方需要 Fabric 账号

- 启动orderer

> 启动orderer的时候我们需要通过环境变量或者配置文件给当前启动的Orderer设定相应的账号。

```
# 环境变量账号:  -> 该路径为宿主机上的路径，非docker启动的orderer节点内部挂载路径
```

```
ORDERER_GENERAL_LOCALMSPDIR=./crypto-config/ordererOrganizations/itcast.com/orderers/orderer.itcast.com/msp
# 账号目录信息
$ tree msp/
msp/
├── admincerts
│   └── Admin@itcast.com-cert.pem
├── cacerts
│   └── ca.itcast.com-cert.pem
├── keystore
│   └── 4968fd5b3fa14639ba61ec97f745b2e0ce5592e54838493d965a08ac7ad1c8e7_sk
├── signcerts
│   └── orderer.itcast.com-cert.pem
└── tlscacerts
    └── tlsca.itcast.com-cert.pem
```

- 启动peer

> 启动peer的时候我们需要通过环境变量或者配置文件给当前启动的peer设定相应的账号。

```
# 环境变量账号:  -> 该路径为宿主机上的路径，非docker启动的orderer节点内部挂载路径
CORE_PEER_MSPCONFIGPATH=crypto-config/peerOrganizations/orggo.itcast.com/peers/peer0.orggo.itcast.com/msp
# 账号目录信息
$ tree msp/
msp/
├── admincerts
│   └── Admin@orggo.itcast.com-cert.pem
├── cacerts
│   └── ca.orggo.itcast.com-cert.pem
├── config.yaml
├── keystore
│   └── a3a19feb11cac708a038d115d26cf96247bcc5821bca3f2b8e9d07847604268b_sk
├── signcerts
│   └── peer0.orggo.itcast.com-cert.pem
└── tlscacerts
    └── tlsca.orggo.itcast.com-cert.pem
```

- 创建channel

> channel是fabric中的重要组成部分, 创建channel也是需要账号的.

```
# 环境变量账号:  -> 该路径为宿主机上的路径，非docker启动的orderer节点内部挂载路径
# 在客户端中做的，客户端要有一个用户的账号信息
CORE_PEER_MSPCONFIGPATH=crypto-config/peerOrganizations/orggo.itcast.com/users/Admin@orggo.itcast.com/msp
# 账号目录信息
$ tree msp/
msp/
├── admincerts
│   └── Admin@orggo.itcast.com-cert.pem
├── cacerts
```

```
10  |   └── ca.orggo.itcast.com-cert.pem
11  ├── keystore
12  |   └── a2f15f92d1b1733a9a901aa4e6fa6d5910248a967b13a00521ba26068a2bc592_sk
13  ├── signcerts
14  |   └── Admin@orggo.itcast.com-cert.pem
15  └── tlscacerts
16      └── tlsca.orggo.itcast.com-cert.pem
```

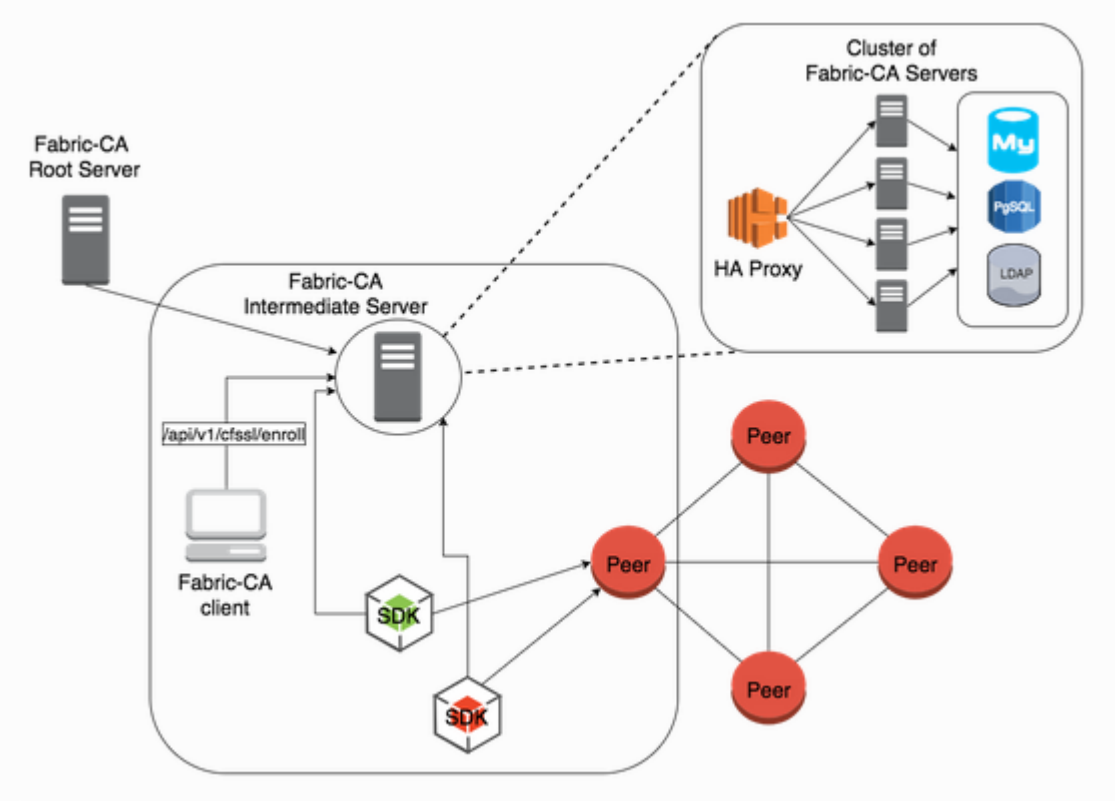
> 通过上边的内容我们可以发现这些账号的内容是一样的, 都包含是5个不同的文件, 但是仔细观察会发现在文件路径上还是有一些区别的。我们来对比一下:

```
1   # Orderer 启动路径
2   crypto-config/ordererOrganizations/itcast.com/orderers/orderer.itcast.com/msp
3   # Peer启动的账号路径
4   crypto-config/peerOrganizations/orggo.itcast.com/peers/peer0.orggo.itcast.com/msp
5   # 创建channel的账号路径
6   crypto-config/peerOrganizations/orggo.itcast.com/users/Admin@orggo.itcast.com/msp
```

> 我们可以发现Peer和Orderer都有属于自己的账号，创建Channel使用的是用户账号。其中Peer和创建Channel的用户账号属于某个组织，而Orderer的启动账号只属于他自己。这里特别注意，用户账号在很多操作中都会用到，而且很多操作的错误都是用户账号的路径设置不当而引起的。

2.3 Fabric-ca

> fabric-ca 项目是专门为了解决Fabric账号问题而发起的一个开源项目, 它非常完美的解决了fabric账号生成的问题。fabric-ca项目由 fabric-server 和fabric-client这两个模块组成。其中fabric-server在 fabric中占有非常重要的作用。我们使用 `cryptogen` 命令可以同配置文件生成一些账号信息, 但是如果有动态添加账号的需求, 就无法满足, 所以这个时候我们就应该在项目中引入fabric-ca。



上图中Fabric CA提供了两种访问方式调用Server服务

- 通过Fabric-Client调用
- 通过SDK调用 （node.js，java， go）

通常情况下， 一个组织会对应一个fabric-server服务器， 下面介绍如何将fabric-server加入到网络中

在一个fabric中有多个组织, fabric-Ca如何部署?

- 要在每个组织中部署一个fabric-ca服务器, 给当前组织注册新用户

2.3.1 将fabric-ca加入到网络

在docker-compose启动使用的配置文件 `docker-compos.yam` 中添加如下配置项:

```
version: '2'

volumes:
  orderer.example.com:
  peer0.org1.example.com:
  peer0.org2.example.com:

networks:
  byfn:

services:
###################### 添加的内容 - START ########################
  ca.example.com: # -> fabric-ca的服务器名, 随便起名
    image: hyperledger/fabric-ca:latest # fabric-ca的镜像文件
    environment:
        # fabric-ca容器中的home目录
```

```
      - FABRIC_CA_HOME=/etc/hyperledger/fabric-ca-server
      - FABRIC_CA_SERVER_CA_NAME=ca.example.com # fabric-ca服务器的名字，自己起
      # fabric-ca服务器证书文件目录中的证书文件
      # 明确当前fabric-ca属于哪个组织
      - FABRIC_CA_SERVER_CA_CERTFILE=/etc/hyperledger/fabric-ca-server-config/ca.org1.example.com-cert.pem
      # fabric-ca服务器的私钥文件
      - FABRIC_CA_SERVER_CA_KEYFILE=/etc/hyperledger/fabric-ca-server-config/ee54a6cc9868ffa72f0556895020739409dc69da844628ae804934b7d7f68e92_sk

    ports:
      - "7054:7054" # fabric-ca服务器绑定的端口
    # 启动fabric-ca-server服务
    # admin:123456
    #  -- admin: fabric-ca-server的登录用户名
    #  -- 123456: fabric-ca-server的登录密码
    command: sh -c 'fabric-ca-server start -b admin:123456'
    volumes:
      - ./crypto-config/peerOrganizations/org1.example.com/ca/:/etc/hyperledger/fabric-ca-server-config
    container_name: ca.example.com  # 容器名，自己指定
    networks:
      - byfn    # 工作的网络

 ca.example1.com: # -> fabric-ca的服务器名，随便起名
    image: hyperledger/fabric-ca:latest # fabric-ca的镜像文件
    environment:
        # fabric-ca容器中的home目录
      - FABRIC_CA_HOME=/etc/hyperledger/fabric-ca-server
      - FABRIC_CA_SERVER_CA_NAME=ca.example1.com    # fabric-ca服务器的名字，自己起
      # fabric-ca服务器证书文件目录中的证书文件
      # 明确当前fabric-ca属于哪个组织
      - FABRIC_CA_SERVER_CA_CERTFILE=/etc/hyperledger/fabric-ca-server-config/ca.org2.example.com-cert.pem
      # fabric-ca服务器的私钥文件
      - FABRIC_CA_SERVER_CA_KEYFILE=/etc/hyperledger/fabric-ca-server-config/ee54a6cc9868ffa72f0556895020739409dc69da844628ae804934b7d7f68e92_sk

    ports:
      - 8054:7054"  # fabric-ca服务器绑定的端口
    # 启动fabric-ca-server服务
    # admin:123456
    #  -- admin: fabric-ca-server的登录用户名
    #  -- 123456: fabric-ca-server的登录密码
    command: sh -c 'fabric-ca-server start -b admin:123456'
    volumes:
      - ./crypto-config/peerOrganizations/org2.example.com/ca/:/etc/hyperledger/fabric-ca-server-config
    container_name: ca.example1.com # 容器名，自己指定
    networks:
      - byfn    # 工作的网络
##################### 添加的内容 - END ########################
  orderer.example.com:
```

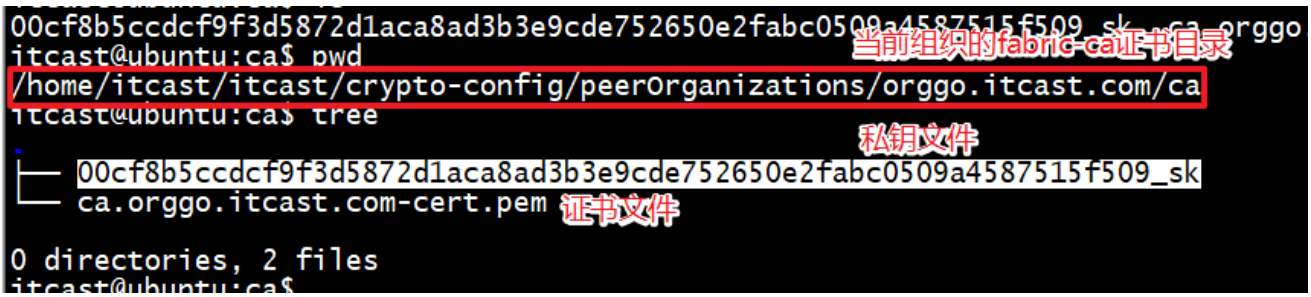
```
    extends:
      file:   docker-compose-base.yaml
      service: orderer.example.com
    container_name: orderer.example.com
    networks:
      - byfn

  peer0.org1.example.com:
    container_name: peer0.org1.example.com
    extends:
      file:  docker-compose-base.yaml
      service: peer0.org1.example.com
    networks:
      - byfn

  peer0.org2.example.com:
    container_name: peer0.org2.example.com
    extends:
      file:  docker-compose-base.yaml
      service: peer0.org2.example.com
    networks:
      - byfn

  cli:
    container_name: cli
    image: hyperledger/fabric-tools:latest
    tty: true
    stdin_open: true
    environment:
      - GOPATH=/opt/gopath
      - CORE_VM_ENDPOINT=unix:///host/var/run/docker.sock
      #- CORE_LOGGING_LEVEL=DEBUG
      - CORE_LOGGING_LEVEL=INFO
      - CORE_PEER_ID=cli
      - CORE_PEER_ADDRESS=peer0.org1.example.com:7051
      - CORE_PEER_LOCALMSPID=Org1MSP
      - CORE_PEER_TLS_ENABLED=true
      - CORE_PEER_TLS_CERT_FILE=/opt/gopath/src/github.com/hyperledger/fabric/peer/crypto/peerOrganizations/org1.example.com/peers/peer0.org1.example.com/tls/server.crt
      - CORE_PEER_TLS_KEY_FILE=/opt/gopath/src/github.com/hyperledger/fabric/peer/crypto/peerOrganizations/org1.example.com/peers/peer0.org1.example.com/tls/server.key
      - CORE_PEER_TLS_ROOTCERT_FILE=/opt/gopath/src/github.com/hyperledger/fabric/peer/crypto/peerOrganizations/org1.example.com/peers/peer0.org1.example.com/tls/ca.crt
      - CORE_PEER_MSPCONFIGPATH=/opt/gopath/src/github.com/hyperledger/fabric/peer/crypto/peerOrganizations/org1.example.com/users/Admin@org1.example.com/msp
    working_dir: /opt/gopath/src/github.com/hyperledger/fabric/peer
    command: /bin/bash
    volumes:
        - /var/run/:/host/var/run/
```

```
109           - ./chaincode/:/opt/gopath/src/github.com/chaincode
110           - ./crypto-config:/opt/gopath/src/github.com/hyperledger/fabric/peer/crypto/
111           - ./scripts:/opt/gopath/src/github.com/hyperledger/fabric/peer/scripts/
112           - ./channel-artifacts:/opt/gopath/src/github.com/hyperledger/fabric/peer/channel-
    artifacts
113       depends_on:
114         - orderer.example.com
115         - peer0.org1.example.com
116         - peer0.org2.example.com
117       networks:
118         - byfn
```



2.3.2 编写node.js客户端

- 初始化node.js项目

```
1   # 创建一个编写node.js客户端的目录，并进入
2   # 1. 执行npm init 生成package.json文件，用于保存更新项目依赖的第三方模块
3   #    要求输入的信息，如果你懒，直接回车就可以了
4   # package.json配置说明: https://blog.csdn.net/Aurora100/article/details/78590346
5   $ npm init
6   This utility will walk you through creating a package.json file.
7   It only covers the most common items, and tries to guess sensible defaults.
8
9   See `npm help json` for definitive documentation on these fields
10  and exactly what they do.
11
12  Use `npm install <pkg>` afterwards to install a package and
13  save it as a dependency in the package.json file.
14
15  Press ^C at any time to quit.
16  package name: (nodejs)
17  version: (1.0.0)
18  description:
19  entry point: (index.js)
20  test command:
21  git repository:
22  keywords:
23  author:
24  license: (ISC)
25  About to write to /home/itcast/nodejs/package.json:
26
27  {
28    "name": "nodejs",
29    "version": "1.0.0",
```

```
    "description": "",
    "main": "index.js",
    "scripts": {
      "test": "echo \"Error: no test specified\" && exit 1"
    },
    "author": "",
    "license": "ISC"
  }


  Is this ok? (yes)
```

```
# 接下来执行如下命令，安装第三方依赖库：
npm install --save fabric-ca-client
npm install --save fabric-client
npm install --save grpc
# 安装过程中，提示如下log信息，无需理会
npm WARN nodejs@1.0.0 No description
npm WARN nodejs@1.0.0 No repository field.
```

- 客户端参考API

```
https://fabric-sdk-node.github.io/release-1.3/index.html
```

3. Solo多机多节点部署

所有的节点分离部署, 每台主机上有一个节点

名称	IP	Hostname	组织机构
orderer	192.168.247.129	orderer.itcast.com	Orderer
peer0	192.168.247.141	peer0.orggo.com	OrgGo
peer1		peer1.orggo.com	OrgGo
peer0	192.168.247.131	peer0.orgcpp.com	OrgCpp
peer1		peer1.orgcpp.com	OrgCpp

- 准备工作 - 创建工作目录

```
1. n台主机需要创建一个名字相同的工作目录
    # 192.168.247.129
    mkdier ~/testwork
    # 192.168.247.141
    mkdier ~/testwork
    # 192.168.247.131
    mkdier ~/testwork
```

- 编写配置文件 -> 生成证书的

```
# crypto-config.yaml -> 名字可以改

```

- 生成通道文件和创始块文件

```
# configtx.yaml -> 名字不能变

```

3.1 部署 orderer 排序节点

- 编写orderer节点启动的docker-compose.yaml配置文件

```
version: '2'

services:

  orderer.test.com:
    container_name: orderer.test.com
    image: hyperledger/fabric-orderer:latest
    environment:
      - CORE_VM_DOCKER_HOSTCONFIG_NETWORKMODE=testwork_default
      - ORDERER_GENERAL_LOGLEVEL=INFO
      - ORDERER_GENERAL_LISTENADDRESS=0.0.0.0
      - ORDERER_GENERAL_LISTENPORT=7050
      - ORDERER_GENERAL_GENESISMETHOD=file
      - ORDERER_GENERAL_GENESISFILE=/var/hyperledger/orderer/orderer.genesis.block
      - ORDERER_GENERAL_LOCALMSPID=OrdererMSP
      - ORDERER_GENERAL_LOCALMSPDIR=/var/hyperledger/orderer/msp
      # enabled TLS
      - ORDERER_GENERAL_TLS_ENABLED=true
      - ORDERER_GENERAL_TLS_PRIVATEKEY=/var/hyperledger/orderer/tls/server.key
      - ORDERER_GENERAL_TLS_CERTIFICATE=/var/hyperledger/orderer/tls/server.crt
      - ORDERER_GENERAL_TLS_ROOTCAS=[/var/hyperledger/orderer/tls/ca.crt]
    working_dir: /opt/gopath/src/github.com/hyperledger/fabric
    command: orderer
    volumes:
    - ./channel-artifacts/genesis.block:/var/hyperledger/orderer/orderer.genesis.block
    - ./crypto-config/ordererOrganizations/test.com/orderers/orderer.test.com/msp:/var/hyperledger/orderer/msp
    - ./crypto-config/ordererOrganizations/test.com/orderers/orderer.test.com/tls/:/var/hyperledger/orderer/tls
    networks:
        default:
          aliases:
            - testwork  # 这个名字使用当前配置文件所在的目录 的名字
    ports:
      - 7050:7050
```

3.2 部署 peer0.orggo 节点

- 切换到peer0.orggo主机 - 192.168.247.141
- 进入到 `~/testwork`
- 拷贝文件

```
$ tree -L 1
.
├── channel-artifacts
└── crypto-config
```

- 编写 `docker-compose.yaml` 配置文件

```
version: '2'

services:

    peer0.orgGo.test.com:
      container_name: peer0.orgGo.test.com
      image: hyperledger/fabric-peer:latest
      environment:
        - CORE_VM_ENDPOINT=unix:///host/var/run/docker.sock
        - CORE_VM_DOCKER_HOSTCONFIG_NETWORKMODE=testwork_default
        - CORE_LOGGING_LEVEL=INFO
        #- CORE_LOGGING_LEVEL=DEBUG
        - CORE_PEER_GOSSIP_USELEADERELECTION=true
        - CORE_PEER_GOSSIP_ORGLEADER=false
        - CORE_PEER_PROFILE_ENABLED=true
        - CORE_PEER_LOCALMSPID=OrgGoMSP
        - CORE_PEER_ID=peer0.orgGo.test.com
        - CORE_PEER_ADDRESS=peer0.orgGo.test.com:7051
        - CORE_PEER_GOSSIP_BOOTSTRAP=peer0.orgGo.test.com:7051
        - CORE_PEER_GOSSIP_EXTERNALENDPOINT=peer0.orgGo.test.com:7051
        # TLS
        - CORE_PEER_TLS_ENABLED=true
        - CORE_PEER_TLS_CERT_FILE=/etc/hyperledger/fabric/tls/server.crt
        - CORE_PEER_TLS_KEY_FILE=/etc/hyperledger/fabric/tls/server.key
        - CORE_PEER_TLS_ROOTCERT_FILE=/etc/hyperledger/fabric/tls/ca.crt
      volumes:
        - /var/run/:/host/var/run/
        - ./crypto-config/peerOrganizations/orgGo.test.com/peers/peer0.orgGo.test.com/msp:/etc/hyperledger/fabric/msp
        - ./crypto-config/peerOrganizations/orgGo.test.com/peers/peer0.orgGo.test.com/tls:/etc/hyperledger/fabric/tls
      working_dir: /opt/gopath/src/github.com/hyperledger/fabric/peer
      command: peer node start
      networks:
        default:
          aliases:
            - testwork
      ports:
        - 7051:7051
        - 7053:7053
```

```
        extra_hosts:  # 声明域名和IP的对应关系
          - "orderer.test.com:192.168.247.129"

    cli:
        container_name: cli
        image: hyperledger/fabric-tools:latest
        tty: true
        stdin_open: true
        environment:
          - GOPATH=/opt/gopath
          - CORE_VM_ENDPOINT=unix:///host/var/run/docker.sock
          #- CORE_LOGGING_LEVEL=DEBUG
          - CORE_LOGGING_LEVEL=INFO
          - CORE_PEER_ID=cli
          - CORE_PEER_ADDRESS=peer0.orgGo.test.com:7051
          - CORE_PEER_LOCALMSPID=OrgGoMSP
          - CORE_PEER_TLS_ENABLED=true
          - CORE_PEER_TLS_CERT_FILE=/opt/gopath/src/github.com/hyperledger/fabric/peer/crypto/peerOrganizations/orgGo.test.com/peers/peer0.orgGo.test.com/tls/server.crt
          - CORE_PEER_TLS_KEY_FILE=/opt/gopath/src/github.com/hyperledger/fabric/peer/crypto/peerOrganizations/orgGo.test.com/peers/peer0.orgGo.test.com/tls/server.key
          - CORE_PEER_TLS_ROOTCERT_FILE=/opt/gopath/src/github.com/hyperledger/fabric/peer/crypto/peerOrganizations/orgGo.test.com/peers/peer0.orgGo.test.com/tls/ca.crt
          - CORE_PEER_MSPCONFIGPATH=/opt/gopath/src/github.com/hyperledger/fabric/peer/crypto/peerOrganizations/orgGo.test.com/users/Admin@orgGo.test.com/msp
        working_dir: /opt/gopath/src/github.com/hyperledger/fabric/peer
        command: /bin/bash
        volumes:
            - /var/run/:/host/var/run/
            - ./chaincode/:/opt/gopath/src/github.com/chaincode
            - ./crypto-config:/opt/gopath/src/github.com/hyperledger/fabric/peer/crypto/
            - ./channel-artifacts:/opt/gopath/src/github.com/hyperledger/fabric/peer/channel-artifacts
        depends_on:   # 启动顺序
          - peer0.orgGo.test.com

        networks:
            default:
              aliases:
                - testwork
        extra_hosts:
          - "orderer.test.com:192.168.247.129"
          - "peer0.orgGo.test.com:192.168.247.141"
```

- 在 `~/testwork` 创建了一个子目录 `chaincode`，并将链码文件放进去
- 启动容器

```
$ docker-compose up -d
```

- 进入到客户端容器中
  - 创建通道

```
$ peer channel create -o orderer.test.com:7050 -c testchannel -f ./channel-artifacts/channel.tx --tls true --cafile /opt/gopath/src/github.com/hyperledger/fabric/peer/crypto/ordererOrganizations/test.com/msp/tlscacerts/tlsca.test.com-cert.pem
```

  - 将当前节点加入到通道中

```
$ peer channel join -b testchannel.block
```

  - 安装链码

```

```

  - 初始化链码
  - 将生成的通道文件 `testchannel.block` 从cli容器拷贝到宿主机

```
# 拷贝操作要在宿主机中进行
$ docker cp cli:/opt/gopath/src/github.com/hyperledger/fabric/peer/testchannel.block ./
```

3.3 部署 peer0.orgcpp 节点

- 切换到peer0.orgcpp主机 - 192.168.247.131
- 进入到 `~/testwork`
- 拷贝文件

```
$ tree -L 1
.
├── channel-artifacts
└── crypto-config
```

  - 通道块文件 从宿主机 -> 当前的peer0.orgcpp上

```
# 为了方便操作可以将文件放入到客户端容器挂载的目录中
$ mv testchannel.block channel-artifacts/
```

- 编写 `docker-compose.yaml` 配置文件
- 启动当前节点
- 进入到操作该节点的客户端中
  - 加入到通道中
  - 安装链码