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Product vs. Organization Approach for the Quantification of Carbon Footprint of Events: The Hero Dolomites Case Study

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Abstract: Events have always played an important role in our society since they are a way to gather and share experiences on music, sport, culture, economy or even only for socialization. The number and variety of events has increased over the past years and the process of globalization has facilitated the constantly increasing participation at international level. As consequence, also the impact on climate change of events is constantly rising, as well as the awareness of citizens and participants on this topic, with the growing request to take action on the GHG (Greenhouse Gas) mitigation. It shall be noted that there is still lack of clarity on the most suitable quantification methodology which shall be used. The two main approaches are the CFP (Carbon Footprint of Product) and CFO (Carbon Footprint of Organization). The most suitable one seems to be the CFP since it is more able to describe an event intended as a service provided to the participants. An important consequence of this approach is the need to develop a PCR (Product Category Rule), with the purpose to establish common rules for the CFP quantification, in order to increase consistency in the methodology and comparability of the results with other events. This PCR was developed on the basis of the Hero Dolomites event case study, here described. The clarity on the most effective methodology for the carbon footprint quantification is fundamental for allowing the implementation of suitable GHG reduction plans by event's organizers, considering the reliable quantification as the base for any GHG mitigation path, even in direction of credible carbon neutrality targets.

Key words: CFP, CFO, GHG, PCR, LCA.

1. Introduction

The main issue, while considering carbon footprint quantification of events, is the lack of clearness about the most suitable methodology to use. In fact, the two most widespread ones are focalized on the CFP (Carbon Footprint of Product) and CFO (Carbon Footprint of Organization), following different approaches for GHG (Greenhouse Gas) accounting.

The preference between an approach rather than another is linked to the different interpretation which is given to the event itself. In the case in which the main focus is on the organizers of the event (i.e., the organizing committee of an Expo), the most suitable methodology is related to the CFO or, to be more precise, the GHG inventory of Organization.

When the aim is to emphasize the impact on climate change of the whole event, from its design to all the post-event activities, the approach of CFP should be preferred. In the latest case the event is considered as a service provided to participants, therefore in full consistency with the definition of product [1] as "goods or service".

The two methodologies imply a different approach in the consideration of indirect GHG emissions, the most significant for events, and in the results representation that will be described further ahead in the article.

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2. Hero Dolomites

Data and results reported in the present article are the outcomes of the CFP case study of the Hero Dolomites [2] event and have been presented at Sharm-el-Sheikh during the Conference of the Parties (COP) 27.

Hero Srl is an amateur sport association, below called Hero, which organizes the event HERO Dolomites, a mountain bike event usually taking place in June in Selva di Val Gardena over a period of 4 days, even though the main event takes place only on the 4th day. The focus of the festival is, in fact, the mountain bike marathon Hero Dolomites, which is considered to be the world's toughest mountain bike marathon and attracts 4,000 attendees from more than 40 countries every year. The event takes place from Thursday to Sunday and comprehends a few collateral events.

Hero is responsible for the organization of other races around the world (Dubai and Thailand) in addition to the one in the Dolomites which constitute the Hero Series. Thanks to these initiatives, Hero has created a circuit of international competitions, but our study is limited to the Hero Dolomites edition.

In April 2022 Hero has joined the initiative S4CA (Sport for Climate Action) [3] launched by the UNFCCC (United Nations Framework Convention on Climate Change) Secretariat and subsequently (30th of May 2022) R2Z (Race to Zero); as a consequence, Hero is committed to reducing 50% of its GHG emissions by 2030 and reaching zero net emissions by 2040.

3. The UNFCCC's Sport for Climate Initiative

S4CA intends to raise awareness about the carbon footprint in the field of sporting events and to promote climate actions for the GHG mitigation. Many sporting societies have already committed to it and are, thus, working towards halving their emissions by 2030 and reaching net-zero emissions by 2040.

Several organizations who joined S4CA [4] have published reports about GHG emissions quantification as well as current and future emission reduction activities. From the analysis of these reports available online, it appears clear that the most used methodology for the GHG quantification is the CFO.

Some of the reports taken into consideration while assessing the state of the art of events' GHG emissions accounting are listed below:

- 2018 FWC (FIFA World Cup) Greenhouse gas accounting report, which calculates its emissions dividing them between Scope 1, Scope 2 and Scope 3;
- 11th hour racing team 2020 sustainability report, they follow the methodology of calculating GHG emissions separately for Scope 1, 2 and 3;
- Juventus Climate Report 2020/2021 follows the GHG Protocol methodology;
- Formula E Season 7 Sustainability report 2020/2021, which assesses the carbon footprint considering its subdivision into scopes;
- Sail GP Purpose and impact report season 2 2021/2022 follows the GHG Protocol guidelines;
- McLaren racing Sustainability report 2021 as well follows the GHG Protocol;
- 2021 WM Phoenix Open Sustainability report, which calculates emissions per each of the three scopes.

As you can notice, all reports listed above have preferred the CFO approach, therefore it is now appropriate to explain why for the Hero Dolomites case study the CFP approach was more preferred rather than the CFO.

It should be also noted that some of these inventories are not related to a specific event but to an organization that participates in sport events (i.e., Juventus and McLaren).

4. Introduction of CFP and CFO Requirements

The Carbon Footprint is a single indicator for the representation of the impact of a given subject on climate change and it is expressed in units of mass (g, kg or ton) of CO2e.

The applicable standards are divided in two main groups: for organizations (CFO) or for products (CFP).

Even though there are standards which are frequently used at a market level such as the GHG Protocol for organizations, in this study only the ISO (International Organization for Standardization) standards are taken into consideration because of their wide acknowledgement at an international level and the availability of the full package of standards [1, 5-9] for the MRVA (Monitoring, Reporting, Verification and Accreditation) of GHG emissions, from carbon accounting (of product, organization and project) to the verification, accreditation of verifiers and the management of their competences.

The ISO 14064-1 (CFO) standard is characterized by a yearly GHG inventory which is intended to be compared with the baseline GHG inventory, representing the situation at time zero which is taken as a reference point to assess the progress of future GHG mitigation actions. GHG emissions were initially divided in three groups, here below described using the GHG Protocol terminology for a simplified understanding:

- Scope 1 comprehends GHG emissions which are directly generated within the boundaries of the organization (i.e., combustion of natural gas for heating);
- Scope 2 includes indirect GHG emissions due to the use of electric energy;
- Scope 3, which was optional, contains all other indirect GHG emissions not related to the use of energy (i.e., transport).

The last revision of ISO 14064-1:2019 introduced six categories in alternative to the three Scopes mentioned above, expanding the old Scope 3 in 4 categories. Another important change introduced by ISO 14064-1:2019 is the request to quantify all significant indirect GHG emissions.

ISO 14067 requires quantifying the CFP considering the entire lifecycle of a product ("service" in this case). GHG emissions are, therefore, divided into upstream, core and downstream that should be understood in this case as pre-event, event and post-event. In addition, this standard introduces the concepts of functional and declared units, with the possibility to give a clear reference to the impact for single participant at the event.

A specific PCR for events has been developed according to ISO 14067, establishing a common methodology for CFP quantification of further events. These two documents guided the CFP quantification of the Hero Dolomites case study here described.

5. CFO vs. CFP Methodology

Even though CFO is a widely spread approach for assessing the carbon footprint of events as stated before, it is characterized by a crucial weakness. The fundamental principle on which the CFO is based consists in the creation of a yearly GHG inventory, which must be compared with the reference baseline inventory calculated at time zero. The logic of the CFO consists in comparing yearly activities which are repeated over time in order to make a comparison with the impact of those activities at time zero. In fact, it is a kind of tracking of the reduction path of GHG emissions undertaken by the organization over time usually aiming at certain stated emission reduction targets. For this reason, the CFO works perfectly in the case, for example, of manufacturing companies which have taken part in reduction programs such as the SBTi (Science Based Target initiative).

In the event sector, the CFO logic could be adopted in the case of yearly events which are repeated over time such as yearly expositions or yearly sport championship. Occasional events or events which require a multiannual preparation such as the Olympic Games or the Expo, do not respect the logic with which ISO 14064-1 has been created.

This happens mainly for two reasons. The first one is the fact that the preliminary phase of preparation of the event is not, by definition, comparable with the event itself in terms of activities carried out and thus of GHG emissions, that happens in a different year. In this case the principle of the baseline of one year to be taken

as reference for future years is not meaningful and misleading.

In some case this inconsistency is so evident to require the adoption of an unusual double level of Scope1-3, for the preparation period and for the event (see Fig.1).

The displayed numbers show the GHG emission distribution between the preparation period and the FWC of 2018 [10].

In the case of multiannual preparation and execution of event, the comparison of GHG emissions year after year, without taking into account the entire service life of the event, is meaningless because in the first year only the GHG emissions of event preparation would be reported while GHG emission of the event execution would be accounted for the following year. It shall be expected that in the year of the event GHG emissions will significantly increase and in this case there is no reason to use the CFO for tracking potential GHG reduction over years even if the organizer implemented several actions to mitigate its GHG emission.

The second reason for not supporting the CFO for the GHG quantification of a multiannual event is that the representation of a series of yearly GHG inventories is not a reliable representation of the whole event's impact, which would be well displayed by the summatory of all yearly contributions instead.

Another weak point of the CFO approach is also applicable for all events. The CFO quantification does not consider the "service function" of the event minimizing any possibility of comparison between similar events. A football championship attended by 24 teams, even if it is managed with great attention towards GHG emissions, will almost surely generate a bigger impact if compared to a championship attended by 12 teams which will have a considerably lower number of matches to be played. Basically, the two championships are not comparable unless emissions are displayed in a relative way by referring the GHG emissions through a comparable unit, such as a single match. This is the principle of the functional unit that is a key characteristic of the CFP logic.

CFP approach is valid independently from the event's duration or dimension which makes it suitable for every type of event.

Another reason pushing for the use of the CFP rather than the CFO for events is the key indication in the ISO 14067 standard, for considering events as a specific kind of product, as clearly stated in paragraph 3.1.3.1: "The product can be categorized as follows—service (e.g., transport, implementation of events); …"

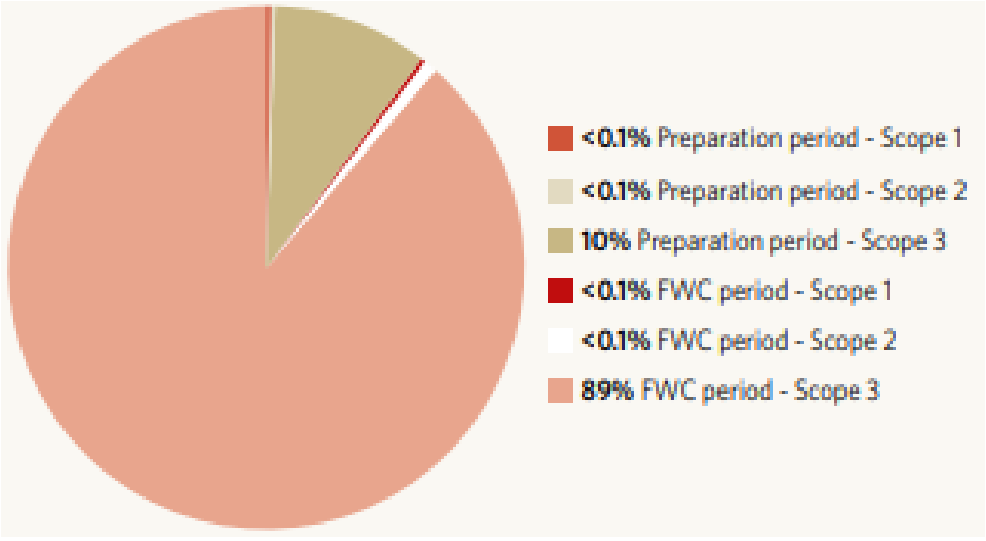

Fig. 1 GHG emissions distribution per scope and period.

Finally the CFP requires the aggregation of GHG emissions into three logic blocks: upstream, core and downstream, that fit well with the key characteristics of: the preparation (pre-event), execution (event) and the decommissioning or closure (post-event).

6. A New PCR for Events

The ISO 14067 requires the use of a PCR for each product category to ensure a consistent approach during the CFP quantification and facilitate the comparability of the studies.

Therefore, the development of a PCR shall be considered the first fundamental step in the CFP development process, when a PCR is not already available.

In the case of event a PCR was missing, therefore a new PCR was developed under the CFI (Carbon Footprint Italy) program for the Hero Dolomite's study.

The product category assessed in the PCR corresponds to the UN CPC code, defined under the UNSD-CPC Ver 2.1 classification. Events are part of the division number 96 (recreational, cultural and sporting services) and group number 962 (performing arts and other live entertainment event presentation and promotion services).

To ensure full comparability between the impact assessment results, in the PCR the functional unit is defined as 1 person participating in the event of any dimension, magnitude and duration organized by public and private entities. Results are expressed in kg of CO2e per attendee regardless of the geographic location.

As additional information, it is possible to report as declared unit, namely the global impact related to the whole event.

For the purpose of different data quality rules and for the presentation of results, the life cycle of products is split into three different life cycle stages:

- Pre-event;
- Event;
- Post-event;

as shortly summarized in Fig. 2.

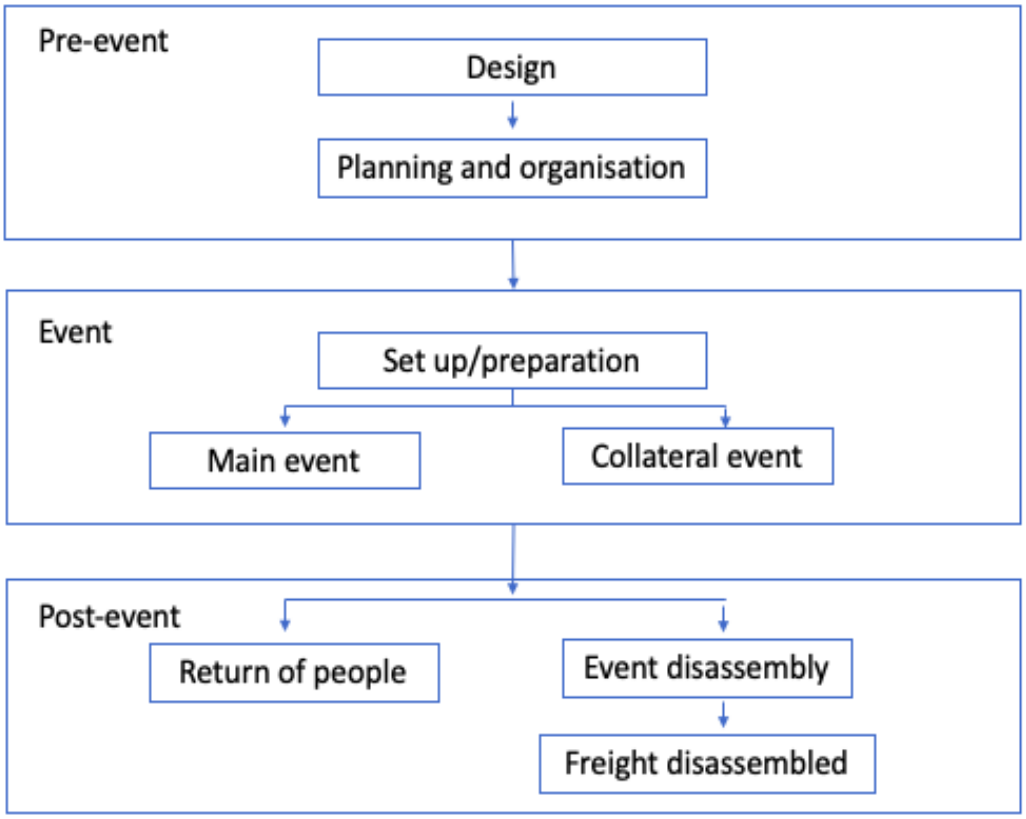

Fig. 2 System diagram illustrating the main processes of the Hero's event.

Regarding the cut-off rules, data for elementary flows to and from the product system contributing to a minimum of 95% of the declared environmental impacts shall be included. The check for cut-off rules in a satisfactory way is through the combination of expert judgment based on experience of similar product systems and a sensitivity analysis in which it is possible to understand how the un-investigated input or output could affect the results.

7. Hero's Case Study

The CFP study quantifies the GHG emissions related to the event HERO Dolomites according to the ISO 14067: 2018 requirements. The scope of the study is related to the strong interest of Hero's organizers to have a full understanding of the impact of this event on climate change and for identifying the most effective areas where a GHG mitigation is possible. Finally, there is the will to share this information with event's partners, attendees and the public since their behaviors and choices play an active role in the generation, management, and reduction of GHG emissions. A communication towards the national program CFI and the operators of the S4CA program will be provided as well.

The objective of conducting a CFP study is to calculate the potential contribution of a product to global warming, expressed in CO2e, by quantifying all significant emissions and removals of GHG over the life cycle of the product.

As mentioned above, the functional unit has been identified in the PCR as 1 attendee taking part in the event, while the declared unit is considered the whole event.

Specific data have been collected by the organization before, during and after the event about all activities included in the study (Table 1). When primary data are not available, secondary data were obtained by database or literature. Those activities have been associated to the different event's phases and emission factors for each datum have been gathered.

For some data emission factors are available on the Ecoinvent database, however, for other data literature research has been necessary to estimate their emission factors.

While associating the most appropriate emission factor to the data provided by Hero, some assumptions have been made, as follow:

(1) Cars: medium size, diesel, EURO 4;

(2) Freight transport: subdivision between ship and road travel for goods coming from abroad through Ecotransit;

(3) Attendees' accommodation: number of guests per night estimated as a percentage of the total number of people overnighting in the area referred to average numbers of previous years (12,188 tourist presences);

(4) Camping: 3 people per camper staying for an average of 3 nights;

(5) Quad and motorcycle: same fuel consumption and comparable to motor scooters for which data are available;

(6) Waste: average density of compost 0.4 kg/L and average distance traveled between event's venue and disposal site equal to 32 km;

(7) Attendees' travel: <1,500 km car, >1,500 km airplane; return trip with the same vehicle and for the same distance;

(8) Staff travel: 180 people traveling round trip to the event every day, average car occupancy of 4 people; 180 people living close to the event's venue thus no transport has been considered.

Once all emission factors needed have been collected, divided into fossil, biogenic and direct Land Use Change (dLUC), they have been multiplied by the total activity data related to the event such as km travelled or liters of beverages consumed. In such a way CFP related to the declared unit has been calculated, results have been expressed for each activity and as total. To obtain data related to the functional unit, previously obtained data have been divided by the total number of attendees which is 2,344.

Table 1 Main information collected for the Hero's study.

Event Phases	Activities
Pre-event	Transport of organizers
	Printing
	Meals
	Beverages
Event	Freight transport
	Staff accommodation
	Attendees' accommodation
	Live broadcast
	Attendees' transport
	Staff transport
	Electrical energy
Post-event	Attendees' transport
	Freight return
	Waste

8. Results

Table 2 and Fig. 3 display the results of the CFP study for the case study. The table contains the total CFP expressed in kg CO2e according to the declared and functional unit and the percentage for the three phases of the event. Fig. 3 below details the percentages of contribution to the total CFP for each of the activities considered during the study.

The largest impacts are generated during the event and post-event phases. Hotspots of GHG emissions are attendees' travel and accommodation and freight transport which are not directly under the organization's control.

It shall be noted that the activities responsible for the greatest impacts are characterized by data of low quality (i.e. the route and means of transport of attendees)

The identification of weaknesses in the data quality collected for this edition of the event is useful to improve the methodology for collection of higher data quality in the future.

It should also be noted that in the specific case study of a mountain bike race there are not significant GHG emissions during the event, in comparison with a car race or a big concert, where a different GHG contribution could be expected among event, attendee's transport and accommodation.

Table 2 GHG emission of the Hero's CFP presented as GHG for FU (attendee), DU (entire event) and as percentage.

Category	Total CFP (kg CO_2e/DU)	Total CFP (kg CO_2e/FU)	% CFP
Pre event	12,102	5.16	1.036%
Event	1,119,293	477.51	95.843%
Post event	36,442	15.55	3.120%
Total	1,167,837	498.22	100%

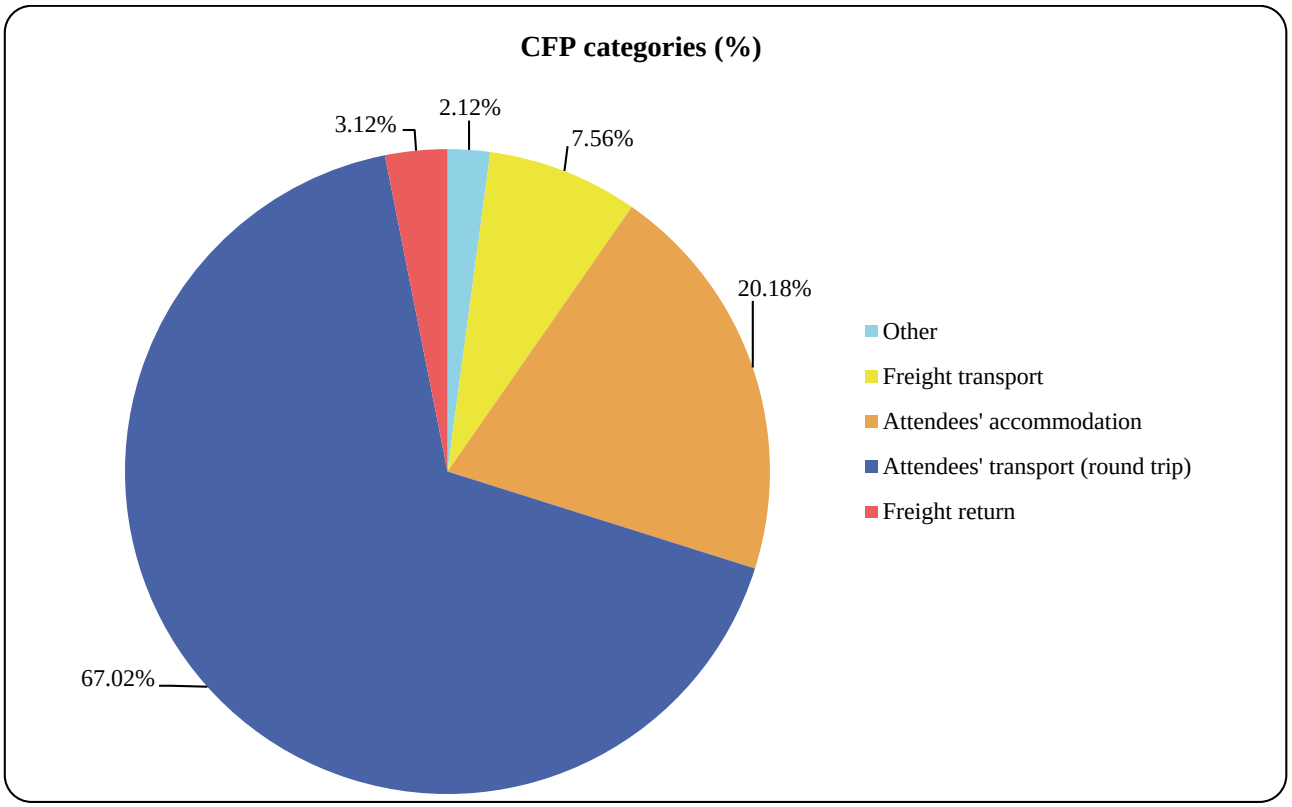

Fig. 3 Most important processes contribution to the HERO's CFP.

9. Conclusions

The great variability of events in term of core topic (i.e., music, sport, etc.), time duration, number of attendees and participants/visitors does not allow identifying a single rigid solution for the quantification of all these carbon footprints.

In the case of single event developed with a multiannual timescale, it shall be more appropriate the adoption of the CFP methodology instead of the CFO, due to the evident weakness of the CFO where a year "zero" baseline is not applicable for the comparison of the year-by-year results.

The CFO is considered the most appropriate solution in the case of GHG emissions quantification of an organization participating in events (i.e., Juventus and McLaren mentioned above).

The Hero Dolomite's case study showed that in all other cases of single event or events repeated each year the CFO approach is possible, however the CFP is considered more suitable, because it can better describe the pre-event, event, and post-event contribution, through the use of the life cycle assessment methodology, where all upstream and downstream contributions to the GHG emissions are considered.

In addition, the use of the PCR allows a consistent approach in the CFP quantification, such as the identification of the Functional Unit and the Declared Unit; a crucial issue for avoiding the GHG quantification of events with very different boundaries that does not allow any comparison between similar events.

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