

Electronic Tracking in Logistics.

Are We Truly on the Edge of a Break Through?

ULD Care Symposium
October 2018

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A bit of Background

- CORE has over ten years supporting barcode scanning systems:
 - Over 1000 scanners deployed
 - All supported remotely
 - International and domestic US mail
- The point: we are very familiar with scanning;
 - Do we like scanners: no
 - Expensive
 - Manual
- BLE designed to reduce manual scanning cost and eliminate errors / fraud in scanning networks.
- It started in 2015 so this was no easy ride.

Competing Technologies:

- But It Is Not Just About The Tag Cost.

- RFID:
 - Passive tag – a few cents
 - Infrastructure costs extremely high
 - Range low (<2m)
- Barcode scanning:
 - Cheap tags
 - Expensive infrastructure
 - Manual labour
- Low Power Wans (LoraWAN, SIGFOX, NBIoT, LTE):
 - Cheap back haul (the connection to the internet [cloud])
 - Expensive tags (needs GPS for location services)
 - Poor battery life
 - Don't work indoors
 - In some cases very restricted bandwidth
 - Range high (> 2km)

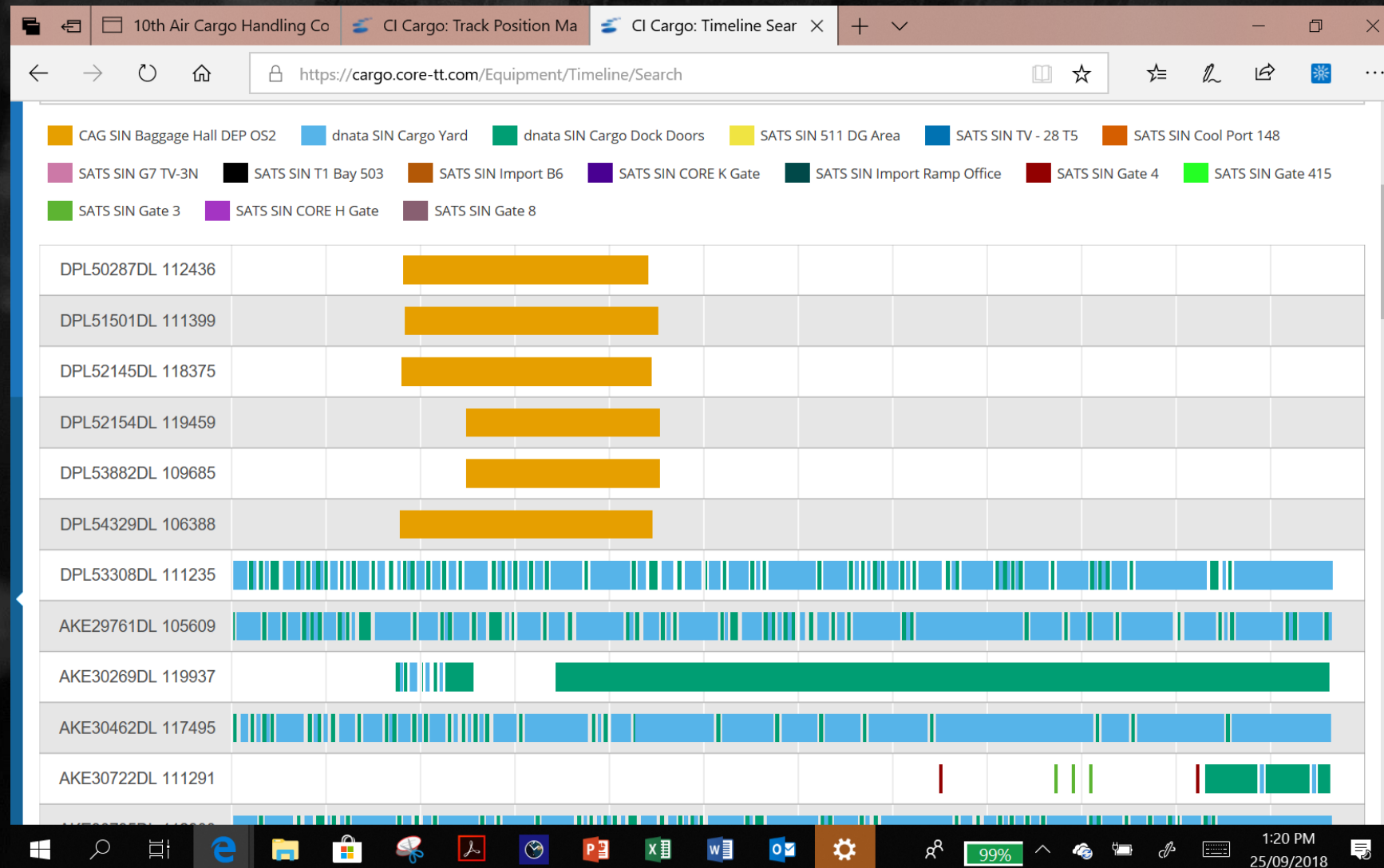
Competing Technologies, cont.

- Bluetooth Low Energy ("BLE")
 - Cheap tags – battery lasts years
 - Can use any backhaul network
 - Local processing power
 - Can be configured not to transmit on aircraft
 - Range medium (0.5-0.8km BLE5)

Does BLE Work? Yes.

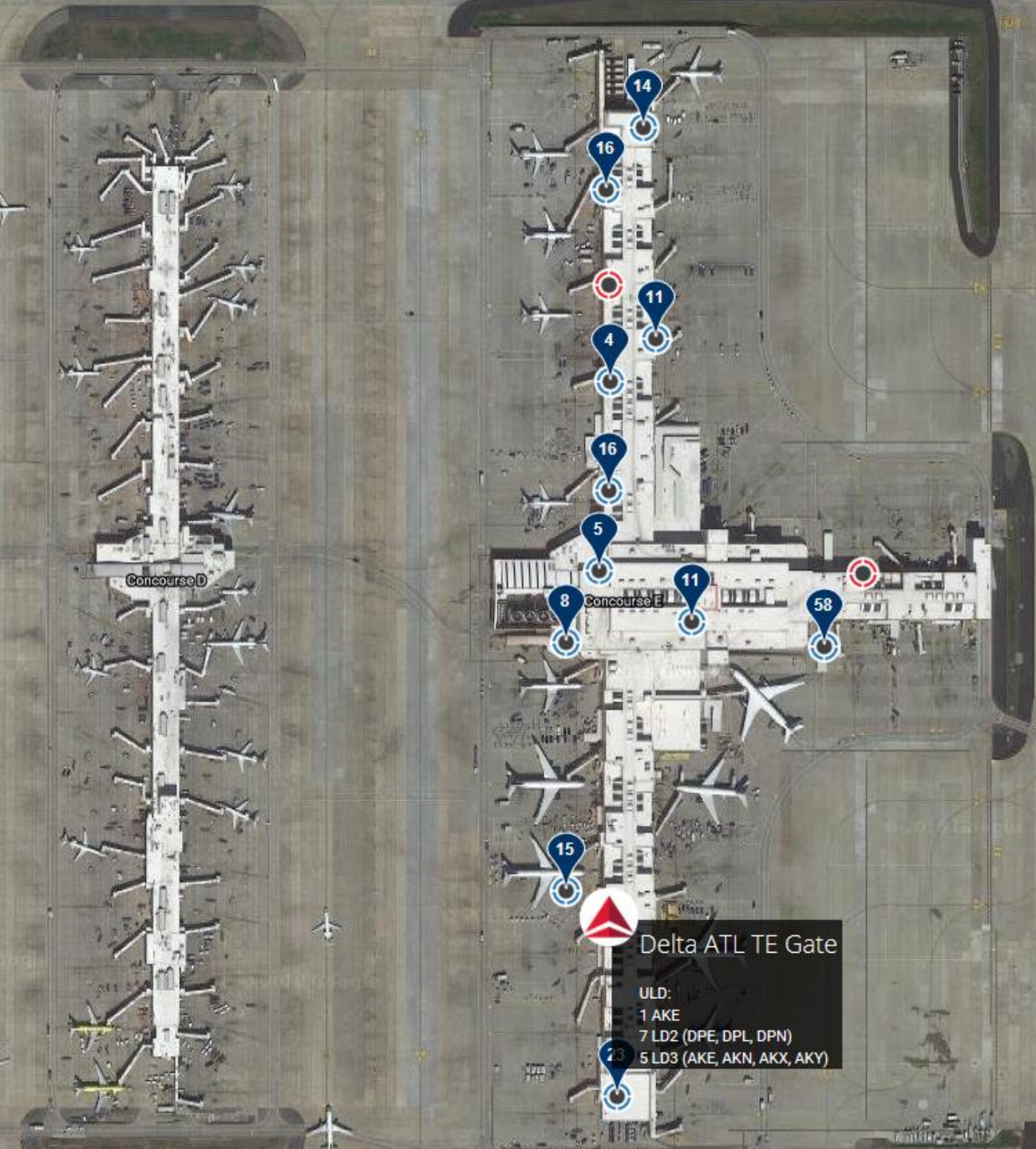


Location Tracking in Real Time



A number of large airports already operational

e.g., AKL, AMS, ATL, EWR, HKG, JFK, LAX, NRT, SEA, SFO, SIN, etc



Delta ATL TE Gate

ULD:

1 AKE

7 LD2 (DPE, DPL, DPN)

5 LD3 (AKE, AKN, AKX, AKY)



Two Domains

- Original focus was ULD but quite a bit of attention being put on GSE at a number of airports worldwide.
- ULD and GSE - similar but not the same technical requirements
- ULD:
 - global – the solution has to work in every location in the supply chain.
 - “relatively” slow moving (allows longer tag sleep times)
 - requires silent mode on aircraft
- GSE:
 - local – a choice at one airport has minimal impact on other airports
 - “relatively” fast moving (requires smaller tag sleep times)
 - need to know whether a dolly is occupied by a ULD
 - ideally need to know which ULD is on which dolly
- Ideal would be a unified ULD and GSE tracking

Other Use Cases in Logistics

- Examples
 - Pharma
 - Animals
 - Perishables
 - Food carts,
 - etc.
- Once the network is enabled it works for all. It is agnostic to the party that caused it to be there, the type of item being tracked and the owner.
- However these uses require ever more sophisticated tags and communication protocols:
 - Precise temperature
 - Shock
 - Humidity
 - etc

Business Benefits

- **Asset Management:**

- Already showing benefits (45 off network ULDs identified for AirNZ in one week)
- Elimination of numerous manual inputs
- Elimination of manual stock takes
- Actions taken in near real time.

- **Quality of Service**

- ULDs are a trackable asset that can be associated with freight (AWB):
- Door to door tracking (right place at the right time)
- Potential service failures detected early
- Location, temperature, shock, humidity, etc.
- Elimination of manual input and associated inaccuracies.

Close the Gap

- Potential to create and sell new services without the major staffing and infrastructure costs incurred by the express carriers.
- US\$2-3 throwaway BLE tags just around the corner. Still not low enough to put on every carton but maybe low enough to offer as an option at a better margin to high value customers.

Big Data and AI

- Whole subject in its own right.
- Note:
 - Network creates vast amounts of data
 - Good for AI
 - Bad for communications costs
 - Bad for backend processing costs
 - Having intelligent edge computers ("readers") supports local decision making as to whether to send data or not.

Data Sharing

- People are initially resistant sharing data, however:
 - Most people want to do a good job
 - Most people want to be paid faster facilitated by non-disputed transactions being paid quickly
 - Most buyers don't want to buy off sellers with a negative attitude to service (usually facilitated by hiding things).
- However in a network like logistics it is to everyone's advantage to maximise transparency and improve response times to errors.
- ULDs temporarily change ownership, GHAs handle multiple carriers and want to see the total inventory they are managing, etc

Not Without Some Challenges

- Unserviceable units – show as part of current available inventory.
- Cellular communication - dead spots
- Power source – not available outdoors
- Weather – need to survive Typhoon 10
- Location – need to know more precisely
- Doorway / gateway – need to know direction and door #

Some Emerging Answers.



Serviceable / Unserviceable

- Android phone app.
- Flags unserviceable units.
- Inventory system calculates available inventory.

Cellular Dead Spots

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Cellular Dead Spots

2x
speed

2x link speed

4x
range

4x range with lower data rates

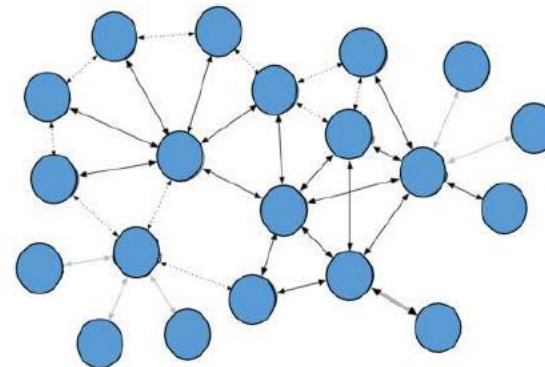
8x
data

8x broadcast message capacity

**BLE 5 meshing
being deployed**

Bluetooth mesh

- Devices relay data to each other
 - Many-to-many topology
 - Improved coverage
- Version 1.0
 - Operates on Bluetooth 4.0 or later
 - Managed flooding on advertising channels
 - Planning for optimal operation
 - Networks of hundreds of nodes
 - Industrial grade security - mandatory



BLE Mesh – Benefits

- Mesh resilience – the messages can go around failed relays.
- Cellular resilience – messages can be routed to any cellular gateway in the mesh (i.e., a reader with a failed cellular connection will reroute BLE reads to the mesh for transmission by another reader).
- Coverage – cost effective coverage of wide areas
- Density – cost effective to have high density of relays for precise locations services
- Optimum reader placement – currently readers are placed for optimum BLE reads which might mean sub-optimum cellular communication. Now readers can be placed for optimal cellular performance and BLE reads can be forwarded through the mesh to the best reader.

No power plus weather

- Waterproof Solar BLE5 Relays
 - Addresses the constraints on power outlets, particularly out doors on hardstands and container yards.
 - Waterproof, solar powered, mesh enabled BLE5 relay.
 - 17cm * 13cm * 5cm, significantly smaller than a current reader
 - Two NCR18650 batteries for a total capacity of 6800mAh
 - Continue to run for long periods with limited or no solar input
 - They are white because that is the most durable for UV damage



Localization.

- Indoor Micro BLE5 Relays
 - Cost effective to install many to create warehouse mesh network
 - Relays collect RSSI (signal strength) to send to reader
 - More points of reference means more accurate location
 - Same range as all relays
 - Small – 7 * 4 * 1cm



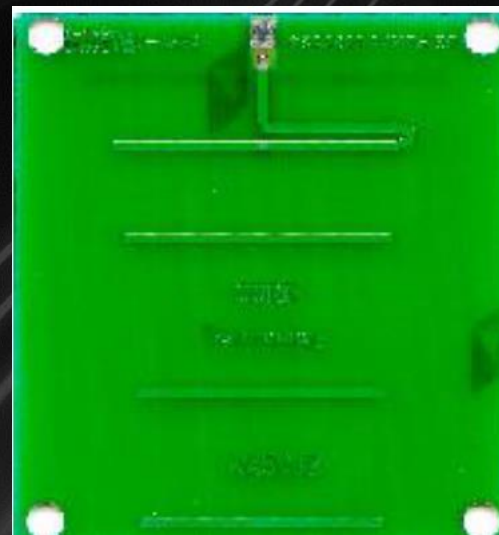
Waterproof Ultrasonic Mesh Enabled Tags

- Also known as "Occupancy Tags".
- Designed to measure distances.
- Initially targeted at detecting whether a GSE dolly is occupied by a ULD or not.
- Also looking at using them as doorway / gateway detectors.



Doorway (Short Range) Detection.

- Based on:
 - Low power mode setting in BLE
 - Highly directional and “choked” aerals
- Still in development.



COREInsight Generation Two

This is a major protocol enhancement for tag to reader communication and is undergoing extensive testing. It enables:

- **Multiple sensor:** support for multiple sensor types via a self-describing payload;
- **Localisation:** ability for tag to record multiple RSSI values (up to 20) from surrounding devices and send these in one payload to a reader for positioning calculation;
- **Wake up on event:** the ability to load a tag over the air with a function (e.g., shock) and a threshold at which point it should seek to connect to a relay / reader and report status.
- **Data logging:** recording values over time to be uploaded on the next connect.

Need to Keep on Top of Change

- Technology always evolving
- No technology perfect therefore a large amount of effort put into resilience features to recover from “flaky” comms, operating system quirks, etc.
- Absolutely vital to be able to upgrade readers and tags over the air (i.e., no hands on).

Summary.

- BLE is increasing in capability all the time.
- Its price is always under downward pressure because of consumer mass market.
- CORE is working to exploit the wide coverage of meshing while developing techniques to make BLE constrained to small areas.
- The best of all worlds: short range and long range and precise location services.