THE ROLE OF INTRALOGISTICS IN THE PHYSICAL INTERNET

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LET’S START THIS PRESENTATION WITH A FEW DEFINITIONS

• I define:

1. Intralogistics as those processes, procedures, systems and tools used to operate and manage the movement of material within the “four walls” of an operation

2. The Physical Internet as a vision of how physical objects might be moved via a set of processes, procedures, systems and mechanisms from an origin point to a desired destination in a manner analogous to how the Internet moves packets of information from a host computer to another host computer
TO UNDERSTAND THE RELATIONSHIP OF INTRALOGISTICS WITH THE PHYSICAL INTERNET REQUIRES UNDERSTANDING THE FOUNDATION OF THE PHYSICAL INTERNET CONCEPT

**Logistics Web**
Set of openly interconnected physical, digital, human, organizational and social agents and networks aiming to serve efficiently and sustainably the logistics needs of people, organizations, territories and society

- **Realization Web**
  Realizing products
  *Interconnected open production, personalising & retrofit centers*

- **Distribution Web**
  Deploying, storing products
  *Interconnected open warehouses & distribution centers*

- **Mobility Web**
  Moving goods & people
  *Interconnected open unimodal & multimodal infrastructures, movers, hubs and transits*

- **Supply Web**
  Supplying goods
  *Interconnected open suppliers and subcontractors*

- **Service Web**
  Enabling and sharing access and usage of services rendered by goods & people
  *Interconnected open users and service providers*

Source: Montreuil, B. (2012), Physical Internet Manifesto ver. 1.11.1
THE PHYSICAL INTERNET IS BASED ON TWO FUNDAMENTAL CONCEPTS – JUST LIKE THE INTERNET

1. Standard sized packets switched and transported from host to host

See Kleinrock, L (1964), Communication Nets

2. Connection of independent networks operating based on independent concepts connected through routers and switches

See Roberts, L (1967), Multiple Computer Networks and Intercomputer Communication

Source: Huston, G., Interconnection, Peering, and Settlements

THIS ANALOGY BETWEEN THE INTERNET AND LOGISTICS OPERATIONS ASSOCIATES TRANSPORT NETWORKS WITH DIGITAL NETWORKS

Logistics Network

Digital Network

Analogical Similarity
LOGISTICS IS COMPOSED OF NUMEROUS INDEPENDENT NETWORKS SIMILAR TO THE MANY DIGITAL NETWORKS THAT MAKE UP THE INTERNET
IF THESE INDEPENDENT LOGISTICS NETWORKS COULD BE CONNECTED, THEN THERE WOULD EXIST A NETWORK OF LOGISTICS NETWORKS, A PHYSICAL INTERNET
THESE INTERCONNECTED NETWORK OPERATORS WOULD NOT HAVE TO ABANDON THEIR OWN NETWORKS, JUST INTEROPERATE WITH OTHER NETWORKS
STANDARDS ARE REQUIRED FOR PHYSICAL GOODS TO TRAVEL THIS NETWORK OF LOGISTICS NETWORKS
THE NEED FOR STANDARDS, PARTICULARLY CONTAINER STANDARDS, IS A CRITICAL CONCEPTUAL SUCCESS FACTOR FOR THE PHYSICAL INTERNET

Source: Montreuil, B. (2011), Physical Internet Manifesto ver. 1.10
THE CONNECTION BETWEEN THIS INTRODUCTION AND INTRALOGISTICS IS BASED ON THE CONSTRAINTS THAT LINKS AND SWITCHING NODES PLACE ON THE INTERNET
LINKS, LIKE TRANSPORT LANES, CONNECT SENDERS TO RECEIVERS FORMING THE ARCS OF THE NETWORK
WITHOUT LINKAGES SENDERS CANNOT SEND AND RECEIVERS CANNOT RECEIVE...

Source: http://creative.colorado.edu/~rami2897/dm1/digital-divide.html
...AND INADEQUATE LINK CAPACITY LEADS TO NETWORK CONGESTION
EVEN IF LINKAGES EXIST, THEIR CAPACITIES, AND THE PROTOCOLS USED, DETERMINE HOW FAST TRAFFIC CAN MOVE ON THE LINK

Source: Nielsen, J. (2016), Nielsen’s Law of Internet Bandwidth
AS INTERNET USE GROWTH ACCELERATES THERE IS INCREASING CONCERNS ABOUT LINK CONGESTION

Video Accounts for Half of Ever-Growing Internet Traffic
Estimated global IP traffic per month (in exabyte)

Source: Cisco Visual Networking Index
PACKETS MOVING OVER THE NETWORK REQUIRE ROUTING BETWEEN THE VARIOUS LINKS THAT LIE BETWEEN THE SENDER AND RECEIVER

Source: http://www.highteck.net/EN/Network/OSI_Network_Layer.html
ROUTERS AND SWITCHES ARE USED TO PERFORM DISASSEMBLY, SWITCHING, STORAGE AND REASSEMBLY OF MESSAGES. . .
. . . VERY MUCH LIKE CROSS DOCK OPERATIONS IN THE PHYSICAL WORLD
ROUTER CAPACITY (INBOUND AND OUTBOUND) AND SWITCHING SPEED (TRANSFER RATES) DETERMINES HOW FAST MESSAGES MOVE BETWEEN LINKS

THESE SPEEDS HAVE BEEN INCREASING, BUT ARE APPROACHING THEORETICAL LIMITS

Source: Stanford University
INTRALOGISTICS ACTS WITHIN THE CONNECTING NODES AS THE SWITCHING FABRIC THAT MOVES ENCAPSULATED GOODS BETWEEN INTERCONNECTED NETWORKS

Evolve from material to $\pi$-container transport, handling & storage means and systems

$\pi$-containers moving and storage means and systems, with innovative technologies and processes exploiting the characteristics of $\pi$-containers to enable their fast, cheap, easy and reliable input, storage, composing, decomposing, monitoring, protection and output through smart, sustainable and seamless automation and human handling.

Source: Montreuil, B. (2012), Physical Internet Manifesto ver. 1.11.1
BASED ON HOW FAST INTRALOGISTICS SYSTEMS WORK DETERMINES HOW FAST THE PHYSICAL INTERNET OPERATES, AND THE QUALITY OF SERVICE IT PROVIDES
STANDARDIZED CONTAINERS SHOULD ALLOW INTRALOGISTICS OPERATIONS TO OPTIMIZE THE DISASSEMBLY, STORAGE, REASSEMBLY AND TRANSFER OF GOODS

Multimodal logistics centers designed for the Physical Internet, enabling seamless, fast, cheap, safe, reliable, distributed, & multimodal transport and deployment of $\pi$-containers across the Physical Internet.

References

Source: Montreuil, B. (2012), Physical Internet Manifesto ver. 1.11.1
THESE FUNDAMENTAL AND ANALOGOUS OPERATIONS BETWEEN THE INTERNET AND PHYSICAL INTERNET ESTABLISH THE IMPORTANCE OF INTRALOGISTICS TO THE PHYSICAL INTERNET

A Supply Web with Myriads of $\pi$-Certified Suppliers, Open & Global Access, Standardized Contracts, Open Monitoring and Supplier Ratings

Multi-tiered, from raw materials to final products

Each exploiting the Mobility, Distribution & Realization webs

Source: Montreuil, B. (2012), Physical Internet Manifesto ver. 1.11.1
HOWEVER, WE ARE LONG WAY FROM REALIZING THE VISION OF THE PHYSICAL INTERNET
FORTUNATELY, THE ADVANCES BEING MADE IN THE WORLD OF INTRALOGISTICS ARE ENCOURAGING
WHAT IS STILL NEEDED IS THAT SET OF VISIONARIES WHO, LIKE MALCOM MCLEAN, HAVE THE VISION AND DETERMINATION TO CREATE A DIFFERENT FUTURE FOR LOGISTICS
THANK YOU FOR YOUR ATTENTION!