

Infosys supply chain traceability solution with Azure Cosmos DB Graph, Azure Integration and Platform Services

APPLIES TO:  Cosmos DB  Azure API Management  Gremlin API  Event Hub  App Service Plan  Infosys Traceability  Infosys Cobalt

This article provides an overview of Infosys traceability graph solutions that leverage Azure Cosmos DB graph and other Azure capabilities to provide global supply chain track and trace capability for finished goods.

After reading this article, you will be able to understand:

- What is traceability in the context of the supply chain?
- Solution design of a global traceability solution delivered using Azure Capabilities.
- How can the Azure Cosmos DB graph help intricate relationships between raw material and finished good in a global supply chain?
- How do Azure Integration Platform Services (API Management, Event Hib etc.) help integrate diverse supply chain application ecosystems?
- How can you get help from Infosys to leverage this solution for your traceability need?

Introduction

In the food supply chain, product traceability is the ability to 'track and trace' them across the supply chain (supply, manufacturing, distribution) throughout the product's lifecycle (farm to fork). Traceability is vital for food safety, brand, and regulatory exposure. In the recent past, after a quality incident, many- organisations failed to track and trace products effectively in their supply chain, resulting in expensive recalls, fines, and consumer health issues.

Infosys traceability solution, developed with Azure Cloud capabilities such as application services, integration services and database services, provides vital capabilities to:

- Connect to Factories, Warehouses/distribution centres etc.
- Ingest/process parallel stock movement events

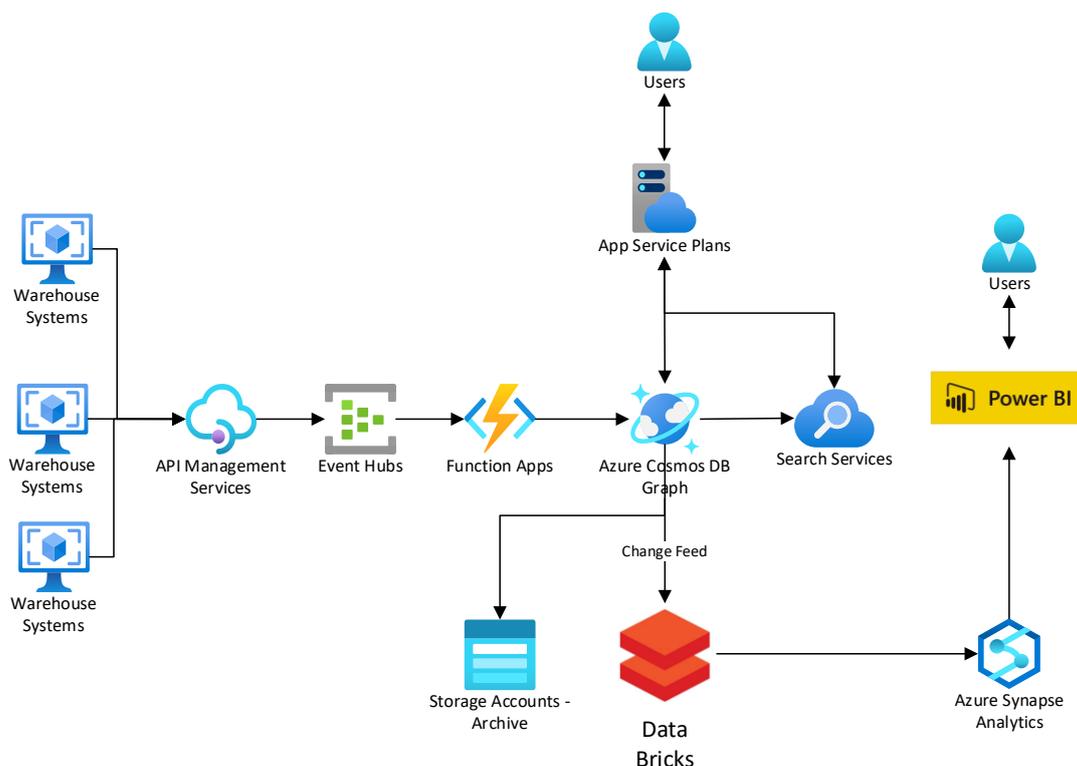
- A knowledge graph which shows connections - raw material, batch, finish goods (FG) pallets, multi-level parent/child relationship of pallets, good movement etc.
- A traceability user portal (not Azure portal) with search to Track & Track pallets
- Identify impacts of a quality incident – impacted raw material batch, pallets affected, location of the pallets etc.

Solution Architecture

Supply Chain Traceability commonly shares patterns in ingesting pallet movements, quality incidents handling, and store data for traceability and analytics. First, these systems need to ingest bursts of data from Factory/WMS systems usually spread across geographies. Next, these systems process and analyse streaming data to derive complex relationships between raw material, production batches, finished good pallets and very complex parent/child relationships (co-pack/repack etc.). Then the system requires to store intricate relationships between raw-material, finished goods items, pallets necessary for traceability. A user portal with search capability allows the users to track and trace products in the supply chain network.

Microsoft Azure offers rich services that can be leveraged for traceability use cases, including Azure Cosmos DB, Azure Event Hubs, Azure API Management, Azure App Service, Azure SignalR, Azure Synapse Analytics, and Power BI.

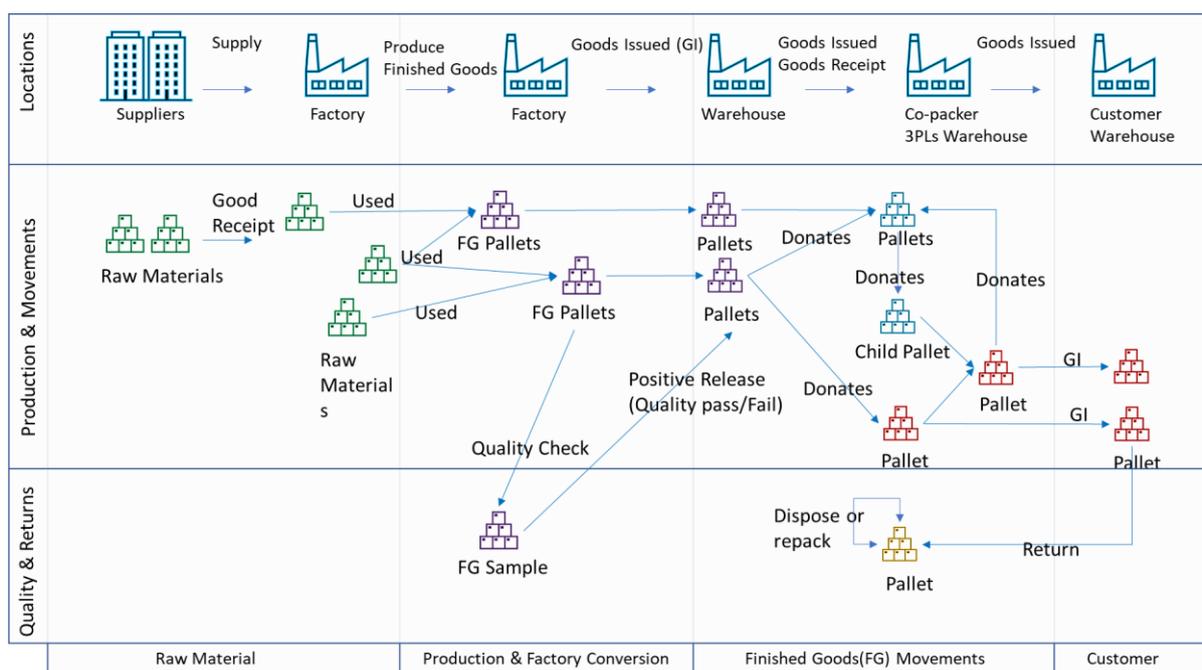
Infosys traceability solution provides a pre-backed solution that customers can leverage to improve track and trace capability.



- Azure Cosmos DB allows performance to be scaled up or down elastically. Cosmos DB Graph allows to create and query complex relationships between raw material, finished goods and warehouses.
- Azure API Management provides APIs for stock movement events to the 3PLs (3rd Party Logistic Providers) and Warehouse Management Systems (WMS).
- Azure Event Hub provides the ability to gather large numbers of concurrent events from WMS and 3PLs for further processing
- Azure Function Apps processes events and ingest data to Azure Cosmos DB using graph API
- Azure Search service allows users to do complex to find/filter pallet information
- Azure Databricks read change feed and create models in Synapse Analytics for self-service reporting for users (in Power BI)
- Azure Web App and App Service plan allow us to deploy the user portal
- Azure Stage Account stores archived data for long term regulatory needs

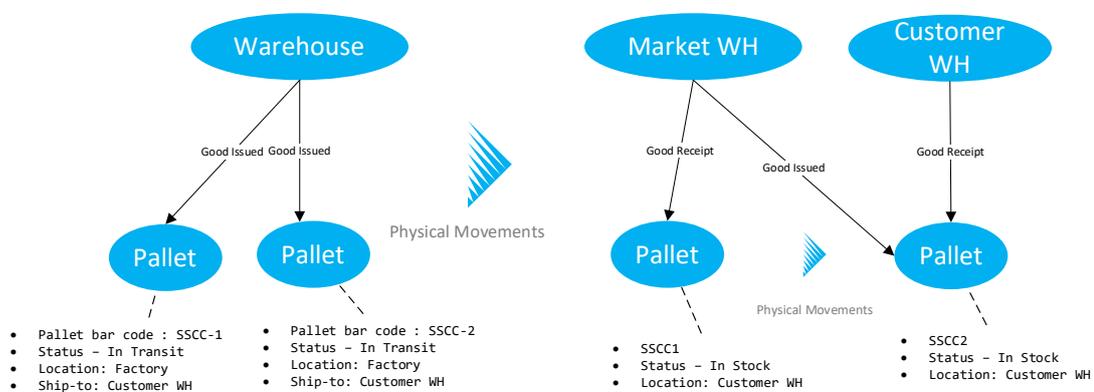
Why a Graph DB and its Data design

The production and distribution of goods require maintaining a very complex and dynamic set of relationships. An adaptive data model of our traceability graph allows storing such relationships starting from the receipt of raw material, manufacturing the finished goods in a factory, transferring to different warehouses during the supply chain, and finally transferring to the customer warehouse. Very high-level visualisation of the process could be:

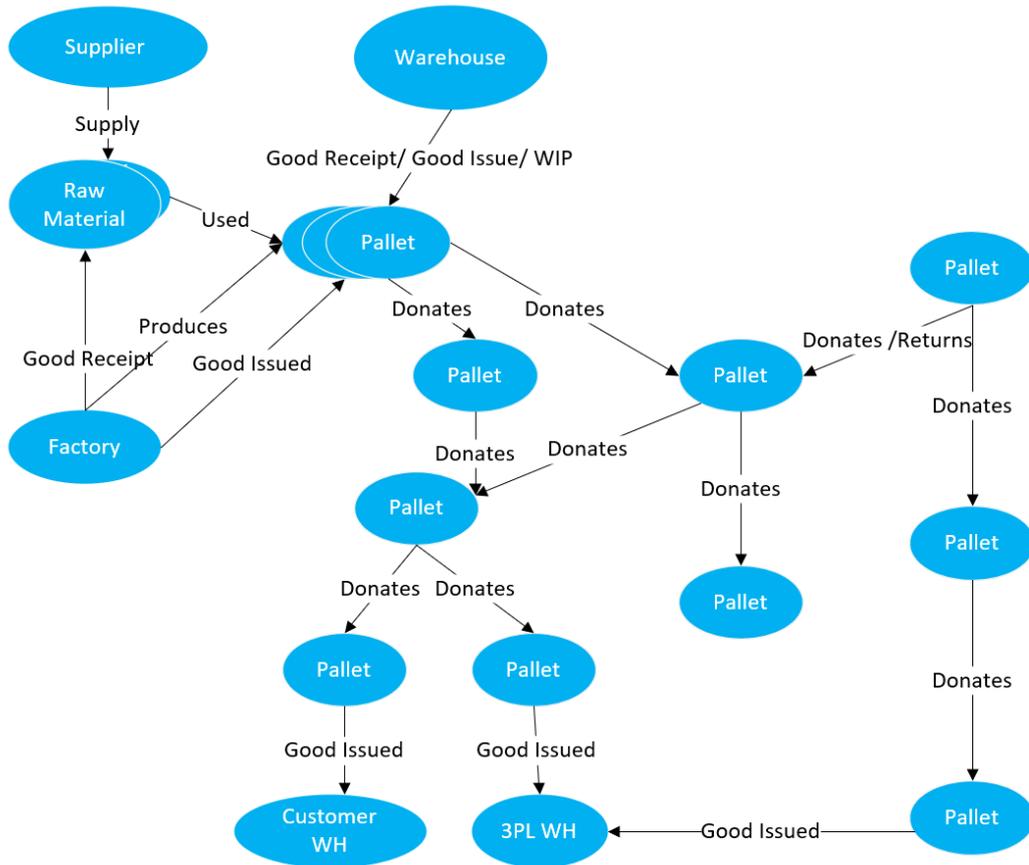


The above diagram shows a very high level and simplified view of a very complex supply chain process. However, getting the vital stock movement information from the factories and warehouses in real-time makes it possible to create an elaborate graph that connects all these disparate pieces of information.

- The traceability process starts when the supplier sends raw materials to the factories, and the initial nodes (vertices) of the graph and relationships (edges) gets created.
- The finished goods (Items) are produced from raw materials and packed into pallets.
- Pallets then moved to factory warehouses or the market warehouses as per customer demands/orders.



- The warehouse could be of company's owned or 3PL (3rd Party Logistic Providers). The Pallets are then shipped to various other warehouses as per customer orders. As per customer demands – child pallets or child-of-child pallets are created to accommodate ordered quantity. Sometimes, a whole new item is made by mixing multiple items (For example, in a co-pack scenario that produces a variety pack). Sometimes, the same item gets repacked to smaller or larger quantities to a different pallet as part of a customer order.
- Pallets then travel through the supply chain network and eventually reaches the customer warehouse. During that process, the pallets can be further broken down or combine with other pallets to produce new pallets to fulfil customer orders.
- Eventually, the system creates a complex graph that holds vital relationship information for quality incident management, which we will discuss shortly.



- These intricate relationships are vital in a quality incident where the system can track and trace pallets across the supply chain. Graph and graph traversals provide the required information for this. For example, if there is an issue with one raw material, the graph can show the impacted pallets, current location.

How Infosys and Microsoft can help:

- The pre-configured platform using Azure services and Infosys Cobolt solution
- Infosys commodity graph framework with ingestion and traceability traversals and algorithms.
- Infosys consulting service to conceptualise the business solution and create the business case.
- Infosys cloud-native integration service to connect factories and warehouses with simple & standardised APIs.
- Infosys cloud-native integration service to enable massive event processing at a global scale.
- Infosys data services for predictive and prescriptive analytics.

Useful links

- [Infosys Traceability Graph](https://azuremarketplace.microsoft.com/en-us/marketplace/apps/infosysltd.infosys-traceability-knowledge-graph?tab=Overview) (https://azuremarketplace.microsoft.com/en-us/marketplace/apps/infosysltd.infosys-traceability-knowledge-graph?tab=Overview)
- [Infosys Cobalt](https://www.infosys.com/services/cloud-cobalt/) (https://www.infosys.com/services/cloud-cobalt/)
- [Market place - Infosys Cloud-Native Integration](https://azuremarketplace.microsoft.com/en-in/marketplace/apps/infosysltd.infosys-integrate-for-azure) (https://azuremarketplace.microsoft.com/en-in/marketplace/apps/infosysltd.infosys-integrate-for-azure)