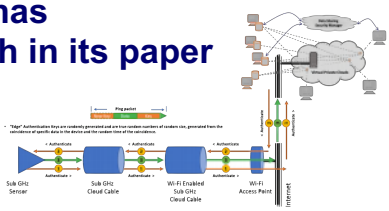
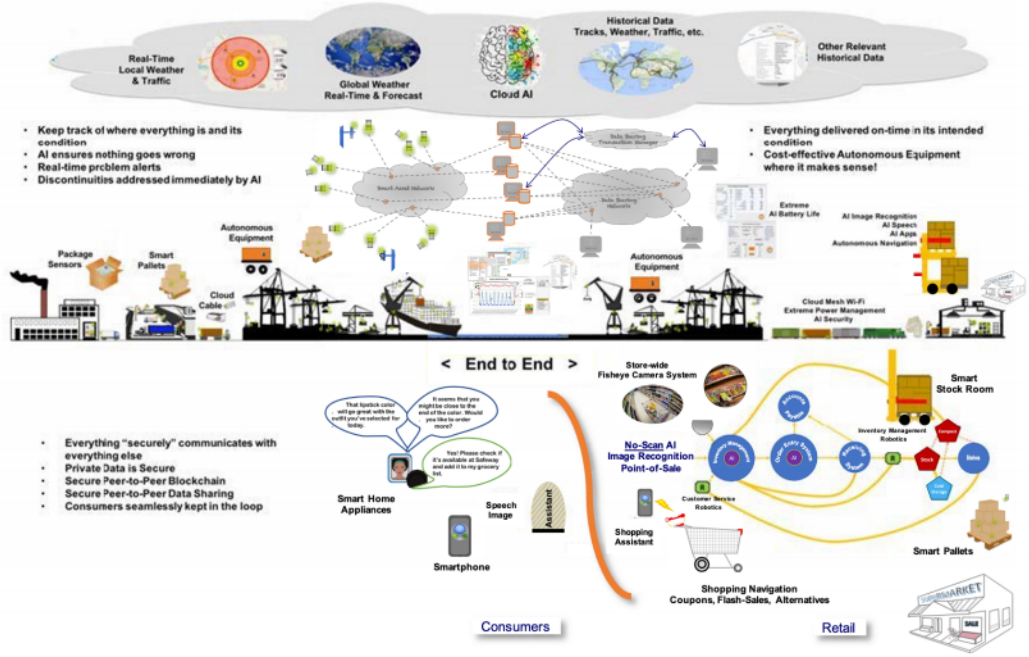
Smart Supply Chain Technologies'
Smart Logistics and Smart Supply Chain Assets Model

Many of the Global Supply Chain's cargo tracking and monitoring needs can be satisfied simply by supply chain constituents sharing their private chain-of-custody data. This method has long been appreciated by supply chain constituents as the most available and cost-effective method of tracking and monitoring cargo moving through the supply chain, but its use has been stymied by data privacy and mutability concerns. Today's widespread and growing confidence in the security and immutability of Blockchain Technology, showcased in its cryptocurrency use, will release that pent-up demand. Secure, cost-effective, and seamless Permissioned-Blockchain Data Sharing is a market inflection point that will be the technology of choice for applications and services whose users demand integrity and privacy for their data.

The high-end segment of the cargo tracking and monitoring market, which includes Smart Containers, broadly requires real-time data from devices in the field. That data requires at least three levels of data security: while it is being aggregated in the field, when sent to a designated data repository, and when shared with supply chain partners. S²CT has documented its in-the-field Blockchain-like approach in its paper Data Security in the Global Supply Chain(1) , so it will not be elaborated upon further here. Once data from the field reaches a designated private data repository, it can be securely shared with supply chain partners using Permissioned-Blockchain Data Sharing.

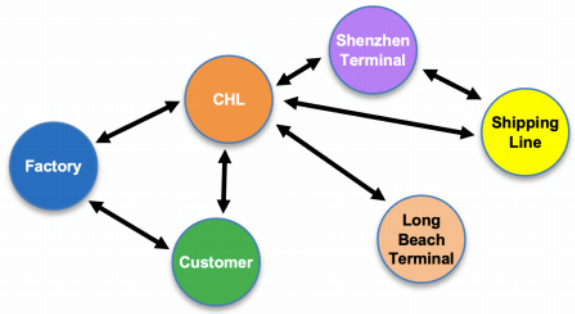




James W. Davis

This paper describes the foundation of S²CT's Smart Logistics and Smart Supply Chain Assets Model, the Permissioned-Blockchain Data Sharing Network, applied to tracking and monitoring a cargo as it moves through the supply chain. The following pages and illustrations intend to add clarity to the paper's description of the Permissioned-Blockchain Data Sharing Network and how dynamic ecosystems come together and operate.

Ecosystems are dynamic Permissioned-Blockchain Data Sharing Network connections between companies and individuals that want to share private data and communications. Ecosystems are self-annealing; each participant benefits from sharing of data. This paper will illustrate how that works and intuitively has value for each supply chain business partner. This hypothetical ecosystem begins with a customer placing an order for parts with a factory in China and expands across the supply chain as the need for sharing data and communications expands.



Each color represents a different ecosystem participant

Ecosystems will range from privately managed and maybe even persistent data-sharing networks to fully ad hoc dynamic ecosystems where participants come and go for logistics, inventory management, healthcare, fleet management, and many other applications.

The model's Permissioned-Blockchain Data Network Sharing Architecture allows users to develop and deploy simple, secure, and immutable Blockchain solutions or more sophisticated solutions compatible with industry components like Hyperledger and Smart Contracts for any industry.

The core Permissioned-Blockchain Data Sharing Network Software (BDSN) helps companies to join existing ecosystems or start their own. Ecosystem participants are either connected to a BDSN web-platform account or have installed BDSN edge software on a computer connected to the Internet with secure access to the private data repositories that hold the data they want to share. The BDSN handles on-demand access and retrieval of data from those data repositories for inclusion in Blockchain blocks it generates. The BDSN generates and manages block hash code creation and validation, encrypts and decrypts block content, and interacts with a Transaction Manager in the cloud to manage block distribution, permissions and keys. The model uses a Secure Hash Algorithm to generate a hash code for the block content before its encrypted. The block's content is encrypted before being released to the ecosystem with its public encryption key. Ecosystem

participant BDSN, working with the Transaction Manager, validates each block's hash code and permission. The Transaction Manager manages and provides the private encryption key to only ecosystem participants given permission to view a block's content by the block's originator.

In this example, ecosystem participants generate and view the Blockchain's blocks as the cargo from the China factory moves through its chain-of-custody journey. That Blockchain illustrated below uses the same color code used in the ecosystem diagram to make clear which ecosystem participant generated which Blockchain block. Note that block permissions, allowing selected ecosystem partners to decrypt and view block content, are set by the ecosystem block author and can include all ecosystem participants or just one.

The example reflects a customer in America placing an order for electronic parts with a factory in Shenzhen, China. The factory consolidates that customer order, packed in a box, with other packages being shipped to customers in America on a pallet. The factory created a new Blockchain-block on the Blockchain when the customer placed the order for the parts and gave permission to a local logistics company, CHL, to view its contents. That essentially begins the cargo's Blockchain chain-of-custody journey from the factory in China to the customer in America. At this point, the ecosystem has three participants, the customer, the factory, and CHL, and there are two copies of the single block Blockchain, one at the factory and a second at CHL.

CHL expands the Blockchain by adding another block that tracks the pallet change-of-custody as it moves from the factory shipping dock into a CHL express vehicle for its journey to the CHL Distribution Center. The CHL express driver scanned the pallet barcode into the CHL ecosystem database.

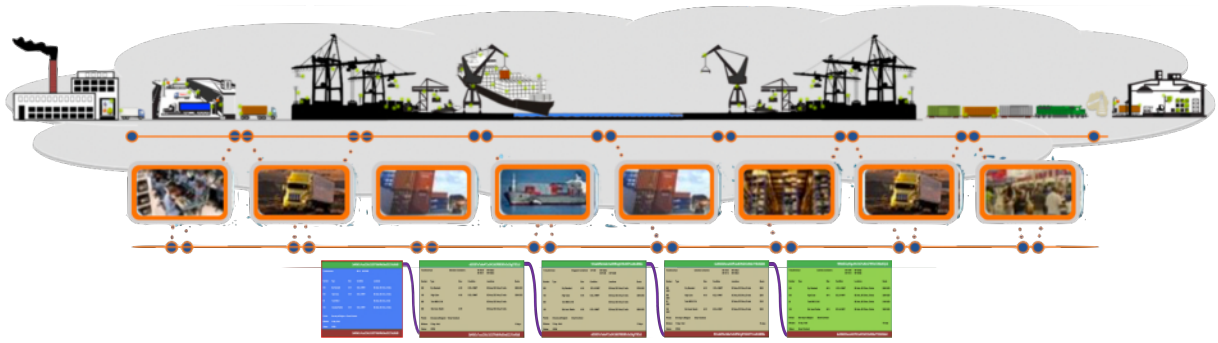
At the CHL Distribution Center, the pallet is loaded into a container with other cargo destined for the Shenzhen Shipping Terminal and eventually to the Port of Long Beach in America. This part of the journey and change-of-custody is reflected in the Blockchain by the next few blocks added by CHL. The Shenzhen Shipping Terminal joined the Ecosystem when CHL generated a Blockchain block indicating that the container was on its way to the terminal and gave the terminal permission to view its contents. The Shenzhen Shipping Terminal acknowledged that the container arrived at their terminal yard by adding a block to the Blockchain containing that information. The Shenzhen Shipping Terminal adds another block to the Blockchain when its personnel loads the container onto a waiting ship bound for the Port of Long Beach. The Shipping Line adds blocks to the Blockchain when the container is loaded onto their ship and another when

it departs the Shenzhen Shipping Terminal. In the example, the Shipping Line does not update the geospatial position of its vessel as it makes its way from Shenzhen to Long Beach but could have by periodically adding blocks with that information to the Blockchain.

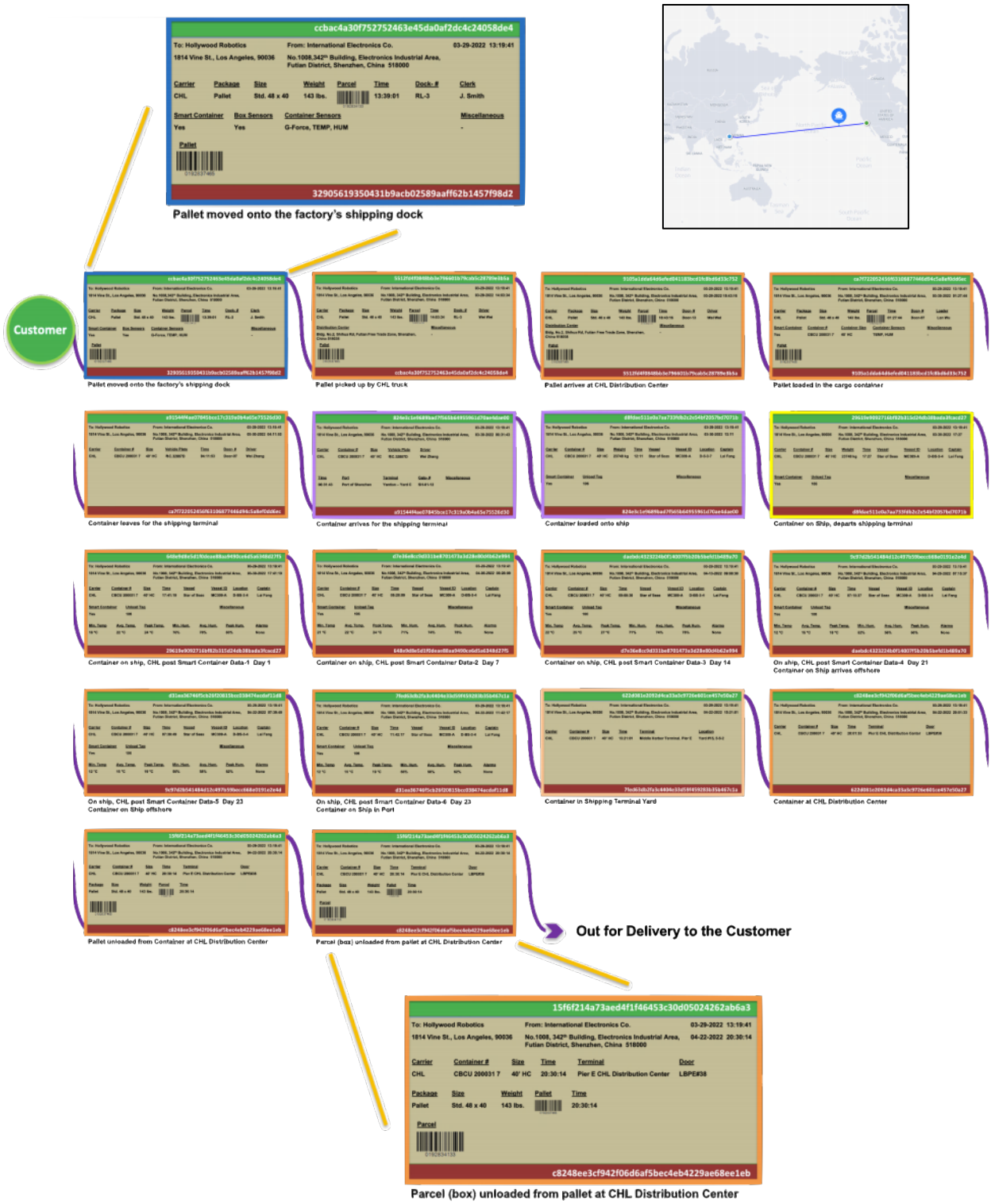
For illustrative purposes, this example also illustrates a CHL Smart Container onboard the ship, above deck, with open communications, that periodically sends data, including its geospatial location, to CHL. CHL selectively shares the Smart Container's location data with selected, permissioned ecosystem participants in Blockchain blocks it adds to the cargo Blockchain. CHL leverages its private data from one of its Smart Containers by securely sharing it with its customers and business partners for its competitive advantage.

The journey and Blockchain continue when the container is unloaded from the ship at the Long Beach Terminal Shipping Yard and taken to the shipping terminal CHL Distribution Center for further handling. The pallet that started in Shenzhen, on the factory shipping dock, is unloaded from the cargo container at the CHL Distribution Center. Eventually, the pallet that the Blockchain was tracking and monitoring, to this point, is unpacked in the distribution center, and the factory customer's box resurfaces. This Blockchain example ends here, for brevity, as it is easy to imagine the additional Blockchain blocks that track the box to the factory customer's door.

Track, monitor, and manage anything from anywhere to anywhere with secure cost-effective Blockchain Technology!



Blockchain Across the Global Supply Chain



(1) Data Security in the Global Supply Chain, Davis et al., https://s2ct.tech/whitepaper-data-security-in-global-supply-chain