Case study:

DESIGN OF A NEW SAAS COORDINATION PLATFORM FOR SATELLITE OPERATORS

Oliwia Konieczna (UX/UI Designer)
+ the science department of
Okapi:Orbits


Conjunction Events
Dashboard / Conjunction Events - Updates
OKAPISAT-1 vs AstraLink-392
TCA :2029-11-22 16:30:41 -4d 4h 20m
CURRENT TIME (UTC): 2029-11-18 14:00:00
Me
Updates
Actions
Event Summary
Risk
Time
Category
Source
Type
Related Action
Description
Critical
2022-11-18 13:00:00
Confirmed
System
CDM
-
New CDM received from Space-Track
Low
2022-11-17 09:55:11
Confirmed
System
CDM
-
New CDM received from Space-Track
Event Timeline
Actions
Updates
Stages
4d 4h 20m
TCA
Now
22 Nov
21 Nov
20 Nov
19 Nov
18 Nov
17 Nov
CAM EXECUTION CONFIRM
CAM DECISION & DESIGN
DATA UPDATE
CONFIRM ASSIGNMENT
EVENT ASSIGNMENT AND DATA UPLOAD
CONJUNCTION DETECTION
Collision probability
Miss distance
Mahalanobis distance
Radial miss distance

THE PROJECT

AND

THE PROCESS

Product

Rule based Coordination Platform for satellite operators. Created while working at Okapi:Orbits.

Goal of the project

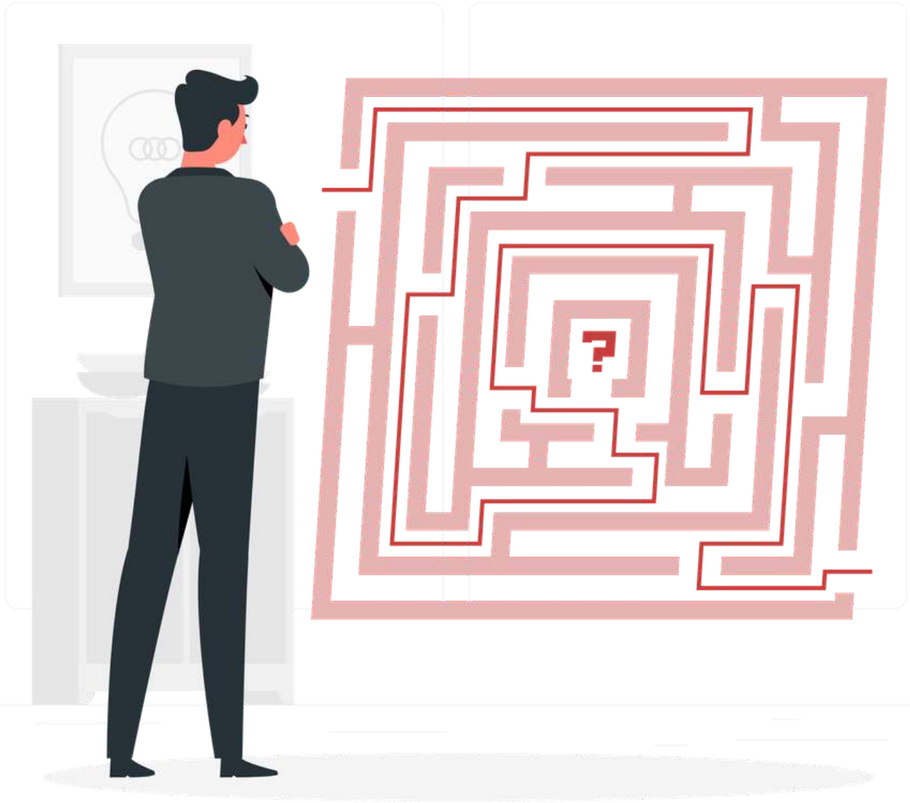
Make the communication between satellite operators easier by development of a tool combining communication channel, data sharing and coordination of conjunctions in one place.

My Responsibilities

- User Research
- Defining problems & finding solutions
- User Experience Design
- Visual Design and Prototyping

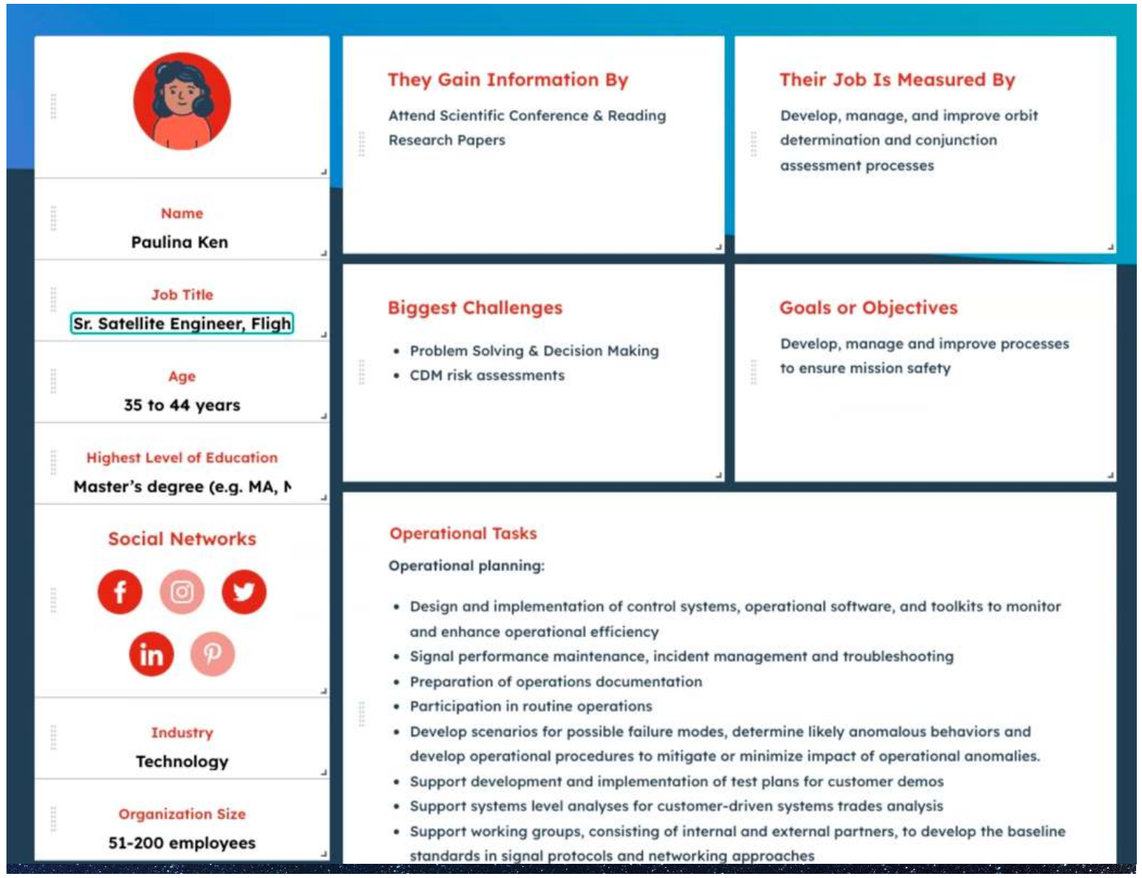
Software

- Figma
- FigJam
- Miro
- Teams
- Gitlab
- Microsoft Planner



Exploring the problem

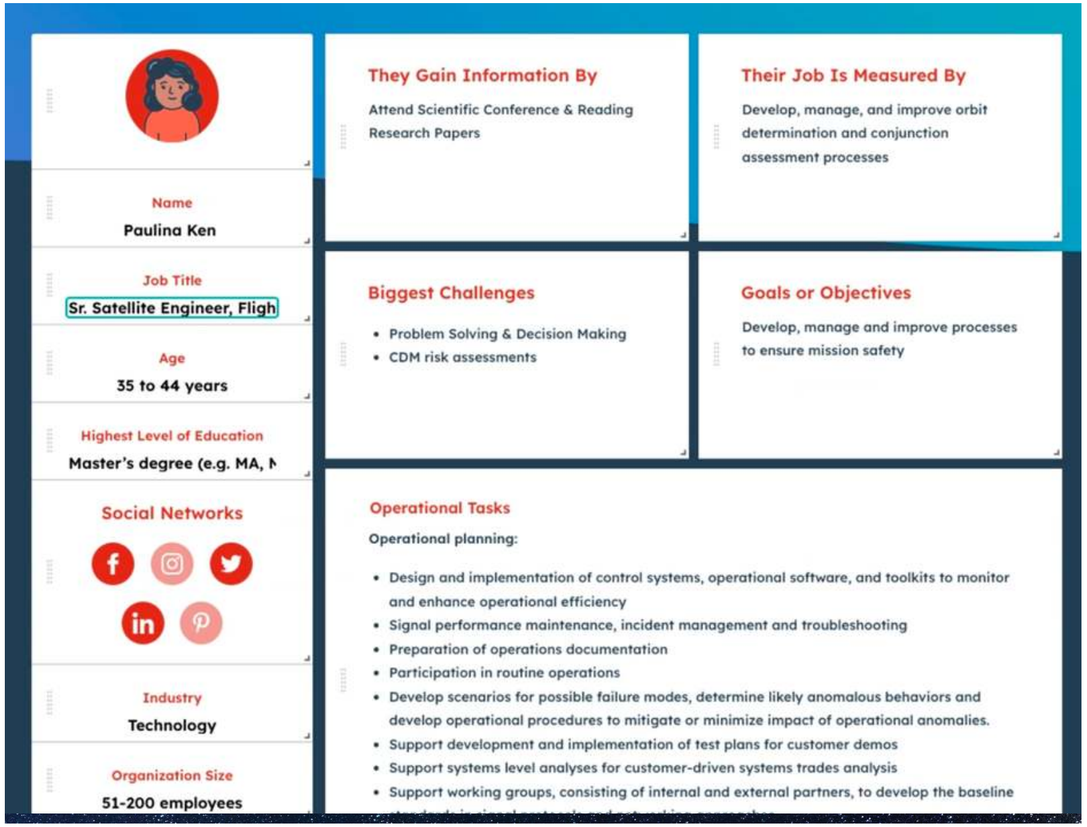
A lot of satellite operators are concerned since they don't know whether they can trust their conjunction partner. Moreover, they have to make quick desicions to perform maneuvers and use a lot of methods in order to reach out to their conjunction partner.



UX Workshops

One of our first moves was to get the lowdown on our potential customers. We had a head start with some of them since we already owned a piece of software used by satellite operators. So, I decided to gather a few key players for a laid-back UX workshop to hash out an Empathy Map and build a cool User Persona.

SAMPLES



Name
Paulina Ken

Job Title
Sr. Satellite Engineer, Fligh

Age
35 to 44 years

Highest Level of Education
Master's degree (e.g. MA, M

Social Networks

Industry
Technology

Organization Size
51-200 employees

They Gain Information By

Attend Scientific Conference & Reading Research Papers

Their Job Is Measured By

Develop, manage, and improve orbit determination and conjunction assessment processes

Biggest Challenges

- Problem Solving & Decision Making
- CDM risk assessments

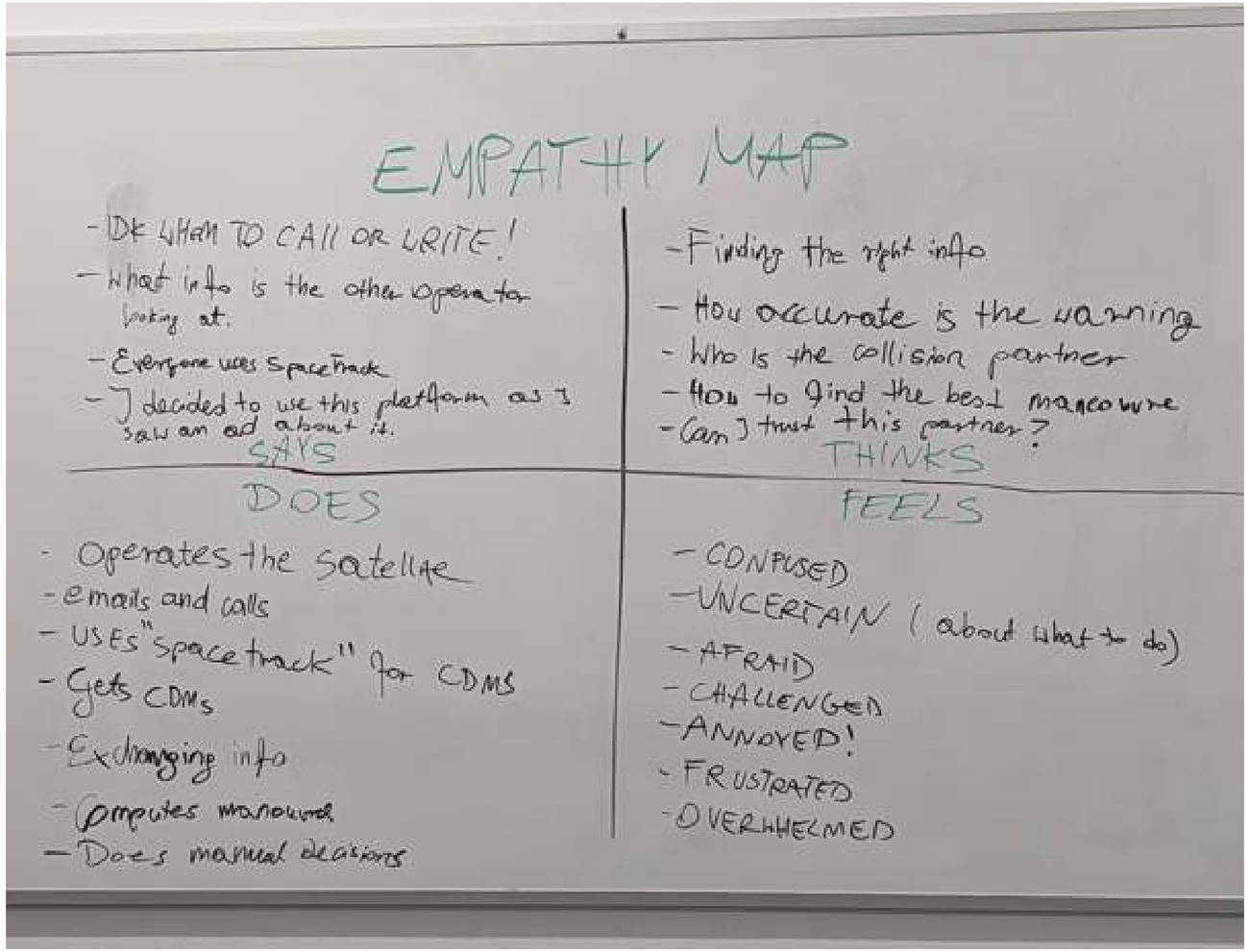
Goals or Objectives

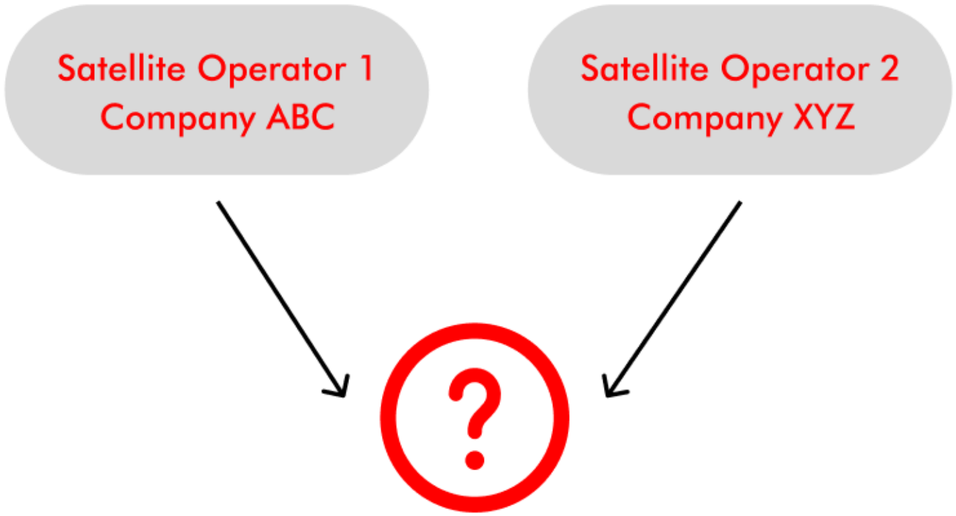
Develop, manage and improve processes to ensure mission safety

Operational Tasks

Operational planning:

- Design and implementation of control systems, operational software, and toolkits to monitor and enhance operational efficiency
- Signal performance maintenance, incident management and troubleshooting
- Preparation of operations documentation
- Participation in routine operations
- Develop scenarios for possible failure modes, determine likely anomalous behaviors and develop operational procedures to mitigate or minimize impact of operational anomalies.
- Support development and implementation of test plans for customer demos
- Support systems level analyses for customer-driven systems trades analysis
- Support working groups, consisting of internal and external partners, to develop the baseline

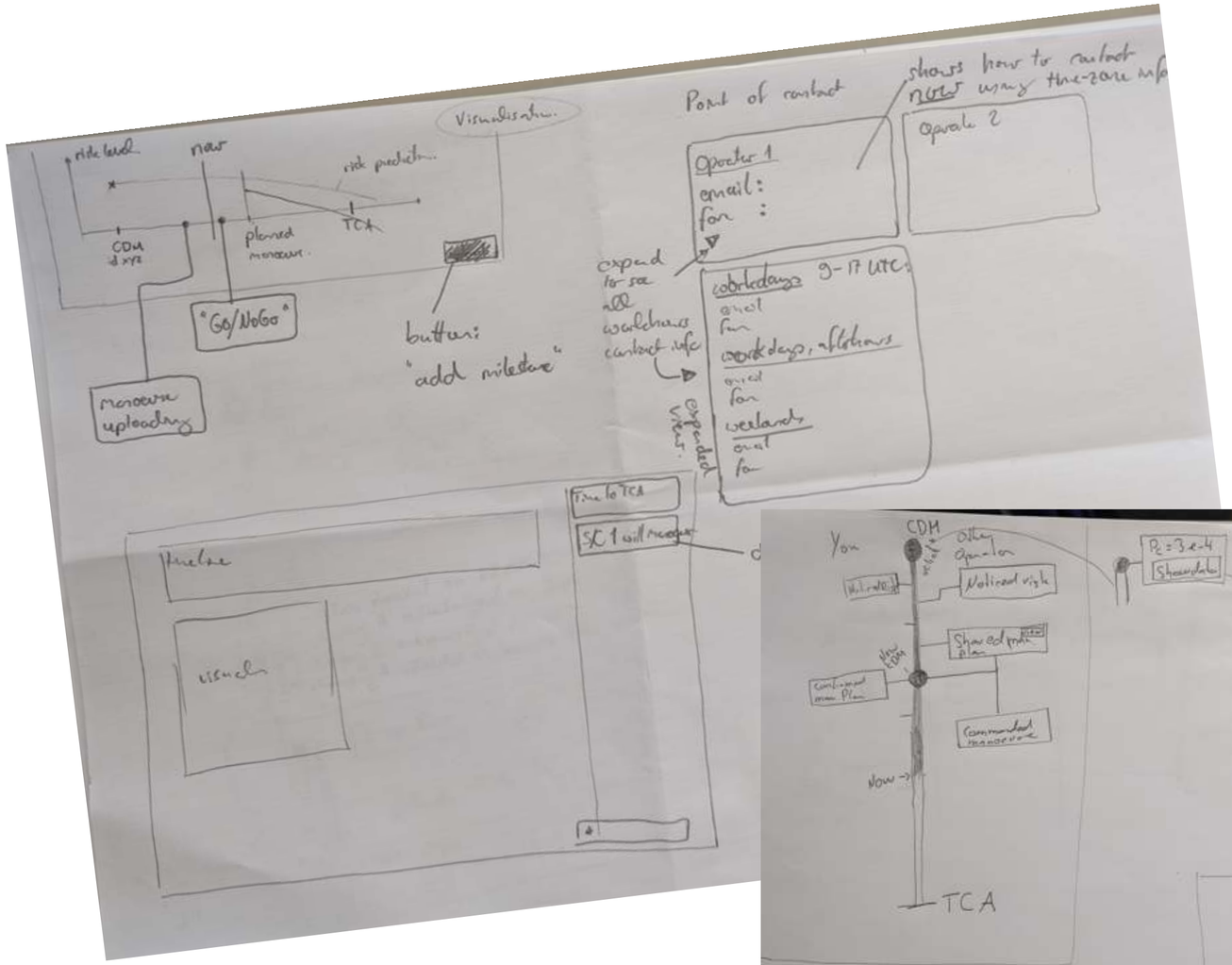


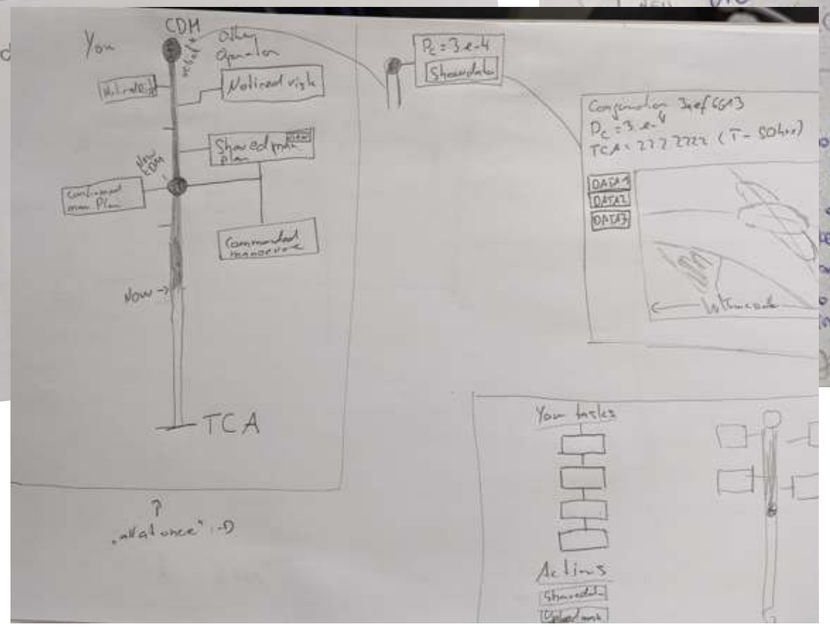


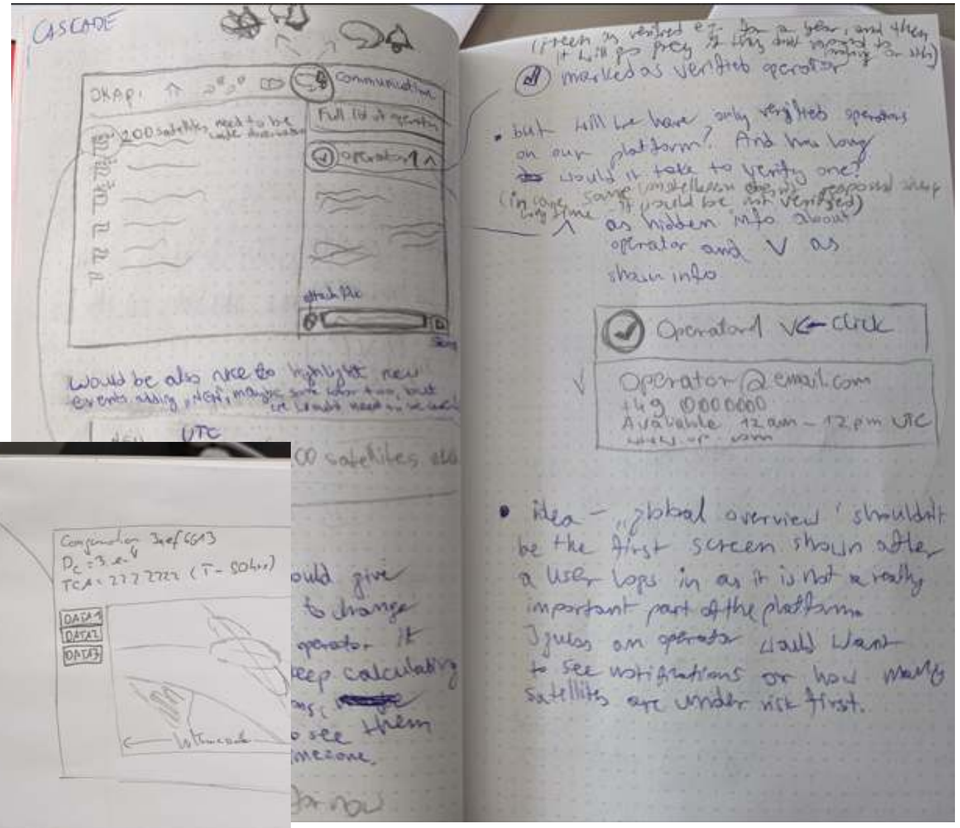
User flows

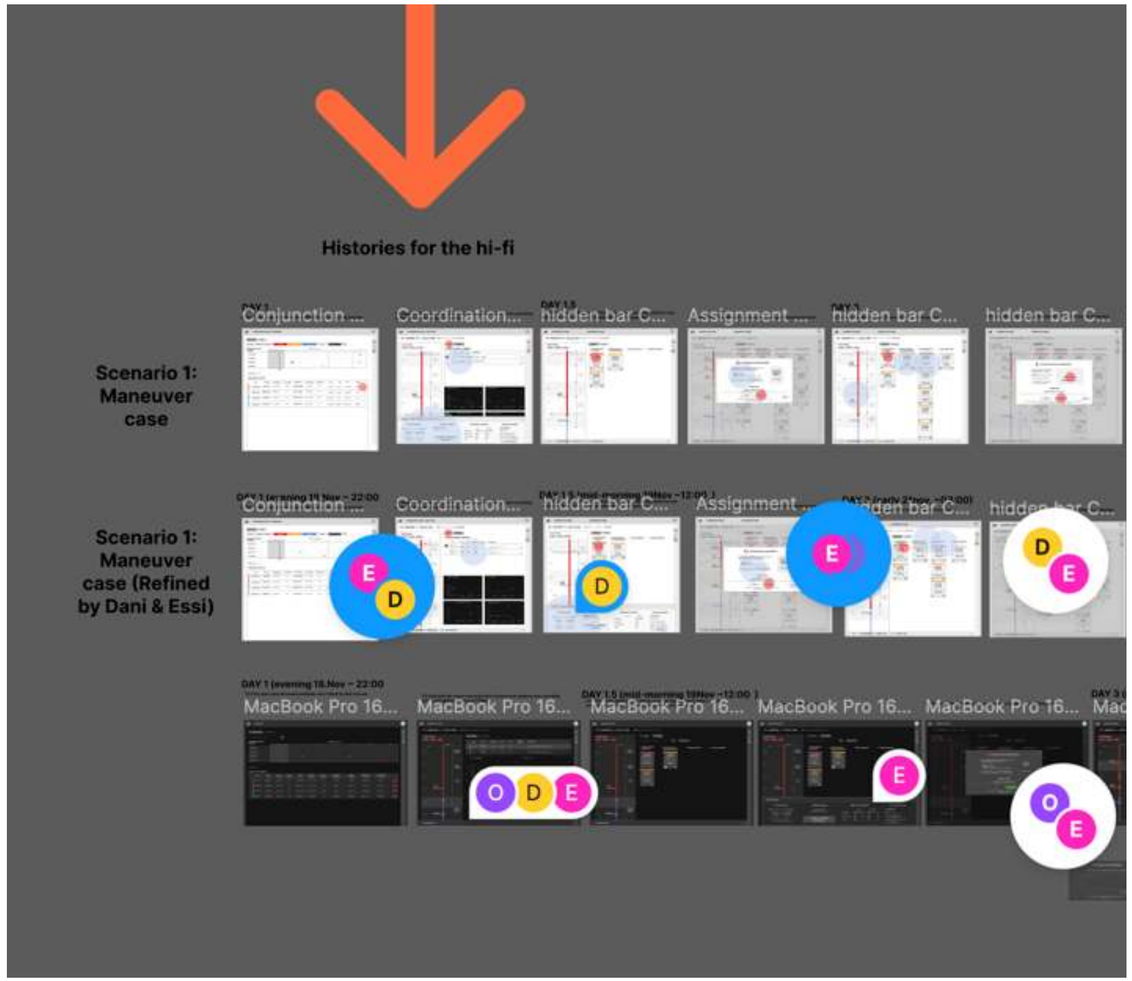
Given the preexisting technical specifications provided by the European Space Agency, who sponsored this project, our team embarked on the task of defining the core components slated for integration into the initial release of our Minimum Viable Product (MVP). This multifaceted endeavor encompassed the generation of various user flows, the construction of a Priority Matrix, and the meticulous crafting of an extensive software architecture. These collaborative efforts were streamlined through the effective utilization of FigJam.

First sketches of the wireframes



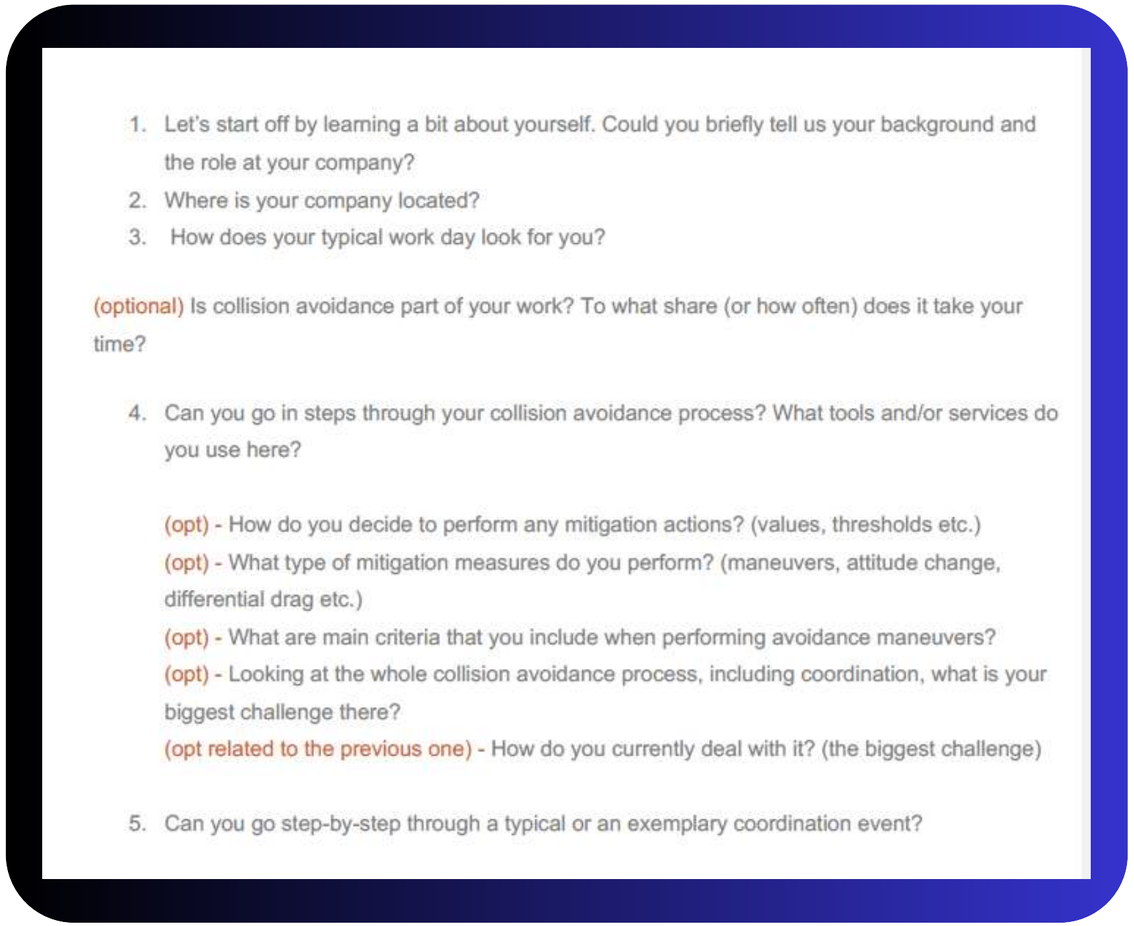






From low fidelty to high fidelity wireframes

In preparation for our MVP release, we made a strategic decision to create wireframes aligning with two distinct scenarios that I thoughtfully defined in consultation with aerospace engineers. These scenarios were designated as "Task 1 - The Maneuver Case" and "Task 2 - Protocol Definition." It was essential to prioritize the acquisition of user feedback on the first task, as the protocols were slated for implementation in the subsequent release of CASCADE.



1. Let's start off by learning a bit about yourself. Could you briefly tell us your background and the role at your company?
2. Where is your company located?
3. How does your typical work day look for you?

(optional) Is collision avoidance part of your work? To what share (or how often) does it take your time?

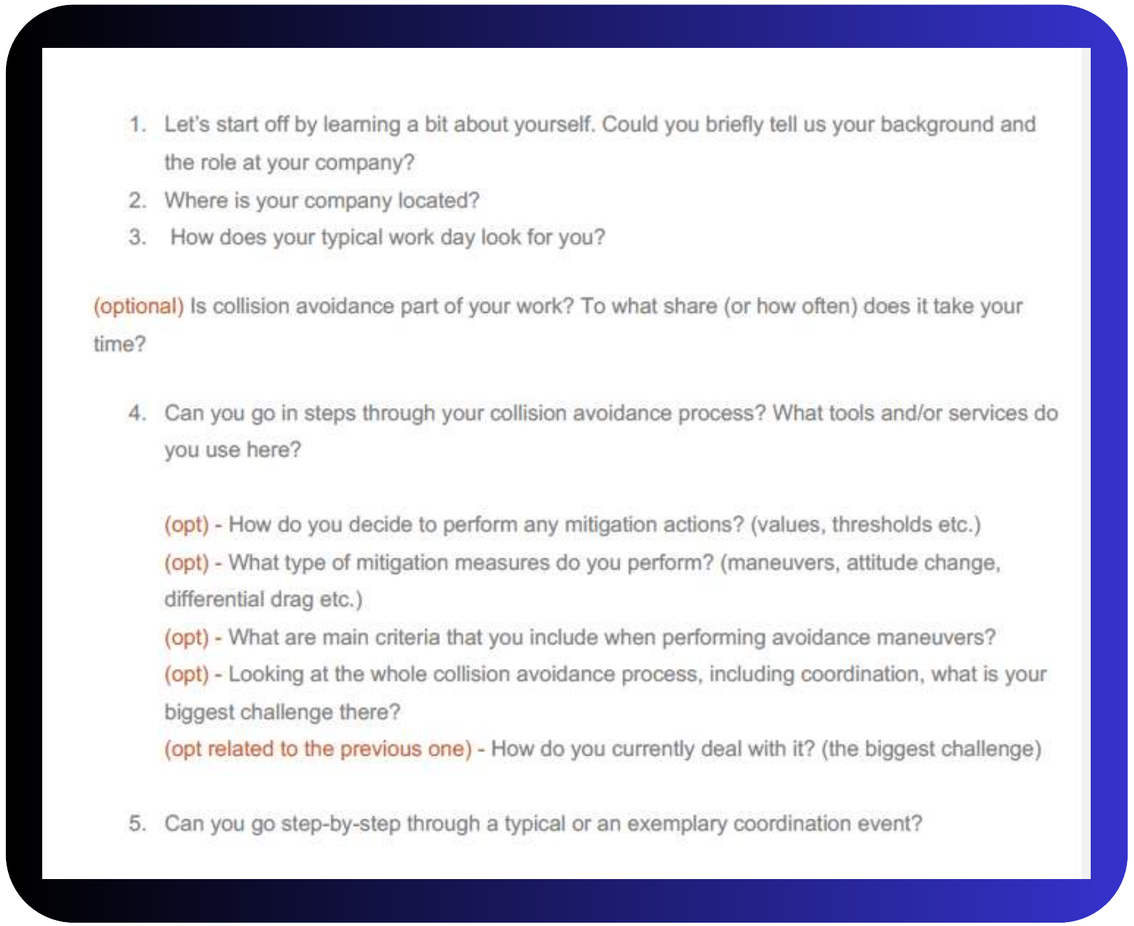
4. Can you go in steps through your collision avoidance process? What tools and/or services do you use here?

   (opt) - How do you decide to perform any mitigation actions? (values, thresholds etc.)
   (opt) - What type of mitigation measures do you perform? (maneuvers, attitude change, differential drag etc.)
   (opt) - What are main criteria that you include when performing avoidance maneuvers?
   (opt) - Looking at the whole collision avoidance process, including coordination, what is your biggest challenge there?
   (opt related to the previous one) - How do you currently deal with it? (the biggest challenge)

5. Can you go step-by-step through a typical or an exemplary coordination event?

User Interviews

Once the high fidelity wireframes were done for the Task 1 and 2 we conducted in-depth-interviews with 11 satellite operators from different countries like the England, France and Italy. We asked them a few questions regarding their work routines in collision avoidance and sent them prototypes on Figma to observe whether they struggle to complete our tasks and to ask extra questions related directly to our prototype. Later we collected and grouped information on a board on Miro.



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5. Can you go step-by-step through a typical or an exemplary coordination event?

User Interviews

One of the major goals we had during the interviews was to find out answers on questions like:

- Will users struggle to navigate in our platform?
- Will they feel comfortable to share data like ephemeris as not every space company does it?
- How would they decide to obtain information about their conjunction partner? Where would they expect to find information about them?

On the left - a small sample of our first version of the interview script.

Scenario

- Participant is a satellite operator in charge of a satellite fleet
- Several conjunction events have been identified for some of the satellites
- The conjunctions are against other active satellites
- The participant is using now CASCADE to get an overview of the situation and to coordinate such a conjunction and mitigate the collision
- Mention that the current date of the "simulation" is the 18.11.2022

Task topics (USPs):

- Show asset management (dashboard)
- Show clear process (time line and phases)
- Show clear responsibilities (actions)
- Show transparency (Actions)
- Show decision making (assign maneuver)
- Show data sharing (upload function)
- Show secondary operator contact info. (event summary)

Interview Task 1 Maneuver coordination

Section 1 topics
- Show asset management
- Show clear process (time li

Scenario

- It is a completely new scenario and has nothing to do with the previous one
- Participant is still an operator
- A conjunction event was identified between two operators and they were able to mitigate the risk using CASCADE, similar to the previous scenario
- We are now after the TCA
- In contrast to the previous scenario, there are no rules defined between the operators
- The operators want to now define a rule for future conjunction events

Task topics (USPs):

- Define common rules (new action with rule suggestion)

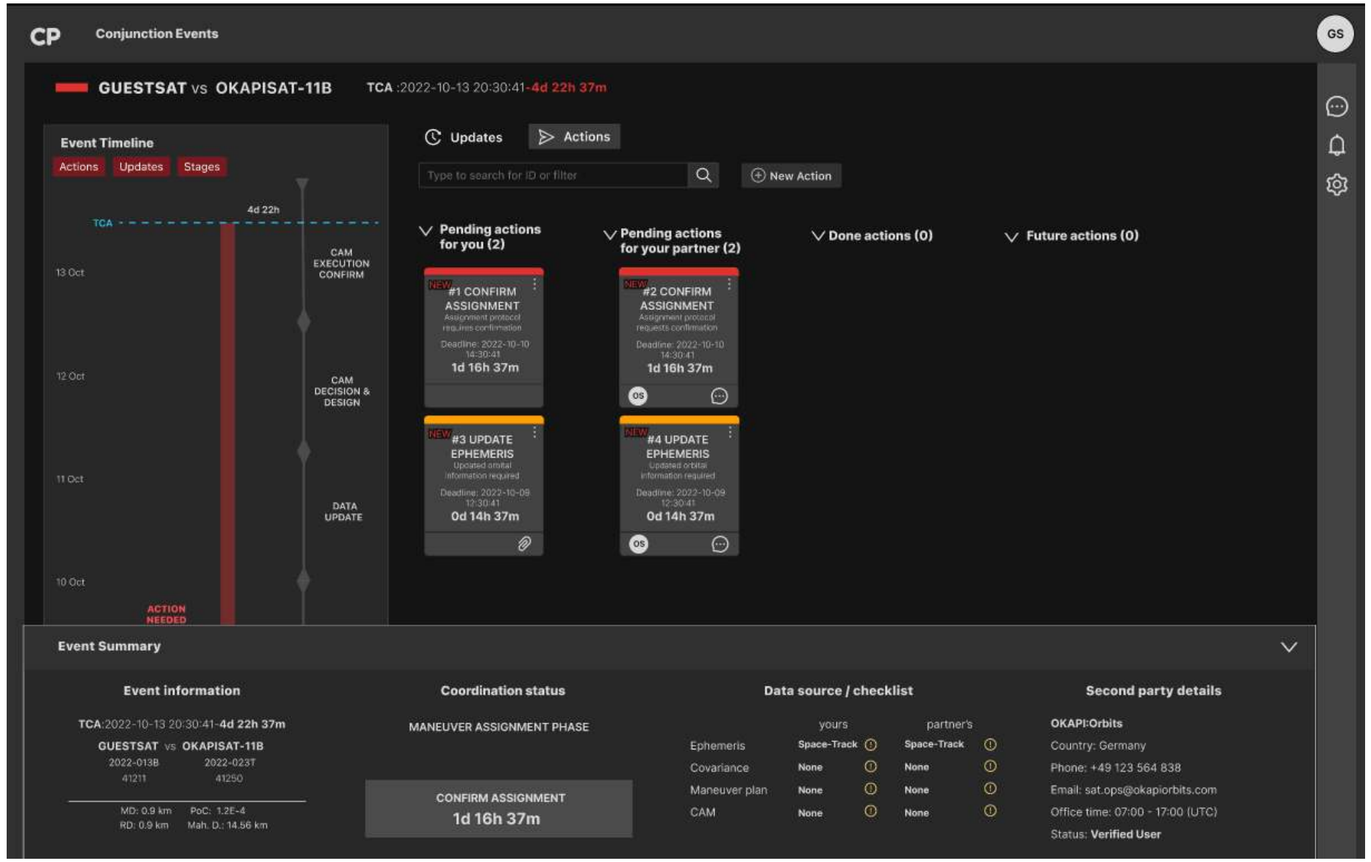
Interview Task 2 Rule Assignment

LESSONS THAT I LEARNT

FROM

THE IN-DEPTH-INTEVIEWS

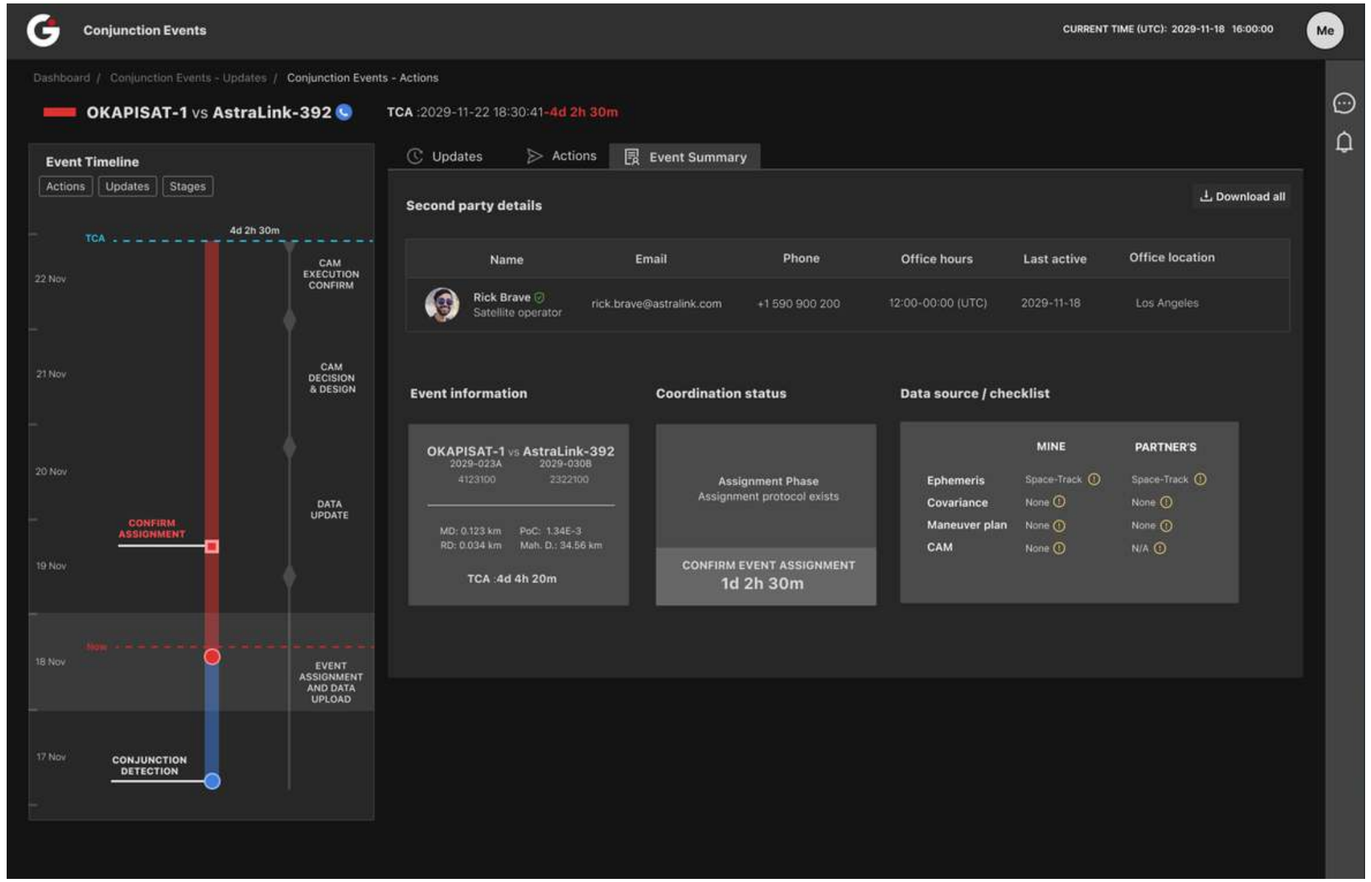
BEFORE THE IMPROVEMENT :



Lesson 1: Before

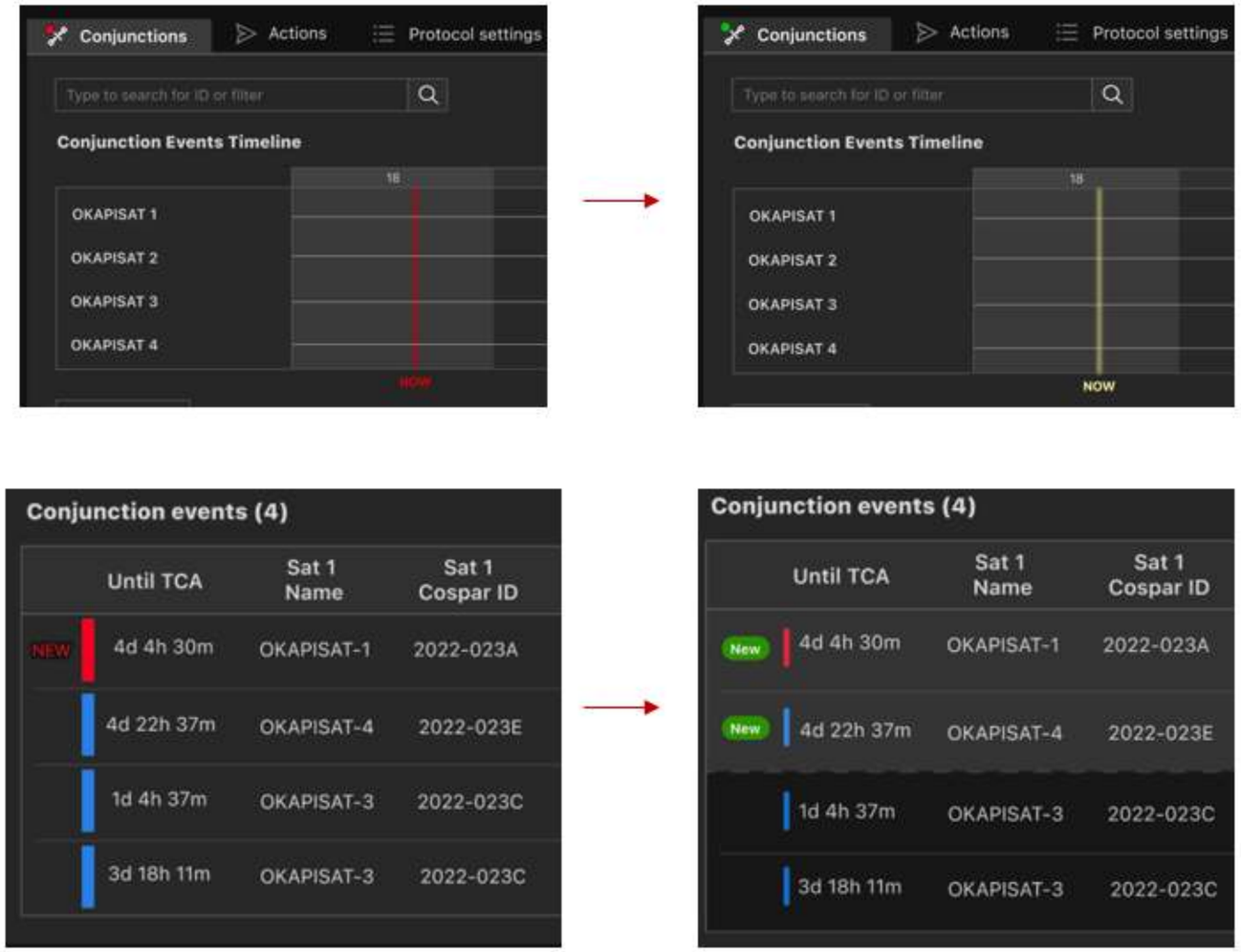
One of the important decisions I learnt was to change the placement of the Event Summary as in the first version of our wireframes it was a bar at the bottom that a user could open after a click (The reference on the left - Event summary while being open).

AFTER THE IMPROVEMENT :



Lesson 1: After

During the interviews I found out it was not easy to find it. Moreover after opening it was limiting the view of the Event Timeline and could also limit the view of Actions and Updates covering important information for the user.



Lesson 2:

I learnt that some items could be interpreted in a wrong way as for e.g. the usage of Red colour for critical events and new notifications so I decided to find a way how to differentiate new conjunctions in a better way plus what colour would make sense to use in our platform so that they would not resemble other items with a specific colour code..
(the changes from this slide would be implemented after MVP Release that happened in August 2023).

HIGH FIDELITY WIREFRAMES

Dashboard

CURRENT TIME (UTC): 2029-11-18 14:00:00

Me

Conjunctions | Actions | Protocol settings

Type to search for ID or filter

Conjunction Events Timeline

NOVEMBER 2029

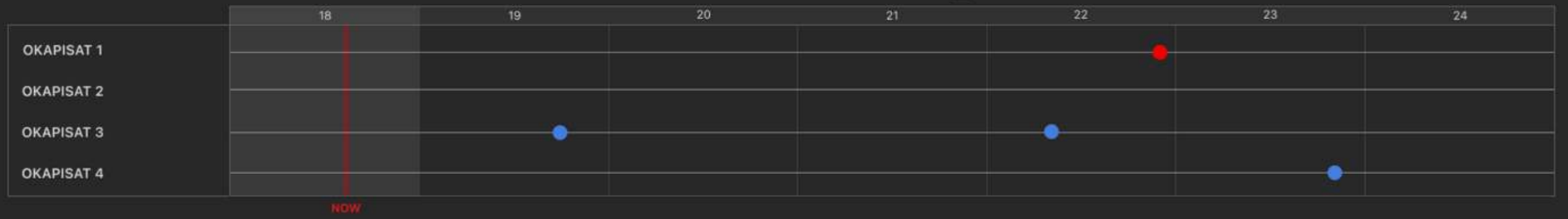
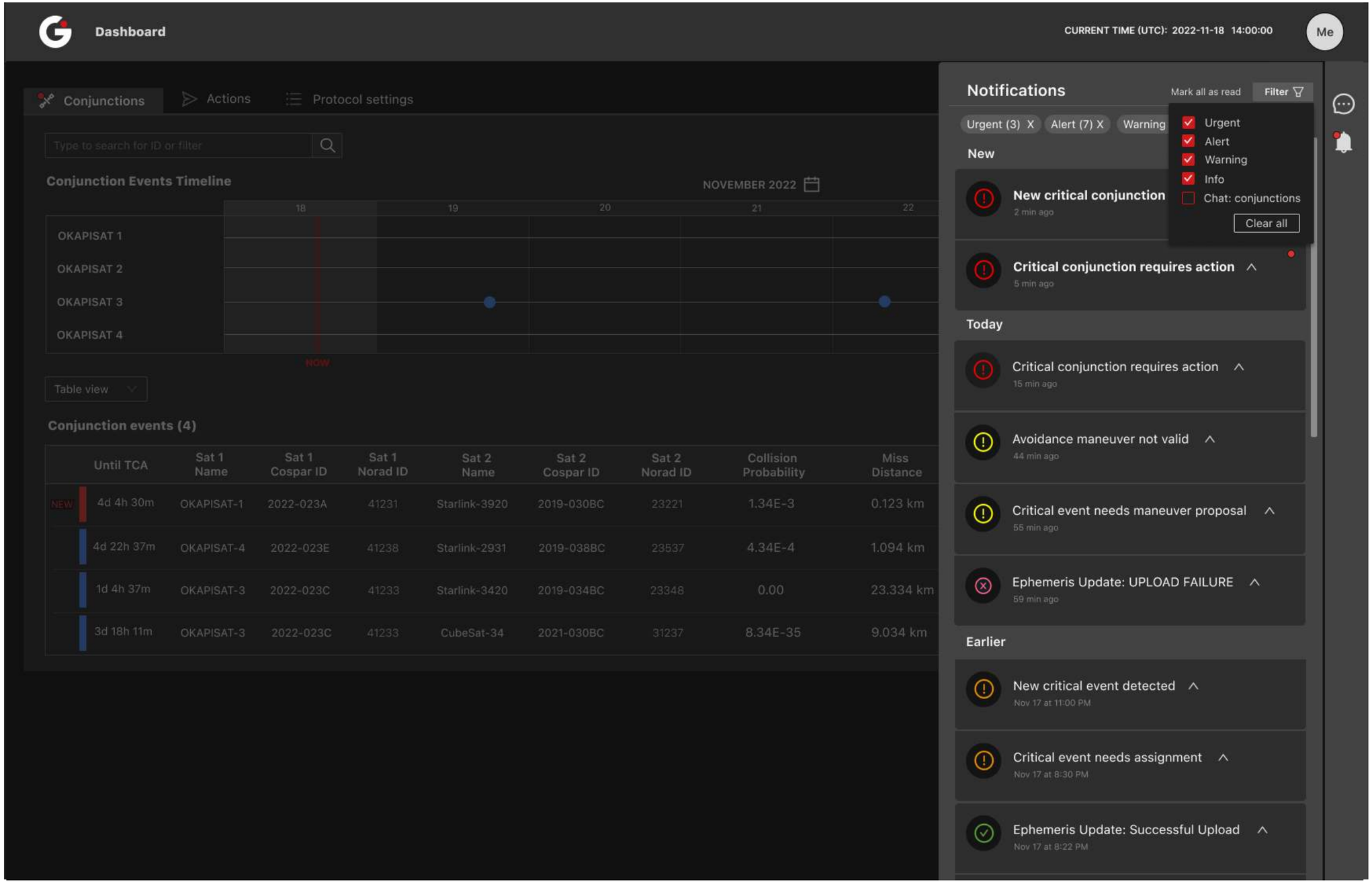


Table view

Conjunction events (4)

	Until TCA	Sat 1 Name	Sat 1 Cospar ID	Sat 1 Norad ID	Sat 2 Name	Sat 2 Cospar ID	Sat 2 Norad ID	Collision Probability	Miss Distance	Radial Miss Distance	Mahalanobis Distance	
NEW	4d 4h 30m	OKAPISAT-1	2029-023A	4123160	AstraLink-392	2029-030B	2322100	1.34E-3	0.123 km	0.034 km	2.56	Details
	4d 22h 37m	OKAPISAT-4	2029-023EA	4123890	CosmoWave-2931	2029-038B	2353700	4.34E-4	1.094 km	1.024 km	14.56	Details
	1d 4h 37m	OKAPISAT-3	2029-023CA	4123301	AstraLink-3420	2029-034B	2334800	0.00	23.334 km	4.394 km	3.56	Details
	3d 18h 11m	OKAPISAT-3	2029-023CA	4123350	AstraLink-34	2029-030B	3123070	8.34E-35	9.034 km	1.934 km	34.56	Details


Dashboard
CURRENT TIME (UTC): 2022-11-18 14:00:00
Me
Conjunctions
Actions
Protocol settings
Type to search for ID or filter
Conjunction Events Timeline
NOVEMBER 2022
18
19
20
21
22
OKAPISAT 1
OKAPISAT 2
OKAPISAT 3
OKAPISAT 4
NOW
Table view
Conjunction events (4)
Until TCA
Sat 1 Name
Sat 1 Cospar ID
Sat 1 Norad ID
Sat 2 Name
Sat 2 Cospar ID
Sat 2 Norad ID
Collision Probability
Miss Distance
NEW
4d 4h 30m
OKAPISAT-1
2022-023A
41231
Starlink-3920
2019-030BC
23221
1.34E-3
0.123 km
4d 22h 37m
OKAPISAT-4
2022-023E
41238
Starlink-2931
2019-038BC
23537
4.34E-4
1.094 km
1d 4h 37m
OKAPISAT-3
2022-023C
41233
Starlink-3420
2019-034BC
23348
0.00
23.334 km
3d 18h 11m
OKAPISAT-3
2022-023C
41233
CubeSat-34
2021-030BC
31237
8.34E-35
9.034 km
Notifications
Mark all as read
Filter
Urgent (3) X
Alert (7) X
Warning
Urgent
Alert
Warning
Info
Chat: conjunctions
Clear all
New
New critical conjunction
2 min ago
Critical conjunction requires action
5 min ago
Today
Critical conjunction requires action
15 min ago
Avoidance maneuver not valid
44 min ago
Critical event needs maneuver proposal
55 min ago
Ephemeris Update: UPLOAD FAILURE
59 min ago
Earlier
New critical event detected
Nov 17 at 11:00 PM
Critical event needs assignment
Nov 17 at 8:30 PM
Ephemeris Update: Successful Upload
Nov 17 at 8:22 PM

Conjunction Events

CURRENT TIME (UTC): 2029-11-18 14:00:00

Me

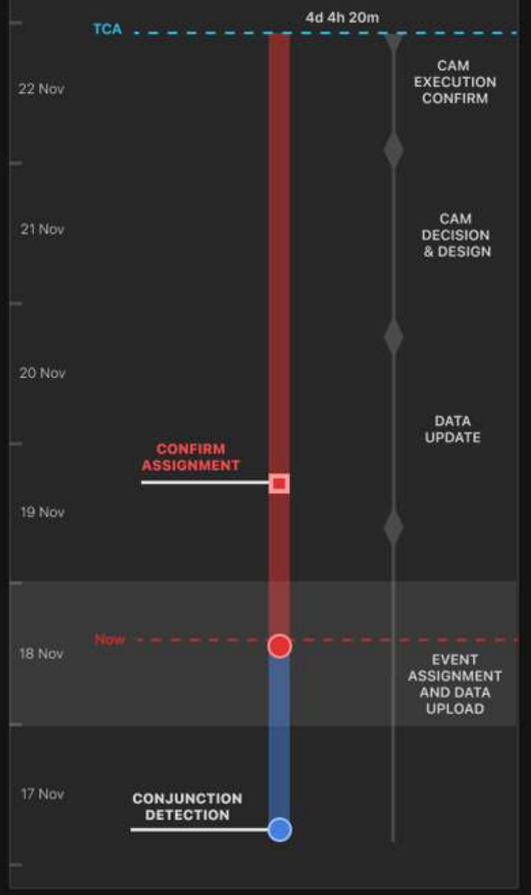
Dashboard / Conjunction Events - Updates

OKAPISAT-1 vs **AstraLink-392**

TCA :2029-11-22 18:30:41-**4d 4h 20m**

Event Timeline

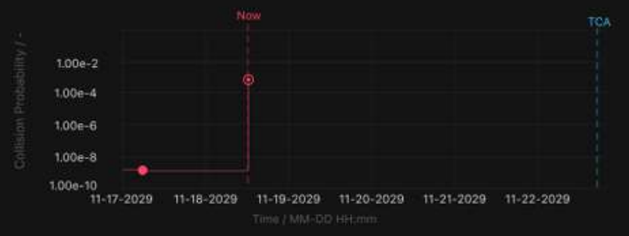
Actions | Updates | Stages



Updates | Actions | Event Summary

	Risk	Time	Category	Source	Type	Related Action	Description
	Critical	2022-11-18 13:00:00	Confirmed	System	CDM	-	New CDM received from Space-Track
	Low	2022-11-17 09:55:11	Confirmed	System	CDM	-	New CDM received from Space-Track

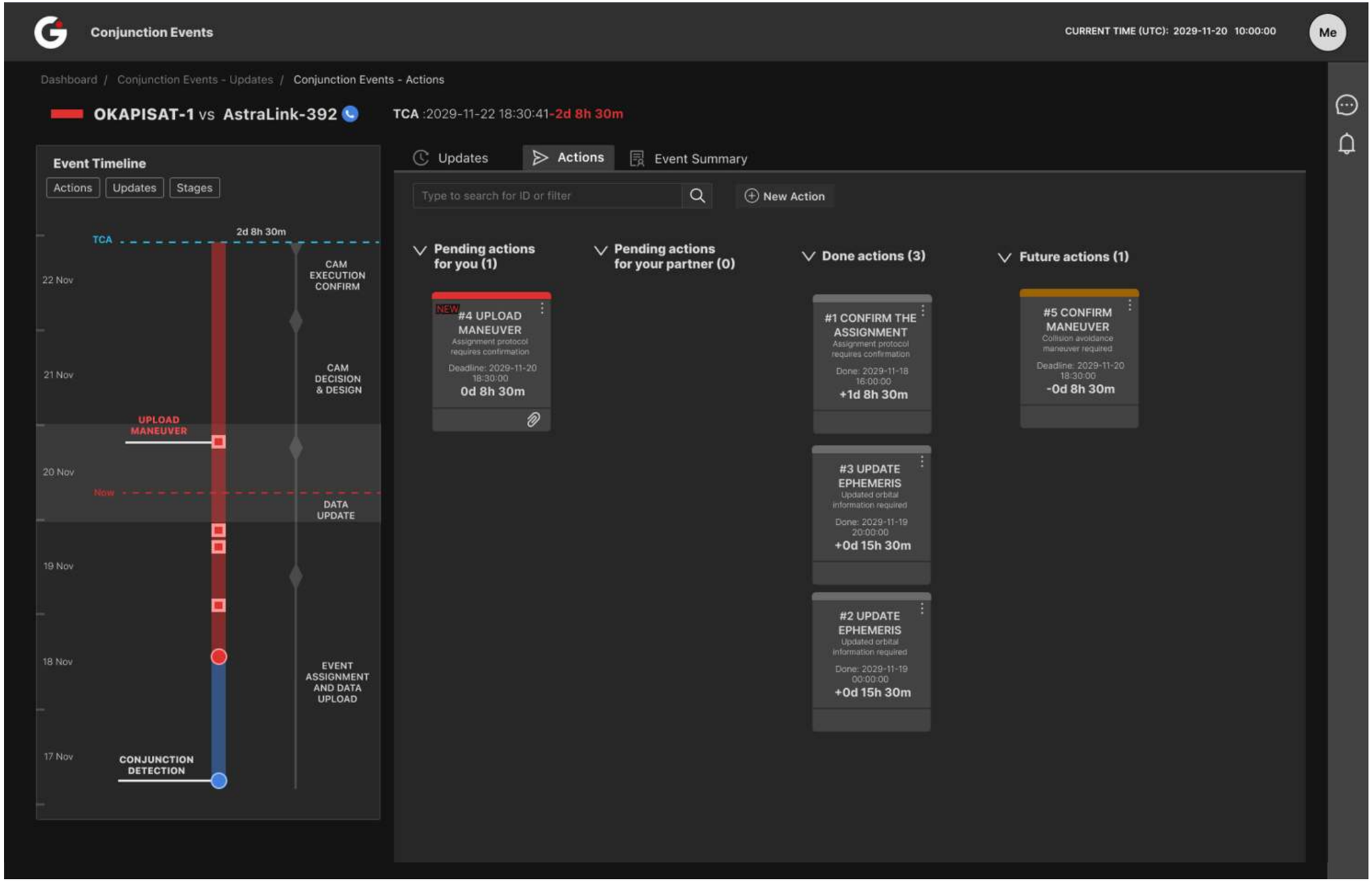
Collision probability

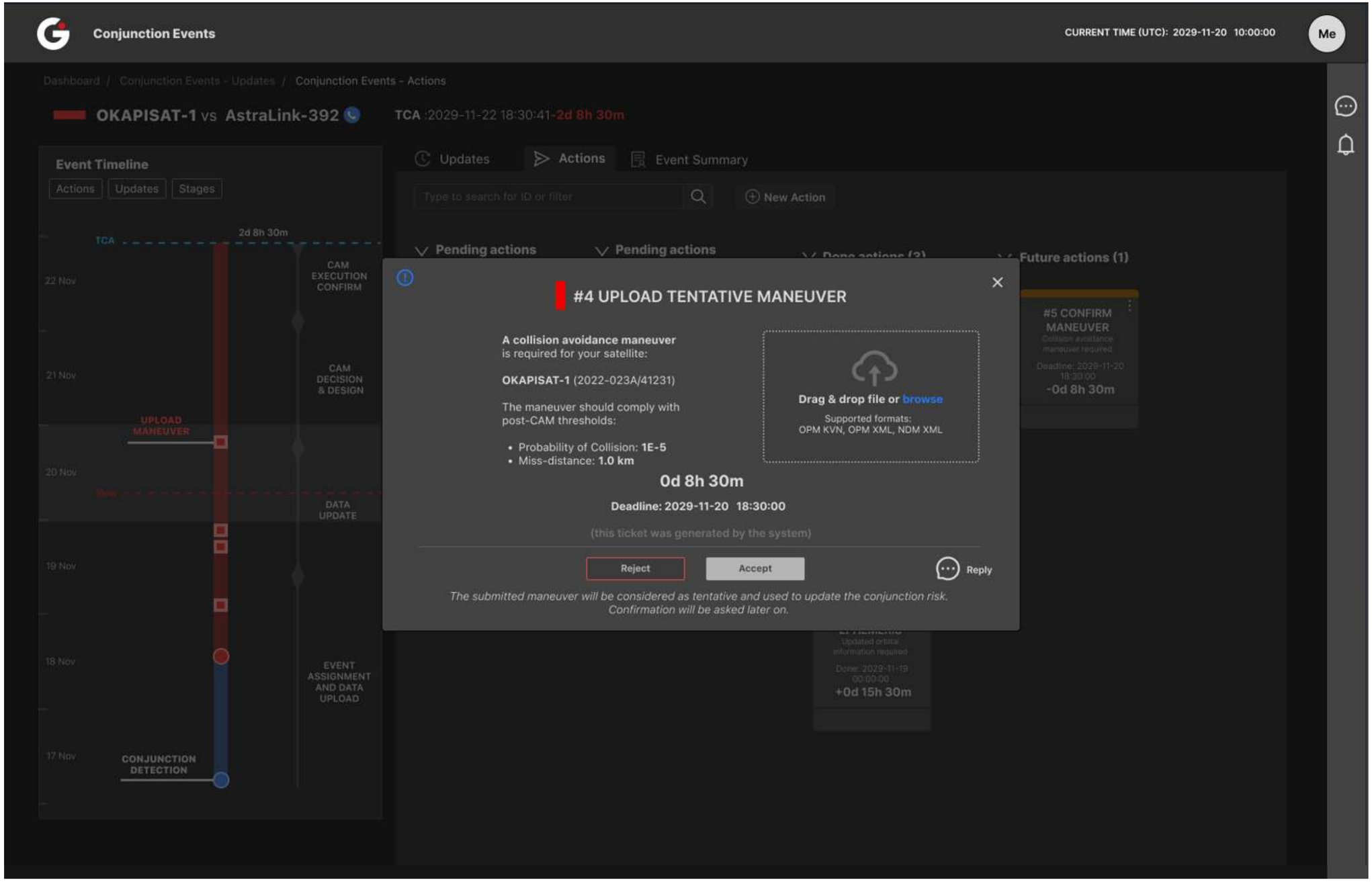


Miss distance

Mahalanobis distance

Radial miss distance


Conjunction Events
CURRENT TIME (UTC): 2029-11-20 10:00:00
Me
Dashboard / Conjunction Events - Updates / Conjunction Events - Actions
OKAPISAT-1 vs AstraLink-392
TCA :2029-11-22 18:30:41-2d 8h 30m
Event Timeline
Actions
Updates
Stages
2d 8h 30m
TCA
22 Nov
21 Nov
20 Nov
Now
19 Nov
18 Nov
17 Nov
CAM EXECUTION CONFIRM
CAM DECISION & DESIGN
UPLOAD MANEUVER
DATA UPDATE
EVENT ASSIGNMENT AND DATA UPLOAD
CONJUNCTION DETECTION
Updates
Actions
Event Summary
Type to search for ID or filter
New Action
Pending actions for you (1)
Pending actions for your partner (0)
Done actions (3)
Future actions (1)
NEW
#4 UPLOAD MANEUVER
Assignment protocol requires confirmation
Deadline: 2029-11-20 18:30:00
0d 8h 30m
#1 CONFIRM THE ASSIGNMENT
Assignment protocol requires confirmation
Done: 2029-11-18 16:00:00
+1d 8h 30m
#3 UPDATE EPHEMERIS
Updated orbital information required
Done: 2029-11-19 20:00:00
+0d 15h 30m
#2 UPDATE EPHEMERIS
Updated orbital information required
Done: 2029-11-19 00:00:00
+0d 15h 30m
#5 CONFIRM MANEUVER
Collision avoidance maneuver required
Deadline: 2029-11-20 18:30:00
-0d 8h 30m


Conjunction Events
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Dashboard / Conjunction Events - Updates / Conjunction Events - Actions
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DATA UPDATE
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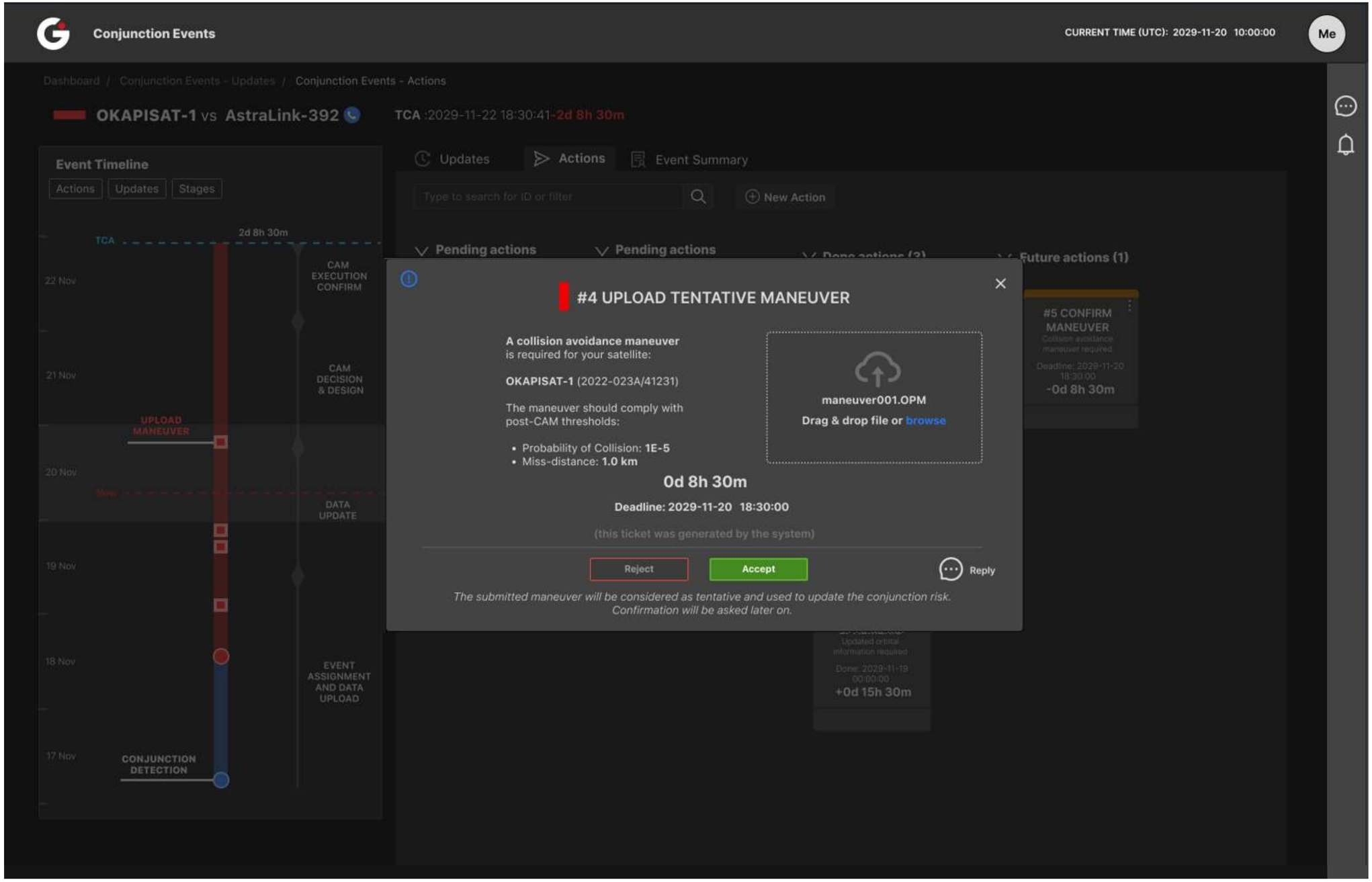
CONJUNCTION DETECTION
Updates
Actions
Event Summary
Type to search for ID or filter
New Action
Pending actions
Pending actions
Future actions (1)
#5 CONFIRM MANEUVER
Collision avoidance maneuver required
Deadline: 2029-11-20 18:30:00
-0d 8h 30m
#4 UPLOAD TENTATIVE MANEUVER
A collision avoidance maneuver is required for your satellite:
OKAPISAT-1 (2022-023A/41231)
The maneuver should comply with post-CAM thresholds:
Probability of Collision: 1E-5
Miss-distance: 1.0 km
Drag & drop file or browse
Supported formats:
OPM KVN, OPM XML, NDM XML
0d 8h 30m
Deadline: 2029-11-20 18:30:00
(this ticket was generated by the system)
Reject
Accept
Reply
The submitted maneuver will be considered as tentative and used to update the conjunction risk.
Confirmation will be asked later on.
Updated orbital information required
Done: 2029-11-19 00:00:00
+0d 15h 30m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Type to search for ID or filter
New Action
Pending actions
Pending actions
Future actions (1)
#5 CONFIRM MANEUVER
Collision avoidance maneuver required
Deadline: 2029-11-20 18:30:00
-0d 8h 30m
Updated orbital information required
Done: 2029-11-19 00:00:00
+0d 15h 30m
#4 UPLOAD TENTATIVE MANEUVER
A collision avoidance maneuver is required for your satellite:
OKAPISAT-1 (2022-023A/41231)
The maneuver should comply with post-CAM thresholds:
• Probability of Collision: 1E-5
• Miss-distance: 1.0 km
maneuver001.OPM
Drag & drop file or browse
0d 8h 30m
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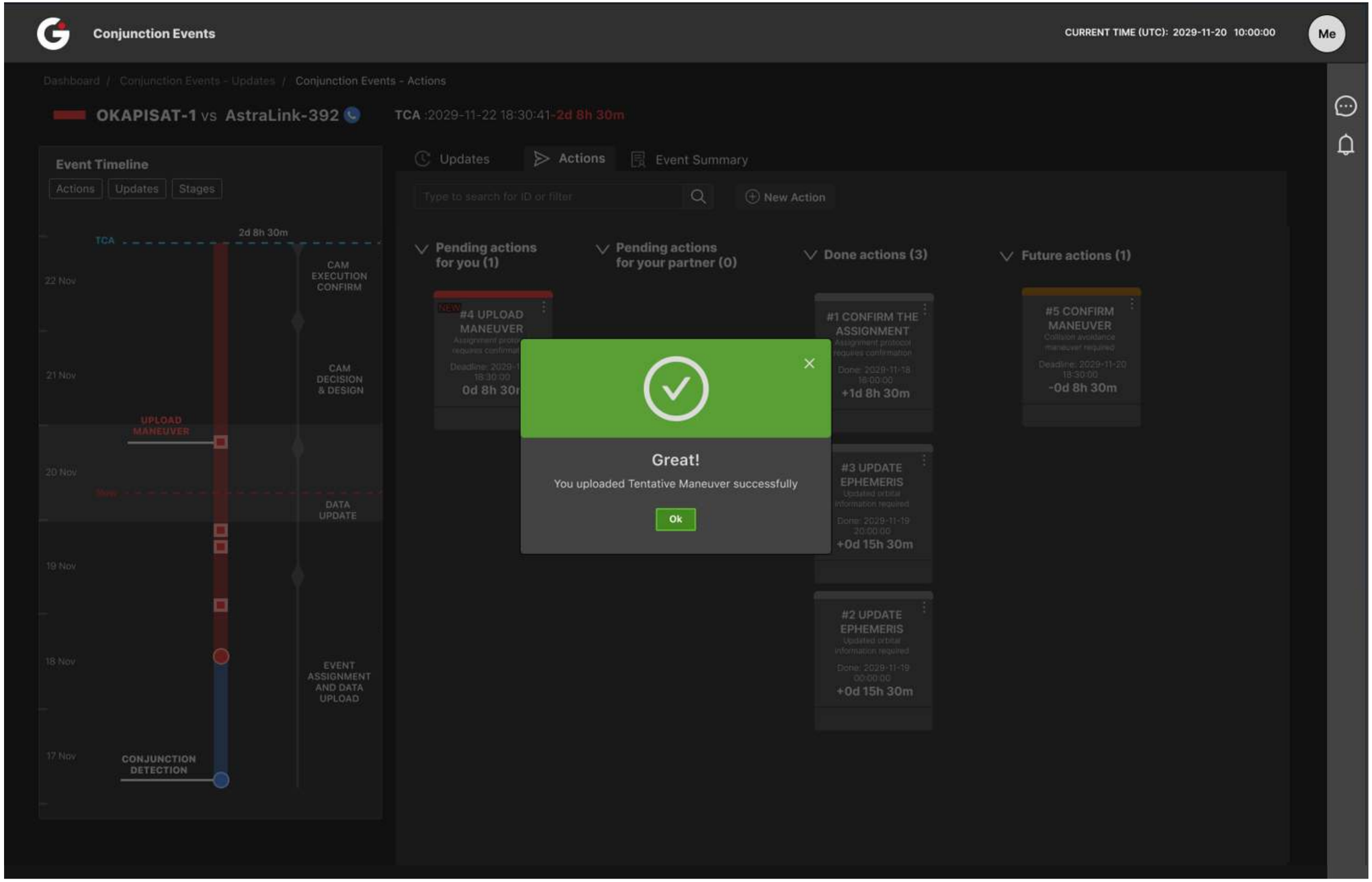
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Event Summary
Type to search for ID or filter
New Action
Pending actions for you (1)
Pending actions for your partner (0)
Done actions (3)
Future actions (1)
NEW
#4 UPLOAD MANEUVER
0d 8h 30
#1 CONFIRM THE ASSIGNMENT
+1d 8h 30m
#3 UPDATE EPHEMERIS
+0d 15h 30m
#2 UPDATE EPHEMERIS
+0d 15h 30m
#5 CONFIRM MANEUVER
-0d 8h 30m
Great!
You uploaded Tentative Maneuver successfully
Ok