Choosing the right network for your business

Helping Business network operators select the right network for their Corda needs

Mark Oldfield and Carolyne Quinn
June 2019

© Copyright - R3

Introduction

Executive Summary
This paper aims to help clients decide on the best network to run Corda on, for their particular situation: whether Corda Network, a segregated network, or a private network. It outlines the pros and cons of each of the three options, ending with a table which summarises the important questions which can help define which is appropriate for any given client. We recognise this is a simplistic overview, and it won't cover all the nuances and details which will most likely need to be considered.

Before making a final decision, clients should be encouraged to contact a member of the R3 team to discuss their requirements in detail.

+++++++++

Context: Many of our early customers are forming groups, or business networks, to use Corda, typically for a specific commercial purpose. We define a business network operator as a company or consortium who sets-up and operates the legal rules and business processes for the business network, often also designing and operating a shared CorDapp.[1]

Purpose: This paper aims to help guide business network operators to choose the best network option for their business network, as well as provide an overview of the different network options for Corda users.

Background on networks and Corda: All Corda software, whether open source or Corda Enterprise, must be part of a network to enable transactions between nodes.

At a minimum, a Corda network should contain nodes, a notary and a Trust Root[2] (which can be operated in-house or outsourced to a third party). All nodes in the network are identified by, and transact using, an X509 certificate issued by an appointed Certificate Authority. The Trust Root is the single, long-term cryptographic key which all networks' X509 certificates root back to, and is the basis of trust in the provenance of data, recognised by participants. A notary prevents "double-spends" by attesting that for any given transaction, it has not already signed other transactions that consumes the proposed transaction's input states (in other words: if the state in a transaction has been previously spent).

Unless they run in a bootstrapper mode, Corda networks will usually also contain an Identity Manager (which can grant and revoke participation certificates, to nodes – based on the Trust Root) and a Network Map (which lists the identities of nodes in the network and maintains the

[1] For more information about business networks, see https://solutions.corda.net/business-networks/intro.html
[2] Together with a Certificate Authority and revocation list service

© Copyright - R3

network parameters list, and makes this information available to all nodes). While not necessary, the last two are being requested by most early Corda customers.[3]

Today, business network operators using Corda have three network options to choose from:

1. **Corda Network** is a shared, permissioned, global network, publicly available, which business networks may join and operate within.[4] It is governed by a not-for-profit Foundation in the Netherlands, which sets network policies for all participants – e.g. around identity checking and security, pricing and network parameter upgrades - and monitors the Network Operator (currently R3). The Foundation's Board has nine external directors (early customers) and two from R3. Business network operators may use the Corda Network provided notary, or operate their own. They also have access to use the Corda Network pre-production ("UAT") test environment.

2. A **Segregated network** is a partitioned sub-network within the Corda Network, which enables membership privacy (only members of the segregated network are visible to each other) and control over its software upgrade schedule. The segregated network is therefore governed by the Corda Network Foundation, in conjunction with the business network operator. The business network operator will operate their own notary (either run by themselves or a third party). The segregated network *may* merge with Corda Network at a time of the business network operator's choosing (as they share a Trust Root). We see this as a balanced compromise for those who desire to retain as much control as possible at inception, whilst retaining the option to merge into Corda Network in the future

3. A **Private Network** can take different forms, but would be set-up, operated, and governed by the business network operator or a third party. This allows the business network operator to retain complete control; making decisions on policies including whether it uses / issues certificates, whether it uses the internet / runs on an internal network, the location of infrastructure and services, as well as its software upgrade schedule. The private network will need to run its own network services, including a notary, and would need a trust root – either set up its own, or outsource to a third party.[5]

The decision about which option is best for a business network operator will be informed by 4 factors:

[3] These two services, Identity Operator and Network Map, will be available to purchase from R3 as the "Corda Enterprise Network Manager" from end-June.

[4] Key services of Corda Network includes a Network Map, Identity Manager, and shared Corda Network notary. Corda Network also has its own Trust Root - the single, long-term cryptographic key which all the certificates on the Network root back to, and is the basis of trust in the provenance of data, recognised by participants.

[5] There are costs and technical challenges for a private network to merge with Corda Network. However, interoperability via some form of network bridge may be possible. It should be possible to **migrate** states from one network to another, by reissuing them on the target network.

© Copyright - R3

Factor	Features
1. Ability to use shared infrastructure	• Policy / governance control • Control of membership • Risk / business continuity (incl. reliance on 3rd parties) • Location of services / infrastructure • Management of software upgrade schedule
2. Privacy required	• Visibility to others on the public directory / Network Map • Visibility of past transactions to others - to support provenance checking (depends on CorDapp design)
3. Shared common standards, for greater interoperability	• Ability to transact seamlessly with other nodes (on Corda Network or otherwise) – using the standard Corda protocol
4. Needs around cost/effort/time to set up and run	• Cost, effort + time allowed to set-up the network • Cost of operating the network • Leveraging shared services

The 3 network options offer different strengths and weaknesses across each of these 4 factors.

1. Why would a business network operator choose to join Corda Network?

Pros

Interoperability: Corda Network is suitable for business network operators who wish to transact either now or in the future with a diverse range of parties and / or utilise global assets. This feature, 'interoperability', can range from one node taking part in many business networks to having the ability to transact seamlessly with any node across the network using the standard Corda protocol.

Lower effort and shorter time to set-up: Corda Network is developing its operating model to support a diverse range of needs. Corda Network is already set-up, and is operated and monitored 24/7 by an in-house team. Effort and time required to join Corda Network is lower than other network options.

Joining it and and running a business network will be at a lower cost if the number of nodes in the business network is relatively low. There are two potential fees: an annual participation fee for each node, which includes access to a test network ("Pre-Production"); and transaction fees. For those who wish to run their own notary, all transactions are free, but for those who use the Corda Network notary, the first 10,000 trxns per year are free and then fees apply.[6] Cost advantages will depend on the Business network operator's requirements and abilities.

[6] See more here: https://corda.network/

© Copyright - R3

Business network operators may use the Business Network Membership Service CorDapp to help manage and onboard their members. They will also have access to shared services (KYC applications, oracles, etc.)

Cons:

Membership visibility: To transact with as wide a range of parties as possible, Business Networks' nodes must be visible to each other (hence not private) on the Network Map.

Transaction visibility: Depending on the CorDapp design, it may also be difficult to ensure that transaction histories (used to check the provenance of data) cannot end up on nodes in other Business Networks in different locations.

Policy control: The Corda Network Foundation (nice of whose eleven directors are early Corda Network customers) will control the network's policies, governance and SLAs. This includes identity issuance for the network, location of services and infrastructure and set the network parameters. Rules will be governed by the community rather than by individual business networks but will only address global issues, not business network-specifics.

2. Why would a business network operator choose to join a Segregated Network?

Pros

Privacy and some control: A Segregated Network is most suitable for Business network operators with membership privacy requirements[7] and / or who require control over the software upgrade schedule, and who wish to keep open the option of merging with Corda Network later.

Interop is possible: A Segregated Network can merge with Corda Network in the future, when they wish to benefit from transacting with a wide group of parties. However, the merging process will require agreement and coordinaton - and will remove the privacy and control benefits of the segregated network.

Cost, effort and time to set up: The joining process is very similar to Corda Network. There is an annual participation fee for all. Cost advantages will depend on the Business network operator's requirements and abilities.

Cons

Control: As the segregated network is governed, at least in part, by the Corda Network Foundation, the business network operator cannot control location of *some* services and infrastructure (Network Map, Identity Manager, trust root), location of the governing body (Foundation), or even have guaranteed full control over membership.

[7] Meaning that visibility (of IP address and legal entity name) on the Network Map is restricted only to members of that business network rather than across the whole Corda Network

© Copyright - R3

The business network operator must also account for the time, effort and costs for set-up and operation of the notary (as they cannot share the Corda Network notary).

3. Why would a business network operator choose to set-up and run a private network?

Pros

Control and privacy: A private network is suitable for Business network operators who require full control of all features. These requirements could include controlling:

- Location of governing entity, all rules and administration
- Location of notary operator
- Location of shared services infrastructure and data, including the Trust root
- Commitments to Service Levels
- How identity issuance is determined i.e. full control of membership

Like a Segregated Network, a private network *also* allows a Business network operator to have control over:

- Membership privacy - who sees your IP address + certificate name
- Who can receive transacitons and copies of transaciton history to check provenance of data
- Network parameter and network version upgrade policy

Cons

Interoperability may be challenging:
It is important to clarify that setting up a private network will also limit a Business network operator's ability to merge with other networks (including Corda Network). States created in one network (under one trust root) cannot be transacted on another (under a different trust root). However, a variant of interoperability, through bridging, may be possible.[8]

Time and effort to set up is more arduous. Possibly cost.
Depending on the scope and scale of the network required, the cost, time and effort of setting up a private network may include:

- Setting up their own trust root (or commissioning this from someone else).
    - We estimate that setting up our own Trust Root cost approximately $85,000 and one man-year of effort. Commissioning this from someone else may be less than half this price
- Setting up an Identity Manager and Network Map
    - Using the Corda Enterprise Network Manager (for pricing, contact R3 sales).

[8] ***Interoperability bridging*** - is communication between existing networks using intermediaries who bridge the two networks

© Copyright - R3

The Corda Enterprise Network Manager is a new product intended to allow private network operators to create and operate their own Identity Manager and Network Map. It is licenced and fully supported.

- Creating their own Notary
- Employing a global operations team to monitor and run the shared services
- Setting up and running governance – including setting up legals and policies related to this.

© Copyright - R3

Table to help with decision-making

When first speaking with an interested client, an R3 employee could walk them through these questions to help figure out what kind of network is the best for their needs:

How important is...?	Scoring
1. **Shared common standards to achieve greater 'interoperability':** The ability to seamlessly transact with nodes in other business networks, now or in future	Very important – CN (Quite) important – SSZ Not important - PN
2. **A Public directory:** The ability to find other nodes in a 'Network Map' – including and outside of your business network (legal entity name and IP address)	Important - CN Not important – SSZ / PN
3. **Network deployment**: **overall** - Does your team have the time and expertise to set up and run your own network? *Will require digging in detail on network design features with the client, including exploring CENM and network operations*	No – CN / SSZ Yes – possibly PN
Network deployment: notary: Do you intend to run your own notary / use the Corda Network notary (and why)? Reasons to run own notary could include • Cost (v high volume of transactions) • Previous expertise in doing so Does this notary need to be exclusive to your business network?	CN Notary – CN Own notary – ALL Exclusive – PN / SSZ
4. **Sharing services and infrastructure or controlling everything**: Can you have some infrastructure or services run by a third party, or is it vital that you / your business network controls all features of your network? (list kinds of control in #2, below.)	Very important – PN (Quite) important – SSZ Semi/not important - CN

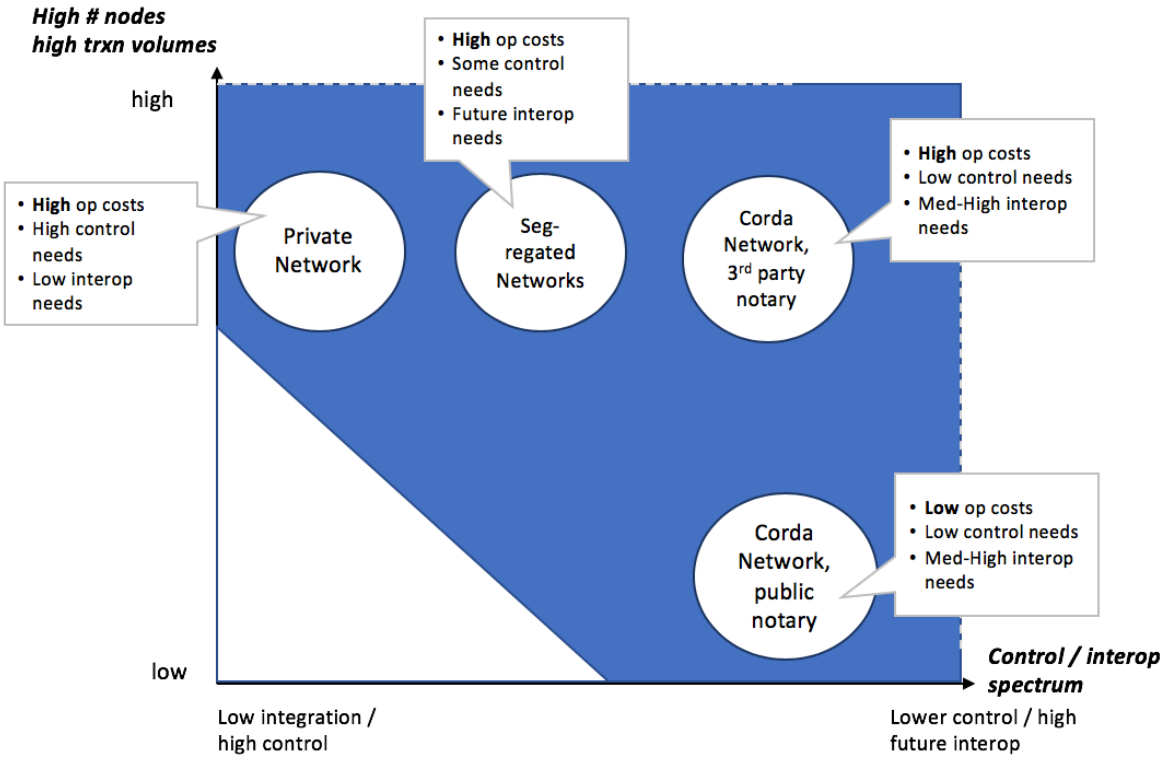
© Copyright - R3

Category	Questions	Private Network	Segregated Network	Corda Network
1. Greater Interoperability	*Can I transact with other business networks, now / in future?*	No (although interop bridging may be possible)	Yes (will require bridging or merging)	Yes
2. Public directory	*Is membership visible on the global Network Map?*	No [9]	No (would if it merged with Corda Network) [10]	Yes
3. Ability to use shared infrastructure	*Do I have control of membership / certificates?*	Yes	No (but has control on BN membership)	No (but has control on BN membership)
	Can I control all policies and the governing body?	Yes	No (but has control on BN policies)	No (board has a majority of customer Directors)
	Do I have control over the location of infrastructure?	Yes	Partial (has control of notary locations)	No unless I run my own notary
	Can I control the location of governance body?	Yes	No (only the Business network Opertor)	No (only the Business network Opertor)
	Can I control the software upgrade policy, including schedule?	Yes	Yes	No (board has a majority of customer Directors)
	Can I control my reliance on third parties?	Yes	No	No
	Can I control response / service levels ?	Full	Partial (notary)	Partial (notary)
	Do I have the ability to run my own notary?	Yes	Yes	Yes
4. Time / effort / cost of deployment	*How long does it take to set up the network?*	Slow (depends on the sophistication of the governance required)	Medium-fast (need to set up own notary)	Fast; all components already set-up
	How expensive is it to set up the network?	Will depend on what features are required. May include CENM, notary, trust root – depending on scale and scope	Notary set-up	Annual participation fee + transaction fees
	Access to shared notary?	No	No	Yes

[9] If they use the CENM software or an alternative that supports a network maps

[10] If a malicious participant gets access to the Network Map url, this may become an issue later and hence 'privacy' may only be partially met

© Copyright - R3



© Copyright - R3

About R3

R3 is an enterprise blockchain software firm working with a global ecosystem of more than 300 participants across multiple industries from both the private and public sectors to develop on Corda, its open-source blockchain platform, and Corda Enterprise, a commercial version of Corda for enterprise usage.

R3's global team of over 200 professionals in 13 countries is supported by over 2,000 technology, financial, and legal experts drawn from its global ecosystem.

The Corda platform is already being used in industries from financial services to healthcare, shipping, insurance and more. It records, manages and executes institutions' financial agreements in perfect synchrony with their peers, creating a world of frictionless commerce.

Learn more at r3.com and corda.net

Locations

New York
11 West 42nd Street, 8th Floor, New York, NY 10036

London
2 London Wall Palace, London, EC2Y 5AU

Singapore
18 Robinson Road, Level 14-02, Singapore 048547

Brazil
Av. Angélica, 2529 - Bela Vista, 6th Floor São Paulo - SP, 01227-200, Brazil

Hong Kong
40-44 Bonham Strand, 7F Sheung Wan, Hong Kong

© Copyright - R3