Collaborative systems & Shared Economy (Uberization): Principles & Case Study

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Abstract - *In the paper we analyze the characteristics of collaborative systems & the characteristics of shared economy supporting systems. Uberization as present in many applications: Airbnb, Uber, BlablaCar, AMAP, circular economy, etc. needs cooperative system support. We examine this approach from the point of view of ICT and, more specifically, HMI (Human Machine Interaction) and CSCW (Computer Supported Cooperative Work) and indicate what must be added to collaborative systems to support uberization. The paper also shows how to identify appropriate collaborative models and how to add new uberization services to obtain an uberization supporting platform. A case of design of a collaborative application for Carbon Free Parcel Distribution will also be presented, and corresponding intermediation algorithms discussed*.

Keywords: Collaborative system; shared economy; uberization; platform; intermediation

1 Introduction

In many activities, individual work (personal or at corporate level), with protection and confidentiality, is progressively evolving towards a more open position. Collaboration & cooperation, and sharing of data and equipment, lay down new bases for product design, production and functioning in a large scope of professional activities. CSCW is known as a multidisciplinary approach to study and propose appropriate approaches for collaboration & cooperation. An integrated system is designed to organize all activities in a consistent and coordinated manner by providing all stakeholders with access to the necessary information. The cooperative / collaborative system is intended to allow a group of people to carry out their activities appropriately (simultaneously or sequentially, in distributed, subcontracting, co-contracting or outsourcing modes). Shared economy is an important field in which integration and collaboration models, architectures, techniques and technologies are able to play a major role in promoting it and facilitating its deployment. We then study in this paper this impact of integration and collaboration systems on shared economy and present a case study treating the problem of carbon free parcel distribution.

2 II. State of the art & examples

2.1 CSCW History and Evolution

CSCW [1] (Computer Supported Cooperative Work) is a field of interactive systems that aims to allow multiple stakeholders to cooperate through a computerized system to perform cooperatively tasks of different natures (design, management, production, research, etc.). The design of such systems is relatively complex because it is not limited to individual activities but focuses on the cooperative work of several stakeholders who can undertake cooperation, coordination and communication according to the definition originally proposed by Ellis [2] and reworked by several other authors. This cooperative work can be undertaken in several cooperative situations initially characterized by Johansen and improved by Ellis [3]. At present, these CSCW systems are becoming increasingly mobile, context-aware and proactive. We named these systems “cooperative capillary systems” (CCS) [4], by analogy with the network of blood vessels. The purpose of the capillary cooperative system is "to extend the capabilities provided by the cooperative work tools in the ramifications of increasingly fine ramifications, which can operate not only on fixed workstations but also and in particular on wearable computers." These systems naturally become pervasive (integrated in the environment), proactive and ubiquitous. Our ultimate goal is to allow stakeholders to move in an augmented reality environment (mixture of physical and digital objects and tools) and to apply the concept of ambient intelligence (AmI), the Internet of Things (IoT) [5] and to spot oriented treatments (Location-Based Services - LBS) [6].

2.2 Wikinomics

Several books [7, 8, 9] by D. Tapscott and co-authors explained progressively the main principles of cooperation using Wiki metaphors and leading to Web 2.0 and its utilizations in different industrial fields. This author identified five main principles of networked intelligence: collaboration, openness, sharing, integrity and interdependence. Shared economy is a human activity that seeks to generate public value and is based on new forms of work organization. It is based on a more horizontal organization, with sharing of goods, spaces and tools and preferring usage to ownership.

2.3 Uberization

The term "uberization" is a neologism popularized by Maurice Lévy after an interview with the Financial Times in December 2014. The term originates from the Uber company that has globally popularized passenger cars with driver, thus competing directly with taxis. The features of this service are almost real time, pooling of resources and the small percentage of heavy infrastructure (offices, support services, etc.) in the cost of service.

Some of the services mentioned are participanting to the uberization of economy, with following examples: Airbnb, Booking.com or Amazon.

The neologism of uberization is generally used to refer to the phenomenon whereby a start-up or a new economic model related to the digital economy threatens to replace an old economic model. It speaks about uberization by analogy with the two models, Uber and Uber Pop, which are currently challenging traditional Cab activity. The car share BlaBlaCar company, initially created in France, is another uberized model for transportation sharing.

2.4 Collaborative and shared economy examples

The collaborative/shared economy is a human activity that seeks to generate public value and is based on new forms of work organization. It is based on a more horizontal organization, with sharing of goods, spaces and tools (usage rather than ownership), the organization of citizens' 'networks' or communities and, generally, intermediation by internet platforms.

The collaborative/shared economy is understood in a broad sense, including collaborative consumption (AMAP couchsurfing, carpooling etc.) but also shared lifestyles (coworking, colocation, collective housing), shared finance (crowdfunding, ready to silver peer-to-peer, alternative currencies), contributory output (digital manufacturing, DIY, Fablabs, 3D printers, maker spaces) and free culture.

It assumes different forms (sharing economy, service economy whose including circular economy, economy of solutions, peer-to-peer economics) according to the types of goods and services concerned or proposed (consumer empowerment, eco-effectiveness).

This kind of economy is placed in a context of mistrust of institutional actors in the traditional capitalist system and in an economic crisis context, as well as in an ethical and environmental context.

Its rise is due to the use of new technologies to improve the collective/shared creativity and productivity. It also responds to the desire of green practices and more friendly social relations.

3 CSCW versus Uberization

CSCW is historically based on the collaboration and cooperation between several actors (identified or anonymous) [10]. They can work locally (at the same place) or at a distance (in different locations). They can work synchronically (at the same time) or asynchronously (at different times). During this collaboration they share data, which can be modified by each of them, and the work organization can be based on a process definition (called workflow), which takes into account the role of the different actors, their activities (tasks) and corresponding data operations (read only, creation, edition, etc.). This collaboration can be either short-term oriented (a short period of time to solve a problem) or, and mainly, long-term oriented (long-term well organized processes such as design, development or long-life support with a relatively stable set of actors. Main components of the 3C model (Communication – Collaboration – Coordination) are fundamental for important groupware systems like CAD/CAM [11].

Uberization is defined as cooperation between consumers and providers using a cooperation/sharing platform. In this context consumers and providers are individuals (proposing and requesting use of a service). In the transportation case, the user - consumer – traveler tries to find a vehicle with driver that could take him/her to their destination. The platform is used to find a vehicle, which is located not far from the consumer's (client's) geographical location and available to make this trip. The 3C model is not fully used in uberized activities (UA), as communication is limited to one of each part of the system: one consumer – one provider. Coordination & collaboration are also limited mainly to a short-term process of negotiation of common activity and its accomplishment.

Compared (Table 1) to CSCW applications, collaboration in uberized applications is mainly short-term oriented and limited to establishing a relationship between provider and consumer intermediated by the platform. Access to shared data is privileged, and the process aspect (workflow) is limited to a short period and a limited number of steps.

We can observe that UA can use all main components and services proposed by CSCW and associated software (groupware). However, it is important to observe that new services are mandatory for uberization. These services can constitute an intermediation platform, which is able to manage the relationship between, usually, a pair of actors (provider and consumer) who are compatible in relation with an expected profile or objective. The intermediation platform has at its disposal a large amount of information either in real time or collected in the past and is able, by appropriate selection techniques and algorithms, to select and propose one or more

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potential answers which are proposed to the client (consumer) to refine and find an appropriate solution.

3.1 Architectures

Collaborative system architecture is generically organized in three layers [10]:

- Distributed System Model: System and network services layer
- Groupware Infrastructure Model: Generic collaborative services layer
- Collaborative Application Model: HCI, sensors and specific application layer

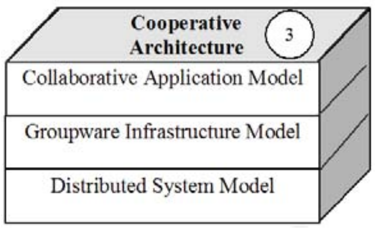

Figure 1. CSCW Platform Architecture

Table 1. Comparison of CSCW and Uberized Applications (UA)

Characteristics	**CSCW**	**Uberized applications**
Mobility	Possible	Possible
Stationarity	Possible	Possible
Data sharing	Large	Large
Process supporting	Large	Limited
Communication between actors	Large	Limited (often 1 : 1)
Intermediation	Limited via platform between known actors	Fundamental via platform to find appropriate actors
Synchronous communication	Dominant	Very occasional
Asynchronous communication	Important	Dominant
Data complexity	Important	Reduced
Data volume	Not necessarily large	Large
Process complexity	High	Reduced
Main activity	Collaboration	Establishment of relationship
Data selection	Occasional	Fundamental
Data mining	Occasional	Fundamental
Provider evaluation	Exceptional	Fundamental
Platform Intermediation	Between identified actors	To find actors

For Uberised Applications the system architecture is not yet clearly defined. For Sangeet Paul Choudary, who is the creator of Platform Thinking [12], his platform architecture is mainly based on Magnet, Toolbox and Matchmaker (Fig. 2). It is producer- and consumer-oriented allowing them to seed collaborations.

3.2 Crosspollination between groupware and uberware

If we observe a Collaborative Platform in more detail, we can see that it is able to support the vast majority of Uberized Application needs. It is thus more appropriate to create a UA Platform by upgrading a Collaborative Platform than to develop a UA Platform from scratch. As we see in (Fig. 3), a Collaborative Platform is able to manage at the first level: distribution and mobility; at the second level: generic services for user identification and management, data identification, user-related access rules and main application generic services, and at the third level: appropriate Human Computer User Interfaces, sensor management and specific applications.

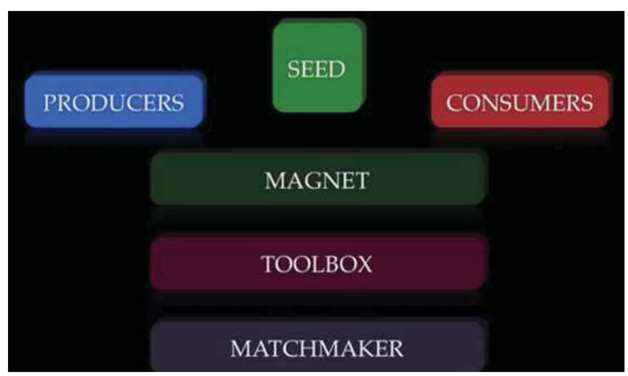

Figure 2. S. P. Choudary Platform Thinking Architecture [13]

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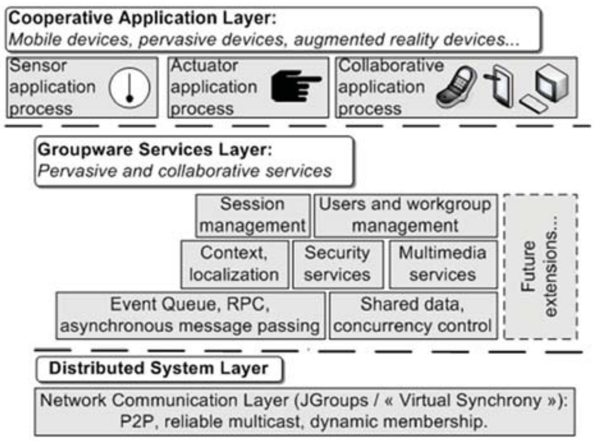

Figure 3. In-depth CSCW Platform Architecture

What is mainly missing is related to the principal Uberized Application specificity, which is related to what Choudary calls Matchmaker [12]. This kind of intermediation is not natural in “classical” Collaborative Systems for Design, manufacturing, etc. [11], in which the actors are clearly identified at the beginning of the process and still the same. In Uberized applications such as Airbnb (rent lodging) and BlaBlaCar (car sharing), the main goal is to match consumer objectives (geographical location, stay period and apartment characteristics for Airbnb; geographical location, trip target, date and number of passengers for BlaBlaCar) and manage the selection process and the transaction outcome. This kind of service is not natural and fundamental in Collaborative Systems, but is in Uberized Systems. It is important to provide appropriate intermediation services based on Big Data and data mining algorithms.

3.3 Intermediation platform or service

Intermediation platforms connect people, services and even things in ways that have been unthinkable until now. Search engines provide relevant references for people searching for information. Social networks connect users in their environment. Carpooling systems link drivers and passengers using the same routes. Intermediation platforms use big data to fuel the services they offer. All these services are evolving extremely quickly but are almost unnoticed.

All intermediation platforms essentially rely on the same structure. To begin with, they collect huge amounts of data which can come from the outside world (e.g., web pages for search engines) or be hosted by the platform (e.g., social networks). However, they are never produced by the platform itself but rather, by the people, services or things around it. These primary data are then indexed and transformed to extract information that fuels the primary services offered.

The activities of users on platforms generate secondary data. These secondary data essentially consist of traces which the platform generally has exclusive rights to, and allow the platform to create secondary services. A key example of this is the precise profiling of users, which permits personalized and customized services: personal assistants trace users as they go about their day-to-day activities, not only online but also in the physical world through the use of geo-localization or quantified-self means.

We studied and proposed a method of intermediation based on an algorithm for Community Detection based on Hierarchical Clustering (CDHC Algorithm). The CDHC Algorithm first creates initial communities from global central vertices, and then expands the initial communities layer by layer according to the link strength of vertices and communities, before finally merging some very small communities into large communities [14].

4 Carbon free parcel distribution case study

Parcel distribution is a very important activity, time consuming, and a source of pollution and traffic jams, mainly in large cities. Large distribution companies very often subcontract to small ones to perform this unprofitable activity. Several reasons account for this non-profitability: access to downtown is complicated by circulation constraints, traffic jam problems, lack of parking availability and also the limited presence of destinataires. This problem is increased by the number of distributors with a relatively small number of parcels to distribute, thus generating increased traffic problems in the same district. A variety of solutions were tested in several cities: identification of distributors for each district, thus reducing the number of vehicles entering each district and increasing the volume of distributed parcels. From a collaborative economy point of view, a more original and effective approach, which is carbon free, is based on the use of existing movements of persons and vehicles to take advantage of these existing trips to have them carry out parcel transportation. We propose to examine three of the different working situations that we have identified: the first is based on public city transportation users, the second relies on supermarket clients and the third is based on a closed network of small craftsmen.

4.1 Public city transportation based parcel distribution

In a large city like Paris, Lyon or Beijing, it is possible to imagine high speed transportation of letters and small parcels by the users of this public transportation (buses, trams and subway). The process is based on identification of segments defined by start and destination public transportation stations, identification start date and time (availability of the parcel at start station) and expected destination time (availability of the parcel at destination station). The next step is to find a transporter, a city transportation user, who is "interested" in carrying out this transportation. This requires a list, at their disposal, of potential transporters with their history of movement on the city transportation network. A tool can determine potential transporters with appropriate profiles (segment used, in the proposed time interval and transportation conditions such as parcel weight and transportation remuneration. A preliminary contact with this identified transporter is established to validate this transaction.

In this case two different solutions can be used for the exchange of parcels at start and destination stations. The first is based on physical exchange between the persons involved in transportation, between sender and transporter first, then between transporter and recipient. The second solution is based on an asynchronous approach using technological support for parcel exchange based on box-lockers located at each city transportation station and electronic key access, which is shared, respectively, between sender and transporter and transporter and recipient. In this case there may be a delay between deposit and withdrawal at each extremity of the segment. This solution is efficient and flexible (no need for synchronous presence of two actors at each segment point. It is also interesting from a security point of view, integrating delivery traceability. In the first case, a scanning of the parcel must be introduced in order to allow its follow-up.

4.2 Market clients based parcel distribution

Another possible approach for carbon free distribution is based on market clients who are neighbors of the client waiting for his/her parcel at home. There are several possibilities: first, the source of the parcel can be the market shop or internet shop, where the addressed person (client) ordered, purchased his parcel. Internet purchase can be connected with delivery in the market shop. Secondly, the process of discovery of a transporter who is a neighbor of the final client (recipient) can also be studied at the higher level, in the shopping mall which is a collection of market shops, with a larger list of potential transporters, persons located near recipients and interested in transportation commission. Traceability is also required by scanning at departure and arrival (delivery to recipient).

4.3 Parcel and object distribution between members of a network of small craftsmen

Small craftsmen work on different sites. Their activities mainly consist of studying the work to be performed (discussion with the client), choosing and purchasing the appropriate elements in DIY stores, and when necessary, transportation to the work site, where the work can be performed. This intermediate activity of choosing, supplying and transportation is a time-consuming activity which could be reduced by more appropriate organization. If the craftsman knows exactly what he needs, he can order by internet and, when necessary, ask a colleague of the network of craftsmen, who is working near his current work site, to transport the objects to him.

In this case, it is also important to find a colleague who is in contact with the same DIY store and who is currently working near his work site. Of course, appropriate authorizations must be established between actors and the relevant store to be able to trace all purchases and deliveries.

4.4 Main specifications

We studied with ECPk Beihang University students the first case of parcel distribution based on public city transportation in Beijing in which we expected to use the subway. We also expected that in each subway station a box-locker is provided to act as a support of the asynchronous buffer between sender & transporter and transporter & recipient. We give in (Fig. 4) the Case Diagram of the asynchronous solution based on box-lockers, in (Fig. 5) the Case diagram of the synchronous solution based on direct exchange of the parcel between persons (sender & transporter and transporter & recipient). In Fig. 6 we give the Sequence Diagram of the asynchronous solution and in Fig. 7 the Sequence Diagram of the synchronous solution. Due to lack of space, we are not able to give more information.

4.5 Intermediation method proposed

In our first case using public transportation based parcel distribution, it is mandatory to discover potential travelers who are interested in this activity. They must explicitly declare to be interested and subscribe to a collaboration agreement. In this way they can be tracked by the system based either on smartphone tracking or public transportation ticket tracking. The data collected are used to find a set of potential transporters, compatible with start and finish subway stations and offering temporal compatibility with sender and recipient timing. This compatibility must be strict in the case of the synchronous solution (physical exchange between actors) but is less so for the asynchronous solution using the box-locker buffer. In two other cases, "market clients" and "network of small craftsmen", the set of potential transporters is more limited, and potential intermediation algorithms can be less sophisticated and less efficient.

The community detection study can be applied in the intermediation method to help find the sets of transporters who have either temporal or spatial compatibility. After the users' data have been collected and analyzed, we can try to build a complex network of transporters. Then, the problem is transformed into the detection of communities in which the transporters have similar properties. The proposed CDHC

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Algorithm is an efficient method for carrying out community detection in complex networks.

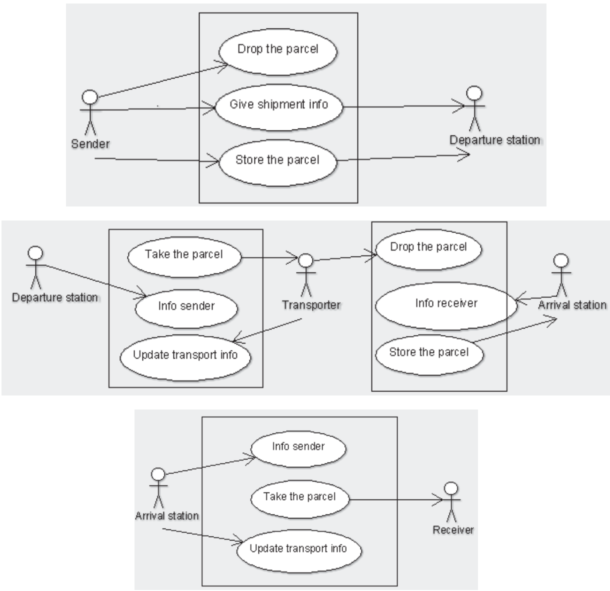

Figure 4. Case Diagram of asynchronous solution

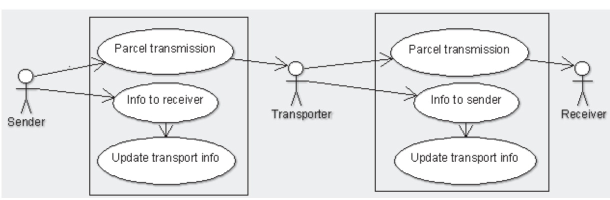

Figure 5. Case Diagram of the synchronous solution

One city has one or more centres and is expanded layer by layer around the centres. The closer to the centre the layer, the denser the connections to the layer. Inspired by the hierarchical structure of cities, a community of transporters should have one or more global central nodes and should be expanded layer by layer around the global central nodes. The nodes in layer p are mainly connected by nodes in layer p+1 and layer p-1. The connection number of one node with other nodes is known as its degree. Community detection of CDHC (Community Detection based on Hierarchical Clustering) includes initializing communities, expanding communities, merging small communities and choosing the best result.

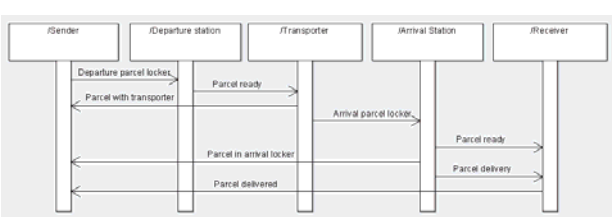

Figure 6. Sequence Diagram of the asynchronous solution

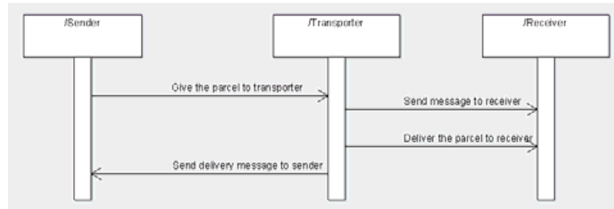

Figure 7. Sequence Diagram of the synchronous solution

In the first step of initializing communities, we first sort all the nodes by degree in descending order and then choose k nodes with maximal degree as global central nodes. Then, the node with the maximal degree is assigned to the first community and is marked as the first community's central node. For each node of the remaining k-1 global central nodes, its similarity with each initialized community's central node is calculated. If there is a similarity greater than a given threshold, the node is assigned to the community maximizing the similarity; otherwise, a new community is initialized, assigned to the new community and marked as the new community's central node.

After finishing the process of initializing communities, we need to expand these communities. The process of expanding communities includes marking node level and calculating link strength. All the global central nodes are marked as the first level. If a node is connected to the first level and is not yet marked, its level is marked as two. By repeating this we can mark all the node levels, if we assume that the network is connected. Starting from each level two node, the link strength between the node and each community is calculated. Then, the node is assigned to the community with the maximal link strength, until the nodes of each level have been assigned to communities.

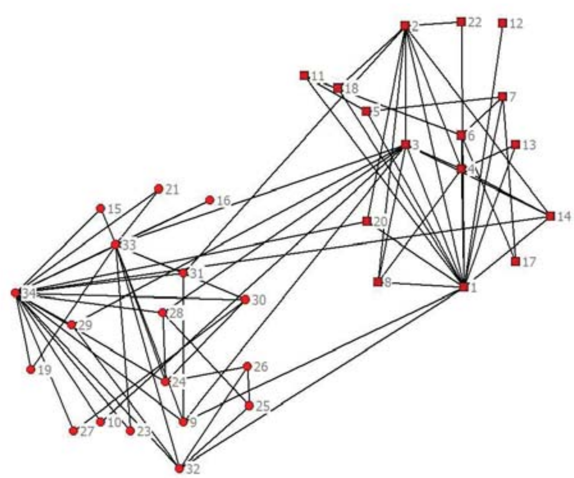

Figure 8. Communities detected for the Zachary Karate football club

The communities have now been detected, in which the nodes have strong connections and good similarities. The final step is to merge some small communities into large ones. Different community detection solutions with similarity threshold could be evaluated by extensive modularity, and the best solution found. We conducted some experiments on peoples' network datasets, and the result showed that the algorithm is very effective. Fig. 8 shows a community detection experiment conducted with 34 members of the Zachary Karate football club (US, 1970s).

5 Conclusion

In this paper we compared Collaborative System and Uberized Application principles and system architectures. We found major functional and architectural similarities between these two domains and supports and pointed out the differences either in characteristics, by a comparative table, or in architectures. We suggested increasing the Collaborative System by the addition of intermediation tools, to find appropriate persons, locations or things in order to create target goals of rental for Airbnb, drivers for car sharing for BlaBlaCar and transportation travelers for our parcels. Via this intermediation tool, a Collaborative System can be used in an Uberized Application.

Of course our study and presentation was scientifically, technically and technologically oriented. It was not in the scope of this paper to judge this problem from an economic or a political point of view [15, 16, 17, 18, 19, 20].

6 Acknowledgements

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