Getting logistics closer to end users

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Nowadays, logistics could make you purchase a book in Amazon and delivering it in 24-hours using a service from a logistics operator or a transport company. In a more complex scenario, an order could be traveling around the globe, passing from hand to hand between unknown actors for months. In most cases the client would not be notified in a proper way. But first of all, what does client means? In a logistic chain the client is the company who hires the logistic service; for example, Amazon hiring DHL for transportation. So, where is the end user? For instance, the client of Amazon would be. For sure, the user is also a client in this operation, but it will never appear in a logistics chain scheme. In this paper we will refer to an end-user as the customer of an e-Commerce company, normally known as consignee in logistics.

Considering this premise, it seems very difficult to have a more social and modern way of communication between logistics and consignees that are excluded from the chain. Some logistics service providers, specially the big ones, provide them with some kind of tracking system. Sadly, most of the times tracking information is provided by a web page not focused enough on their needs. Once again, consignees are not considered as clients. This white paper is focused in two main aspects:

- **A scenario where logistics are closer to the consignees and,**
- **A publication/subscription architecture as an enabler of implementing that scenario.**

In that scenario the consignee requests logistics information in the way he is more used to. He would request information like "notify me when my order is 15 kms close to my "postal area". To notify means a flexible mechanism for real time communicating events, including predictive analytics and forecasting. These events will be used to feed applications designed to support different functionalities, such as a mobile bi-directional track and trace application. In order to make this scenario possible, a publication/subscription mechanism is proposed to create and manage real time communications channels. The architecture is based on the strongly communication needs that we need to face nowadays, with billions of interconnected user/devices and short time of response. It also will make use of standards to facilitate his implementation and integration.

Simplifying the scope, this paper shows a vision about logistics and technology from the final user's point of view, instead of a more traditional business-2-business perspective.

Keywords—logistics; technology; real-time communications; e-Commerce;

I. THE WHOLE LOGISTICS CHAIN FOR CONSUMER IS CHANGING

Internet revolution has changed the way consumers make use of logistics: one click for buying products in any part of the world, with the reputation of retailers and quality in delivery as the key factor to distinguish your e-Commerce capabilities.

James Greenbury, CEO of Parcel2Go (website for consumers to pick their preferred delivery service) says: *"If you sell on eBay and you want to get good feedback you have to deliver typically within 2 days, but increasingly you are also having to offer choices to the consumer. They sometimes want the cheapest possible service, sometimes they want to do Click and Collect, which can now cost as little as 75p. The whole logistics chain for consumers is changing"* [1].

So we live in an interconnected world with end-users using innovative technologies to access retailers, and retailers using innovative technologies to make possible their business. The complexity in a logistic chain is focused in optimizing business processes between actors and companies implementing a logistic service, in order to reduce costs and time. But consignees do not perceive any improvement of communications during delivery processes, even the supply chain sector is experimenting a real increasing in efficiency.

- At best, during delivery, users will access a static web (Figure **1**) for track and trace where we can distinguish two main issues: Detailed tracking information. It is not about quantity or quality is about who will receive information. As mentioned before, consignees are not represented in a common logistics chain composition. Thus, the information gathered through the execution of the processes cannot be properly focused. The vocabulary in this example is difficult to be understood for a regular end-user.
- Interaction. Even if the information received by the user is properly focused on his needs, he would not be able to interact. Internet is about creating and consuming information; unidirectional communications isolate users, which are notified but

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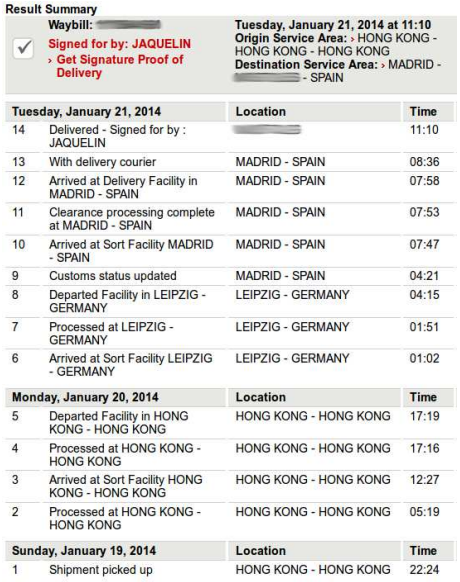
cannot reply. This is fairly understandable by an end-user who is used to send around 1200 messages by month just using mobile messages apps as Whatsapp [2].

So, the statement "The way that users are used to request information making use of new technologies…" implies interaction, because consignees cannot only be mere observers. Flexibility about means to receive information implies the use of mobiles applications, web pages, social networks, etc. Also, filtering information and mechanisms to configure the information they are interested on receiving. Covering these topics will make logistics closer to the end-user.



Result Summary

Waybill: [redacted]
Signed for by: JAQUELIN
› Get Signature Proof of Delivery

Tuesday, January 21, 2014 at 11:10
Origin Service Area: › HONG KONG - HONG KONG - HONG KONG
Destination Service Area: › MADRID - [redacted] - SPAIN

Tuesday, January 21, 2014		Location	Time
14	Delivered - Signed for by : JAQUELIN	[redacted]	11:10
13	With delivery courier	MADRID - SPAIN	08:36
12	Arrived at Delivery Facility in MADRID - SPAIN	MADRID - SPAIN	07:58
11	Clearance processing complete at MADRID - SPAIN	MADRID - SPAIN	07:53
10	Arrived at Sort Facility MADRID - SPAIN	MADRID - SPAIN	07:47
9	Customs status updated	MADRID - SPAIN	04:21
8	Departed Facility in LEIPZIG - GERMANY	LEIPZIG - GERMANY	04:15
7	Processed at LEIPZIG - GERMANY	LEIPZIG - GERMANY	01:51
6	Arrived at Sort Facility LEIPZIG - GERMANY	LEIPZIG - GERMANY	01:02
Monday, January 20, 2014		**Location**	**Time**
5	Departed Facility in HONG KONG - HONG KONG	HONG KONG - HONG KONG	17:19
4	Processed at HONG KONG - HONG KONG	HONG KONG - HONG KONG	17:16
3	Arrived at Sort Facility HONG KONG - HONG KONG	HONG KONG - HONG KONG	12:27
2	Processed at HONG KONG - HONG KONG	HONG KONG - HONG KONG	05:19
Sunday, January 19, 2014		**Location**	**Time**
1	Shipment picked up	HONG KONG - HONG KONG	22:24

Figure 1 Track and Tracefor a purchase

II. CURRENT SITUATION OF E-COMMERCE

In the current situation, e-Commerce is often supported by large express carriers like DHL. These carriers have contracts with e-Commerce suppliers for delivery of small parcels within a certain time period after having accepted these parcels at a Distribution Center (DC) of the e-Commerce suppliers. Since these types of supply chains are global, mostly, air transport is applied with delivery to a national distribution center of the carrier. The 'last mile' from that national DC to the final recipient can be performed by the same carrier, but can also be subcontracted. There is a tendency to install city distribution centers for large cities. The last mile is thus from that city distribution center to the final recipient.

Return logistics is another important aspect of e-Commerce. A number of retailers utilizing e-Commerce as a sales channel have return stickers attached to the delivery, for instance H&M. In case a customer wants to return his goods, he has to package them and drop them at a pick up location for carriers. In the Netherlands, the postal infrastructure offered by Post.NL is for instance used for this purpose. Other retailers like grocery retailers utilizing e-Commerce, potentially with their own transport function, provide a call center facility. In case of missing or damaged deliveries, a customer can contact the call center and the purchase amount is discounted from the next delivery. So, they do not have return logistics, but just provide discount facilities on next shipments. A hold is an example of this type of grocery deliveries, where you can select a timeslot of 2 to 4 hours with a certain price for delivery.

The above solutions to e-Commerce logistics show various challenges. Firstly, the actual delivery time and location needs to be agreed and, secondly, return logistics has to be organized. In this respect, the logistics chain might be complex consisting of various partners, each with their own objectives and goals and not particularly interested in the end customer. Especially the so-called 'last mile' to the end customer might cause various challenges, also related to traffic congestions in larger cities.

III. A FUTURE WITH COMMUNICATIONS FOR COLLABORATIVE LOGISTICS

A future with collaboration between actors participating in an e-Commerce service should provide better logistic services. The usage of innovative technologies and software solutions needs to be the base to open a fully collaborative e-Commerce future.

In this paper we propose to focus these objectives by two main pillars:

- A platform to allow real time visibility, predictability, and interactions
- A collaborative application involving all actors (including consignees of parcels) participating from a logistics service execution. This application will be used to expose the ideal future scenario raised in this paper.

To change the way people make use of communication is not an easy task. Specially, if this implies to change complex business processes. Thus, the usage of this "collaborative application" needs to be as less intrusive as possible; it cannot modify or interfere in the current processes. Also, the usage of this application has to be optional; as much as it is used with more actors, the best information you produce. The success of delivery cannot be affected because of trying to produce a better trace of executing the process.

A good example in order to understand these ideas of collaboration can be found in Google Docs [3]. Someone, easily, can create a new document to be written with the collaboration of others. After that, the document is shared with others with (potential restricted) access rights. Other users are invited to collaborate and they can choose if they want to or not. You can choose to participate or you can just ignore it and continue with your business. This mechanism could be used to write a collaborative trace for a purchase order and different actors could contribute with more information. Conceptually, this solution provides these ideas of collaboration, but it is difficult to expect implementing a logistic service in that way. Mainly, it lacks of a more structured way of sharing data, like events.

Going further with these ideas, a dedicated collaborative application could cover these functionalities. In a funny reference to avoiding refreshing web pages, <f5> will be the proposed name for this conceptual application.

In a first prototype, <f5> would be based on a web of collaborative logistics. The logistic service provider is the only one that needs to be registered in the application. In that way, he will be able to configure collaborative timelines inviting participants. The structured way of creating and consuming information will be managed by events. Thus, depending on roles, different actors will be able to create and consume proper events.

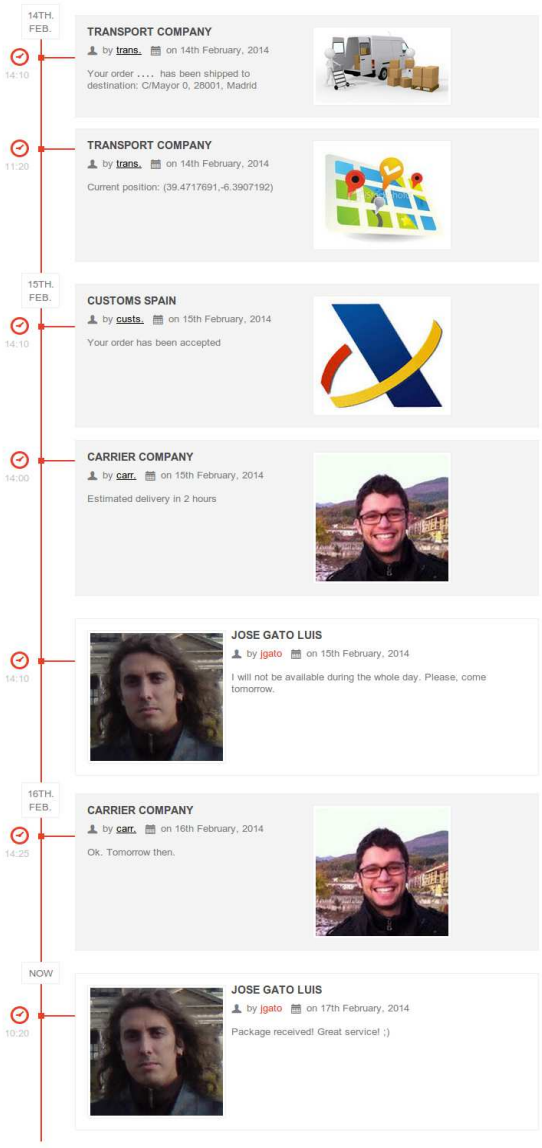


Figure 2 <F5> conceptual idea

Figure **2** <F5> Conceptual idea represents a time line where the different actors interact in a bilateral communication way. Despite this is just a concept, it represents the ideas of "the way that users are used to share information and collaborate for instance via Twitter or Facebook": received information is focused around various stakeholders, and the final customer or consignee is actively involved. This example shows a "verbose" interaction to make it more "visual", internally the interchanged information should be modeled in a more controlled structure like events: <dispatched> from <coordinates>, <location> update <coordinates>, <alarm> not available, and similar ones.

Different extensions of <f5> could allow creating rules based on events in order to improve the way information is managed. For example: end-users could automatically notify they will not be available at the estimated delivery time, based on predictive analytics, speed, and locations. At the same time, a carrier could receive an event that allows him to automatically re-plan a delivery route. These situations are feasible only when you have very flexible mechanisms, like events and interactive communication channels.

The Figure **2** represents a mockup of how this collaborative timeline could be. It also shows a future ideal scenario, where logistics are closer to the end-user and provides collaborative mechanisms to enrich the final result. But how this application could be built? First of all, <F5> needs a platform providing services for real time interactive communications. AEON[1] platform is proposed to support these communication needs.

IV. AEON SOLUTION TO SUPPORT INTERACTIVE COMMUNICATIONS

The proposed scenario is ambitious and challenging aim that can reach in a successful way by taking the right steps. Therefore, a publish/subscribe pattern has been proposed.

Nowadays, we live in a world where large information volumes flow around the globe ('big' data) and it is impossible to be informed about everything in a proper way. To manage this situation, a publish/subscribe mechanism takes an important role but what is publish/subscribe?

The publish/subscribe [4] paradigm is a pattern in which the information is generated by any entity and shares it (publish) over the network with those that have subscribed to it. Let's think about a truck carrying goods from point A to point B. At every moment, the truck, which in this case would be the publisher, can publish his current position, speed, and direction or destination(s). On the other hand, this information would not have any sense if there is another entity capable of receiving and processing it, whereas it will not be publically available to everyone. Here is where the concept of subscriber arises. A subscriber is an entity that receives all the information submitted by a publisher, to which it has a subscription. This is not a one-to-one relation. A publisher can send any kind of information and many subscribers can retrieve it. One of the key points of this model is that the publisher does not need to know neither who are the subscriber nor the numbers of them. On the other hand, a publisher will need to control who can

[1] AEON real time communication network http://aeon.atosresearch.eu

really access or subscribe to the data, since the data might be commercial sensitive.

This schema allows each entity to get the information needed or desired from all the different publishers and ignore the rest of the information. These sets of information are known as topics.

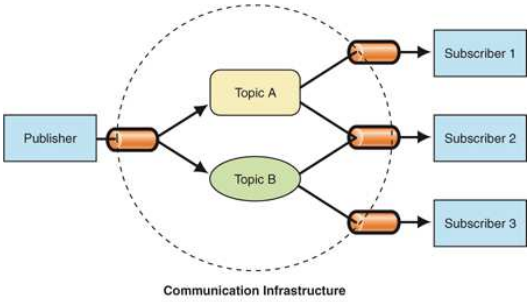


Figure3. Pub/Sub model example

The Figure**3** shows a basic pub/sub schema[2] in which there is a publisher sending two different types of information and some subscribers consuming it in different ways.

These are the basis of the proposed solution. AEON is a real time communication platform based on a pub/sub mechanism. It manages two important concepts: entities and channels.

An Entity can be defined as any object belonging to the Internet of Things. AEON allows the user to create a taxonomy of entities that will allow him to facilitate their management. A Channel is a concept strongly linked to the Entities. Each of these entities can have as many channels as required, acting each as topics managing different kind of information. Channels are the communication link between an owner of an entity and its subscribers. Each channel owns an endpoint to publish information and another one to get subscribed and receive it.

Technologies used to develop AEON are extremely fast and scalable. That allows getting response times close to real time. That means that, when an entity publishes information, the subscribers get it instantaneously, e.g. on their app on a smart device signaling that there is new information. These conditions are subject to external factors such as network quality or peeks usage. Let's see a usage example based on the previous one:

There is a particular truck carrying goods from point A to point B. At destination, they want to know the truck position at every minute. To reach this, an application based on AEON can be developed. These are the steps to be done in order to configure the scenario:

- Create a new entity in AEON. It will be called "Truck A".
- On entity "Truck A", create a channel named "GPS".
- To receive the truck's position, people at destination have to subscribe to the channel subscription endpoint.
- After that, when Truck A published its GPS location through the Publish endpoint, people at destination will receive it.

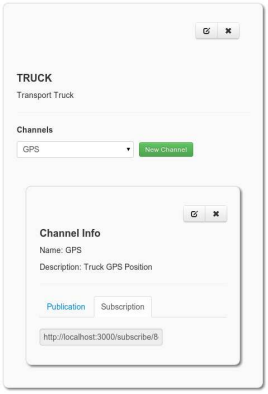


Figure4 AEON Entity Example

AEON is based on a RESTful [5] interface that allows both endpoints to be urls. Thus, publication and subscription will be managed through HTTP protocol in a really simple and standard way of communication.

Thanks to this example we demonstrate how easy should be to have real time bi-directional communication using AEON as a cloud solution. This platform could be used to create other applications such as, the<F5> prototype aiming to get logistics closer to the end-user.

V. IMPACT

The combination of AEON, and the concept of <F5>, shows how carriers can improve the coordination of last mile deliveries to consignees that are customers of e-Commerce providers. Having bought products at a website, customers can automatically subscribe to events of these products in logistic chains. Each of the logistic service providers in those chains will need to register particular events to these products. Relations between AEON entities need to be known, e.g. whenever a bought product is packaged and transported, the relation to the transport means has to be registered. EPCIS, (Electronic Product Code Information Services) provides an XML format for sharing relationships between entities. By registering events to particular entities like trucks, these events could be propagated to parcels on those trucks, thus enabling tracking and tracing to a customer.

In this respect, it is worthwhile considering which events a customer would like to subscribe to. Possibly, a customer would only like to receive aggregated events like 'arrival in his country'. Another event of interest to a customer could be the

[2] Pub/Sub patterns: http://msdn.microsoft.com/en-us/library/ff649664.aspx#despublishsubscribe_solution.

last address of delivery before the address of the customer is called upon. Knowing this address, the time of call at this address and an estimate of driving time to his address, a customer can better plan his activities and be at his delivery address.

On the other hand, logistic service providers and carriers can better synchronize their delivery with customers. Since a customer is better informed of the time of call at his address, he can better plan to be at this address. A carrier will thus be able to be more efficient in parcel delivery.

VI. CONCLUSIONS

This paper has demonstrated a first version of a solution that is able to synchronize parcel delivery at the last mile, including potential milestones that are of interest to a customer. The current version of the product AEON allows a customer to subscribe to a particular event of an entity, which can be anything of interest to that customer, e.g. a parcel or a truck.

There is yet a lot to be done. There can of course be an customer app running on a smart device that allows a customer to view the status of his orders. We will mention some potential extensions that will improve the solution, namely relations between entities, implementation and adoption of AEON, and interaction. Firstly, a data structure like EPCIS needs to be implemented by AEON to register and relate events of different entities. By implementing this data structure, a customer will not need to subscribe to a truck carrying his parcel, but can automatically receive an event for his parcel generated by that truck. Having such a data structure, e-Commerce providers can refine their tracking and tracing information, e.g. a customer will be able to select to which events he wants to subscribe. The advantage of applying a data structure provided by EPCIS is also that it is an open standard, already supported by various COTS (Commercial Off The Shelve) – and open source software solutions. AEON could directly be implemented on top of such a standard solution.

Of course, each of the logistic service providers and carriers involved would need to generate particular events to provide visibility, which is the implementation and adoption aspect. One of the first stages to cover would be the so-called ‘last mile’, since that is what really impacts delivery times. An option to the implementation and adoption issue that considers all involved logistic service providers and carriers need to generate events would be a completely distributed implementation of AEON. Each actor involved in a logistic chain could implement AEON and each customer of that actor would automatically subscribe to particular events. For instance, a logistic service provider acting as customer to a carrier could subscribe to truck related events and link those events to one or more parcels of his customer, the e-Commerce supplier. One could also imagine that each of the actors would thus have a dashboard monitoring the flow of his orders. A linked data chain relating to a logistics chain would thus exist.

Conceptual applications like “F5” try to show the specific type of information that the final users expect to obtain when they use a logistic service. In these kind services, information has to be handled very cautiously by different reasons: personal privacy, competence, business strategies, etc.

Meanwhile, the final users live in a world where information is shared and flows with scarcely limitations constantly (Facebook, Twitter, Linkedin…). Therefore, we meet a great difference between both worlds, which implies a change of mentality at the moment of sharing information. It is not only a question of solving a technological barrier but a mindset.

Finally, interaction needs to be supported. In particular occasions, an e-Commerce supplier only indicates that the products will be delivered in a particular time period like a week and informs a customer when these products have been shipped. Yet a customer is still not aware of actual delivery times. Supporting interaction, AEON (together with a specific application, such as <F5> concept) could provide especially a carrier for the last mile with status information of delivery. It would also allow a customer to change a delivery address, for instance not his home address, but the one of his neighbor or his work address. Changes of locations need of course to adhere to particular conditions; it would for instance not be possible to change delivery to another city without increasing transport costs. In case AEON utilizes an open standard like EPCIS interaction possibly requires extension of such an open standard.

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