Data Confidentiality -

The core idea of blockchain is collaboration based on shared data ownership, governance and operations. The major difference from centralized system architectures is that peers, collaborating in a network, can continue using their own systems and technology stack without the need to integrate them in the classical way. Instead, blockchain provides a shared data layer that allows these systems to interoperate on top and acts as the single truth.

As a result, the network has no single authority, which owns the data or controls the systems. The decentralization of the ledger means a decentralization of power. No single participant can decide to prohibit access or shut-down the infrastructure. This reduces control of intermediaries in many multi-party scenarios. Nevertheless, you would want to ensure transactional consistency across companies and data confidentiality.

There are many events occurred in the VaccineLedger, some key events are listed down below:

1. Organization onboarding
2. New user/employee signup
3. Adding inventory
4. Creating and processing orders
5. Creating, sending and receiving shipments
6. Updating shipment status throughout its journey
7. Administering a vaccine at the last mile
8. Monitoring and reporting alerts related to temperature, location etc.

These events generate a lot of data and involve different stakeholders.

To simplify the usage of blockchain per data type or event basis, a table is provided below. It is recommended to not store the data or events marked as DO NOT STORE.

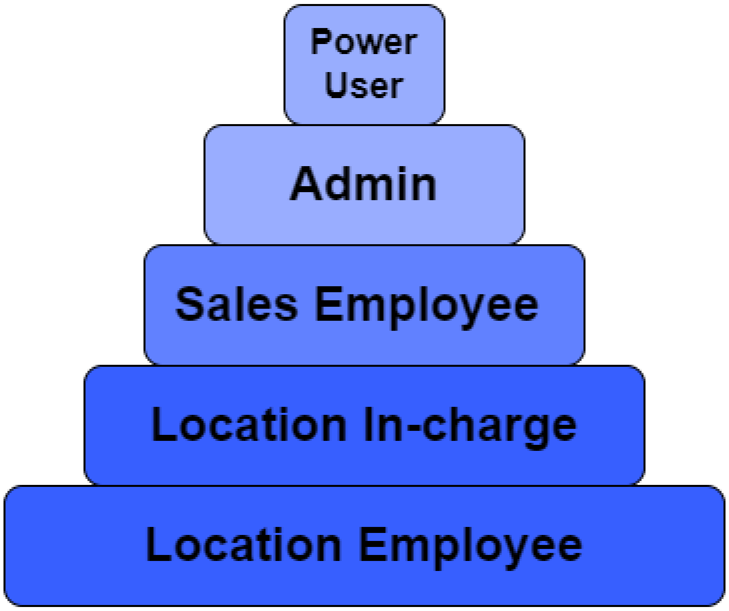
Data/Event	**Blockchain**		**Centralized Database**
	Public	**Private**	**NOSQL/SQL**
User Information Like Phone number, email address	DO NOT STORE	NO	YES

User Information Like Wallet address, organization name etc.	YES	YES	YES
Organization Information like	YES	YES	YES
Phone number, address etc.			
Product information like name of product, type of product, other attributes	YES	YES	YES
Product information like pricing	NO	YES	YES
Product quantity in the inventory	NO	YES	YES
Orders created, processed	NO	YES	YES
Shipments Created, shipped, received	NO	YES	YES
Alerts configuration for the users	NO	NO	YES
Alerts generated	YES	YES	YES
User Activities	NO	NO	YES
Last Mile related information like identification number, name, phone number, email	NO	NO	YES
Last Mile Cryptic Information	YES	YES	YES

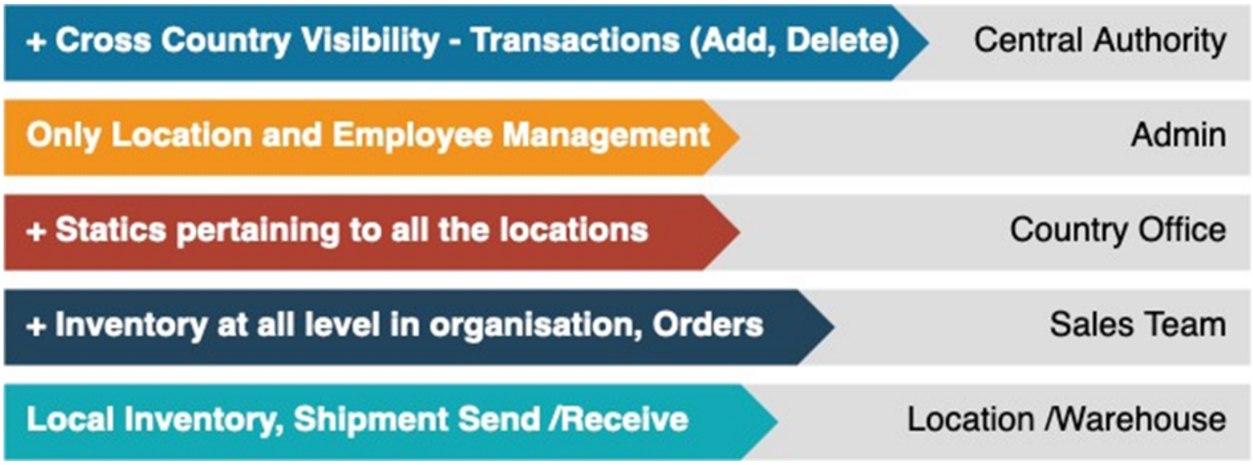
As VaccineLedger involves multiple stakeholders and each stakeholder has its own hierarchy and permission control for its employees, It is necessary to devise one more layer to enhance data fencing in the private blockchain and centralized database.

VaccineLedger archives these data segregation and protection between the employees and users of different organizations by using a customizable “Role Based Access Control” (RBAC). All the read requests to the blockchain are validated by these RBAC rules, and it prevents unauthorized access to the data. A default set of rules for VaccineLedger is given below, however in the customer version, these rules are customized while first deployment.

The default hierarchy used in designing the RBAC is shown below:



As VaccineLedger involves participants from different entities and some entities are spread in different geo locations, the inherited organization – location design embedded in the VaccineLedger takes care of data fencing. A high level data ring design is shown below:


+ Cross Country Visibility - Transactions (Add, Delete)
Central Authority
Only Location and Employee Management
Admin
+ Statics pertaining to all the locations
Country Office
+ Inventory at all level in organisation, Orders
Sales Team
Local Inventory, Shipment Send /Receive
Location /Warehouse

Data Captured -

Create Order - Manual or Import	
Select Product Category	The user would have to select the type of product category they desire
Product Name	Select the product they wish to order
Product ID	Product ID will be mapped in the backend
Manufacturer	Manufacturer will be mapped to the product
Quantity	The user would have to enter the required product quantity
Unit of Measure	Unit of measure is mapped to the product
From Organization Type	User will select the type of organization
From Organization Name & ID	User will select from where they want to order
To Organization Type	User will select the type of delivery organization
Region & Country	Select the region and country of delivery
To Organization Name & ID (Delivery Location)	Select the delivery location (ID mapped to the location)

Add Inventory - Manual or Import	
Product Category	User will select the Product category
Product Name	User will have to select the product name
Product ID	Product ID will be Mapped to the product
Manufacturer	Manufacturer will be mapped to the product
Batch Number	User will have to enter the batch details of the product being saved in the inventory
Quantity	User will have to enter the quantity associated with that batch
Unit of Measure	Unit of measure will be mapped to the product
Manufacturing Date	User will have to enter the product's Manufacturing Date
Expiry Date	User will have to enter the product's Expiry Date
Serial Number	User will enter the product's serial number range

Create Shipment - Manual or Import	
Order ID	The user would have to select the Order ID

Reference Shipment ID	The user would have to fetch the previous shipment Reference ID
From Organization Name	Organization details will be auto-populated from the Order ID
From Organization Location	User will have to
To Organization Type	The user would have to enter the product quantity
To Organization Name	The user would have to select the product Unit of measurement
To Delivery Location	The user would have to select the Delivery Location
Delivery Details- Transit Number	The user would have to enter the Transit Number
Delivery Details- Shipment Date	The user would have to select the Shipment Date
Delivery Details- Label Code	The user would have to enter the Label Code
Delivery Details- Estimate Delivery Date	The user would have to select the Estimate Delivery Date
Product Category	The user would have to select the product category
Product Name	Select product name/ID
Manufacturer	Product will be mapped to the manufacturer
Quantity	The user would have to enter quantity required
Unit of Measure	UOM will be mapped to the product
Batch Number	The user can either enter the serial number manually or fetch it from the product list in the Inventory