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Software for Optimising UxV Planning Over Large Areas

SeeByte Summary



- Offices in Edinburgh, Southampton (UK) and San Diego (US)
- Serving over 20 navies across the globe
- Providing solutions to the oil and gas domain
- Adding value to hardware through expert software engineering
- Working in partnership with leading sensor and vehicle vendors
- SeeByte is appraised at CMMI® Level 2 and has ISO 9001 (2015) certification
- SeeByte is a subsidiary of Battelle



Unmanned Warrior 2016

Royal Navy's Maritime Autonomous Systems Demonstration

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- Hell Bay 4 a TTCP Trial
- Neptune used to run autonomous collaborative missions
- Integrated assets from US NSWC-PCD, DRDC, Dstl and Royal Navy's MASTT team
- Working with 5 different manufacturers
- Across air, sea surface and subsea



World first multi-squad collaborative autonomous MCM mission using seven AUVs, two USVs and one UAV. A total of ten robots.

Unmanned Warrior 2016

Royal Navy's Maritime Autonomous Systems Demonstration

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UK



Canada



US

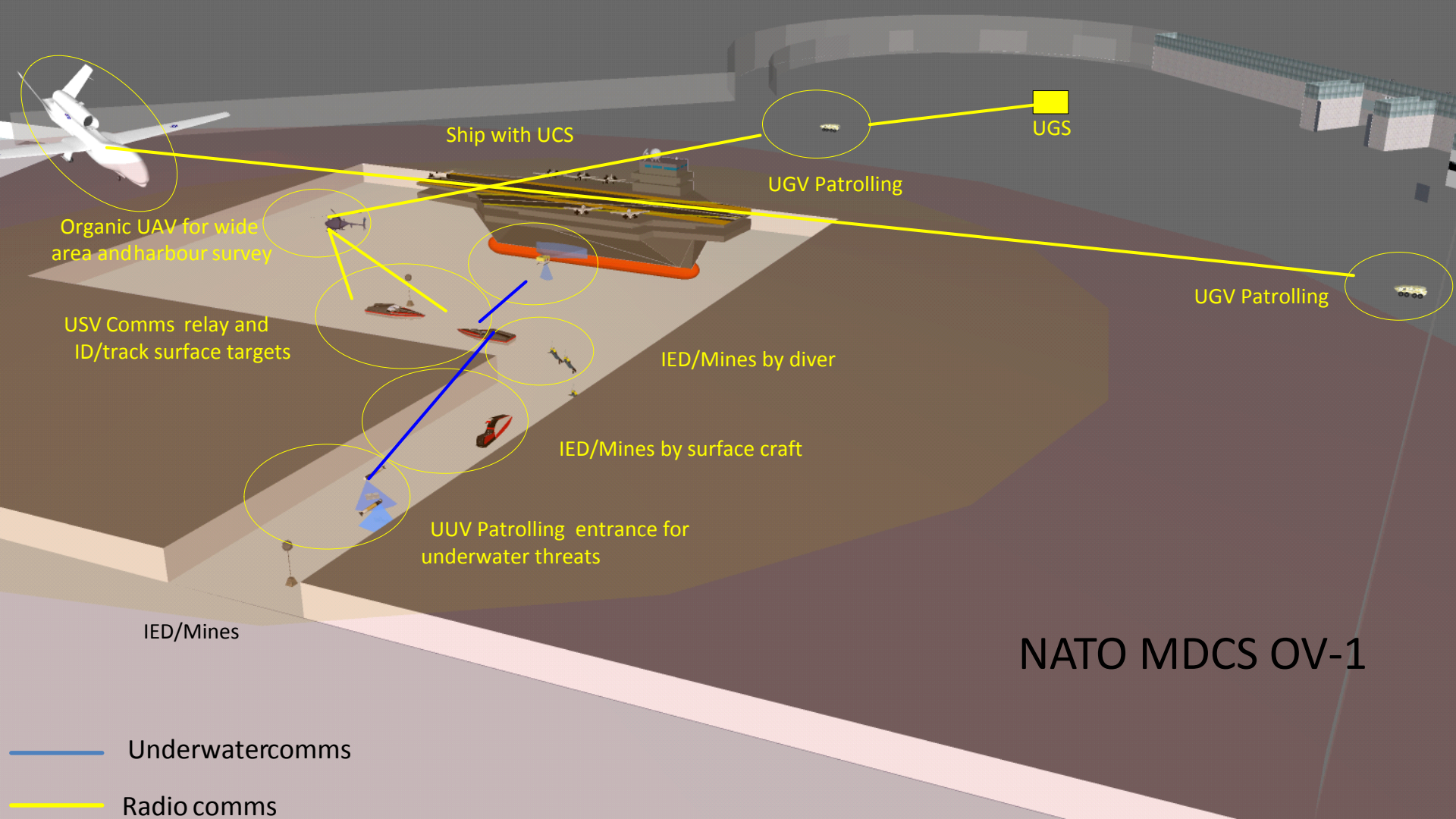
Unmanned Warrior 2016

Royal Navy's Maritime Autonomous Systems Demonstration

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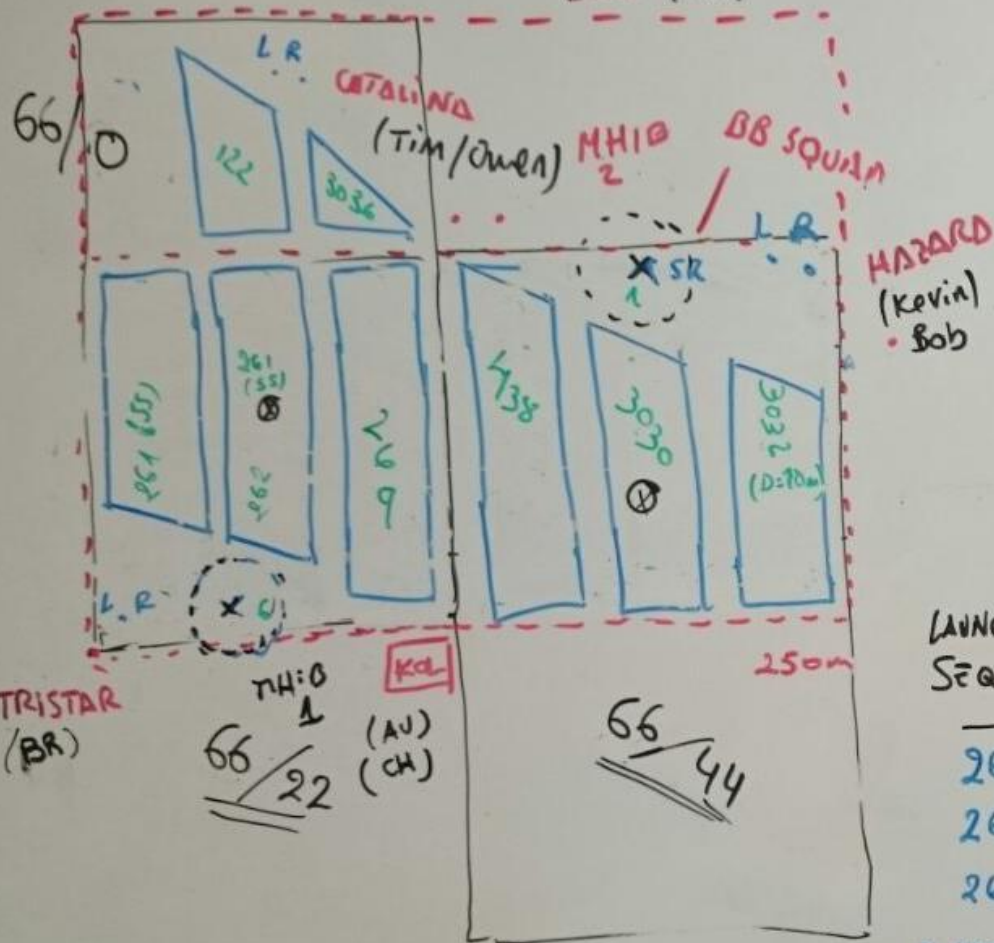


So what is the problem?





(\mathcal{H}, F)



	261 262	3030 3032	2600 CW
PLAN	GPS timecast 180 RECON Altitude CLOCKS Remus Transit Depth	WP tol 7 Depth CLOCKS	Pc ✓ Mode m CLOCKS
PUSH			
CHECKS	<ul style="list-style-type: none"> - Check UTC - Baseline same - Remus transit depth (DVL) - Survey Alt for Remus - Connect I/Os. - Invert Transit Depth (not too deep) - Guess WP tol. - GPS time and Remus - Arson time ok. - Arson on R. - USVs target longer - Connect off / date. 		

LAUNCH SEQ	SURVEY ALT	MODEL ID	DR
261	5	8	1
262	8	10	3
269	6	11	4
5-1000000	0	6	





DISCOVERY

TOBI

AUTOSUBS

www.autosubs.co.uk

Key Technologies

Large-scale Planning Tools

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- Smart tools to breakdown areas
- Automated plan optimisation
- User interface for scheduling

Key Technologies

Large-scale Planning Tools

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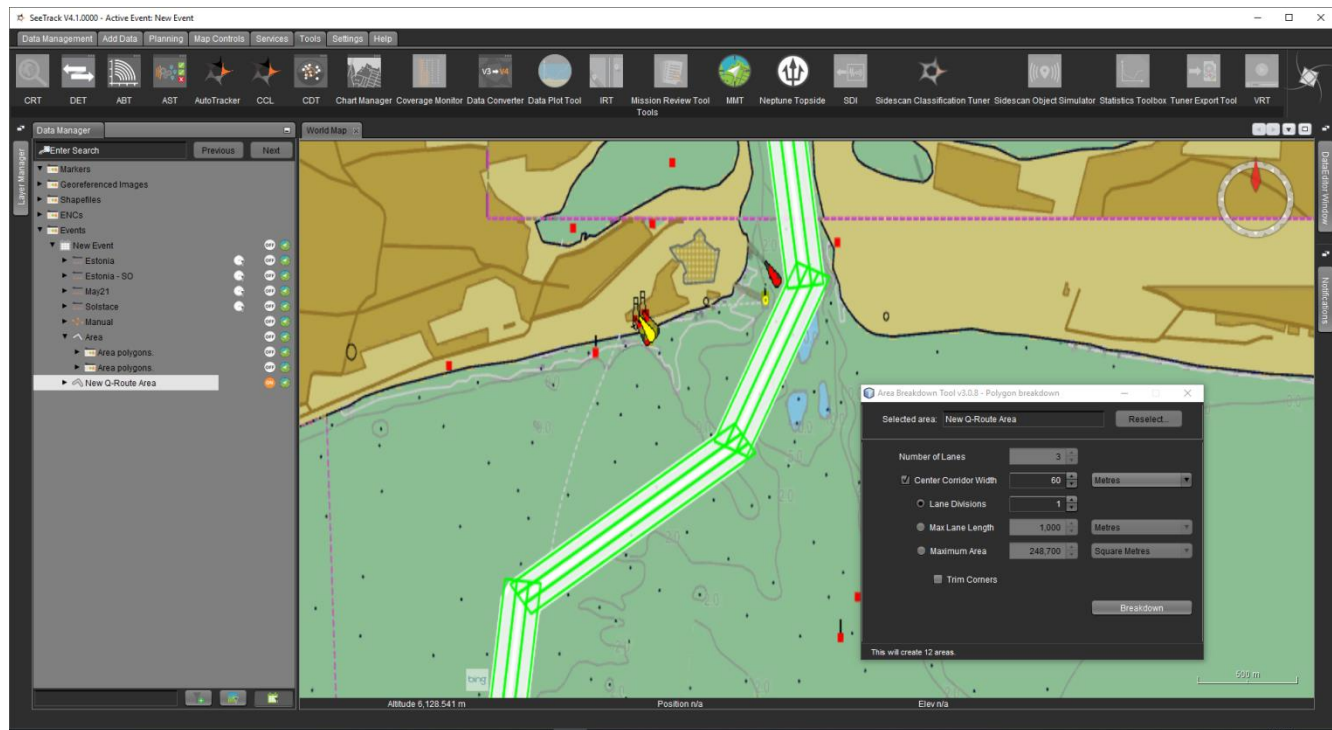
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Large-scale Planning Tools

Smart tools to breakdown areas

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- Q-route
- Survey Area
- Polygon

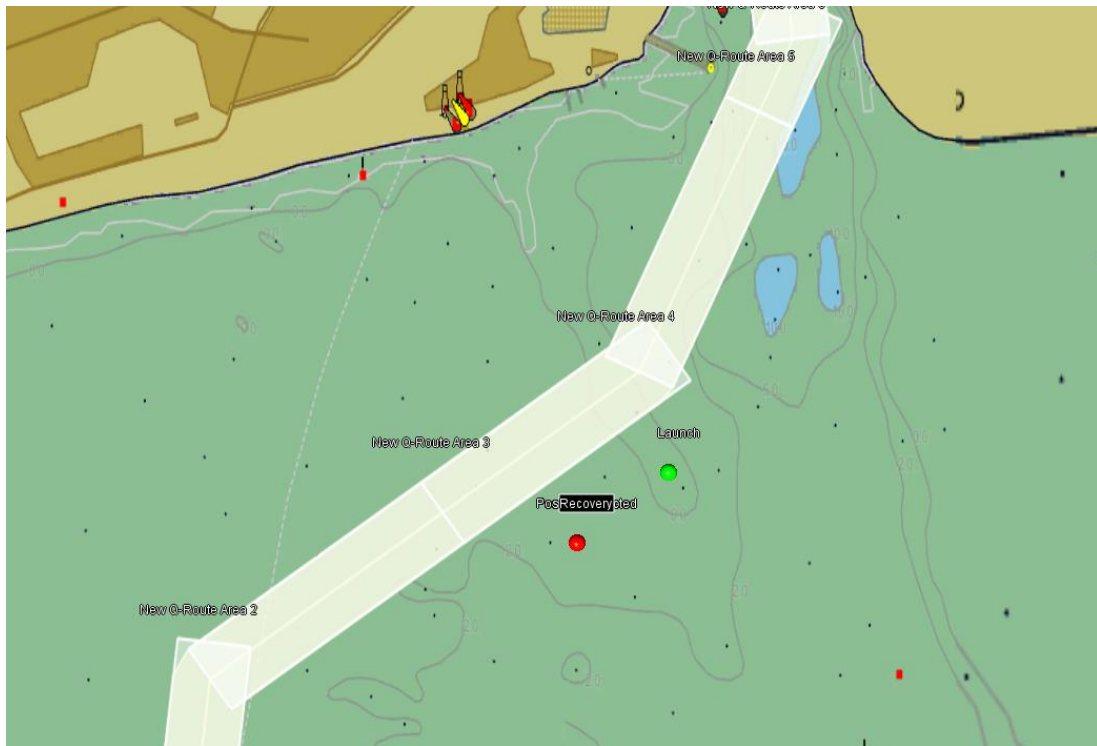


Key Technologies

Large-scale Planning Tools

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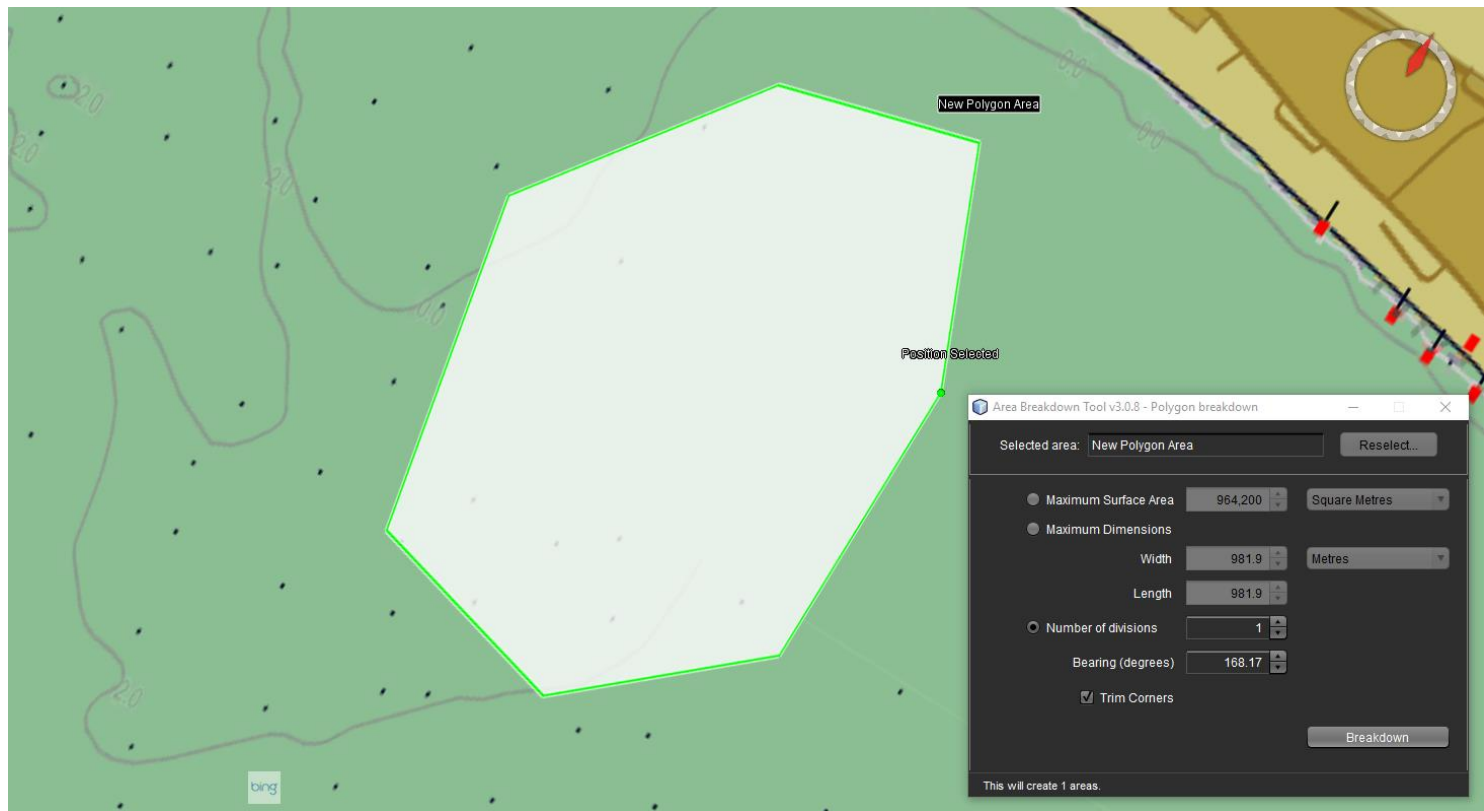
- Encode expert knowledge
- Offer some parameters
- E.g. Length, endurance, ordering



Large-scale Planning Tools

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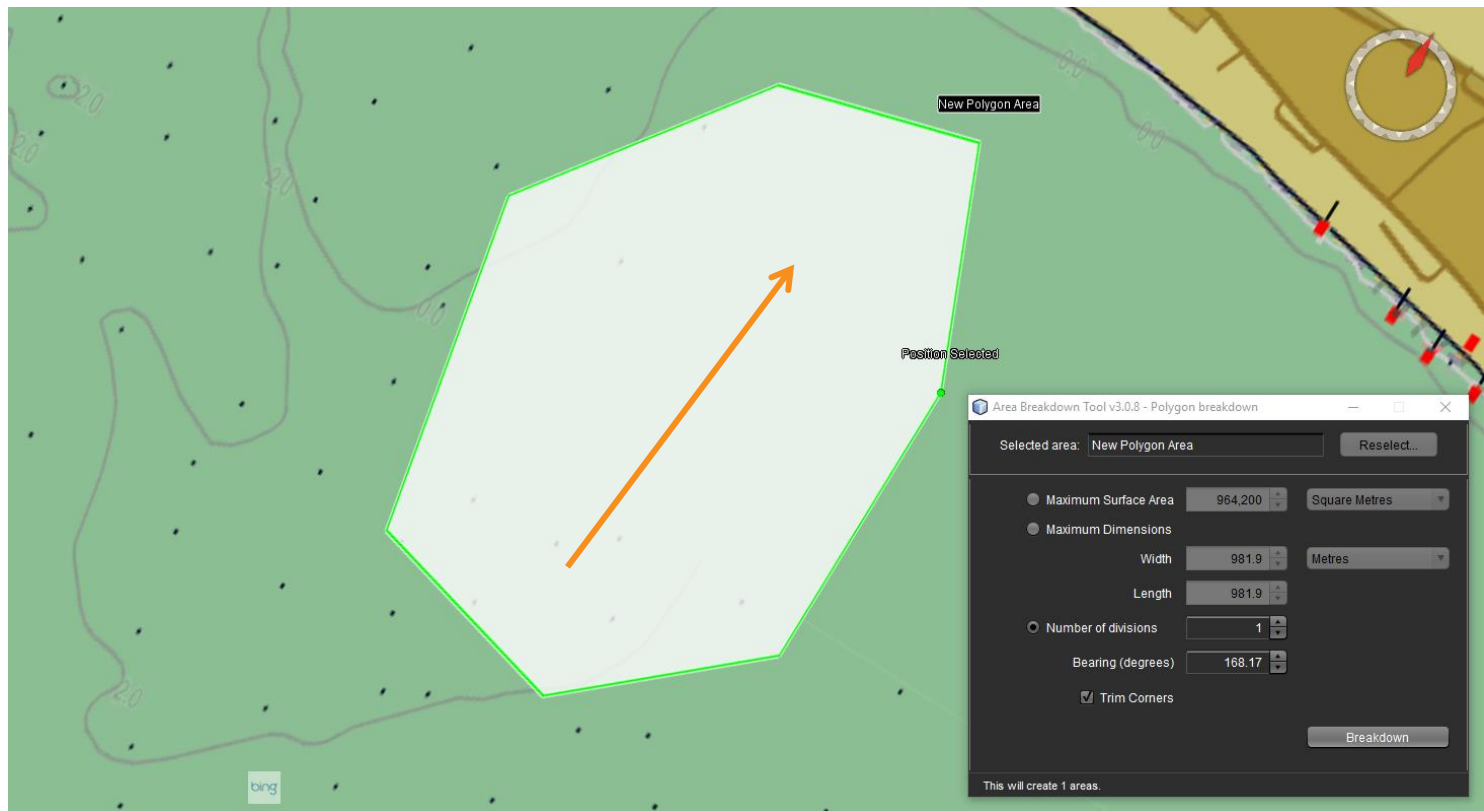
Smart tools to breakdown areas



Large-scale Planning Tools

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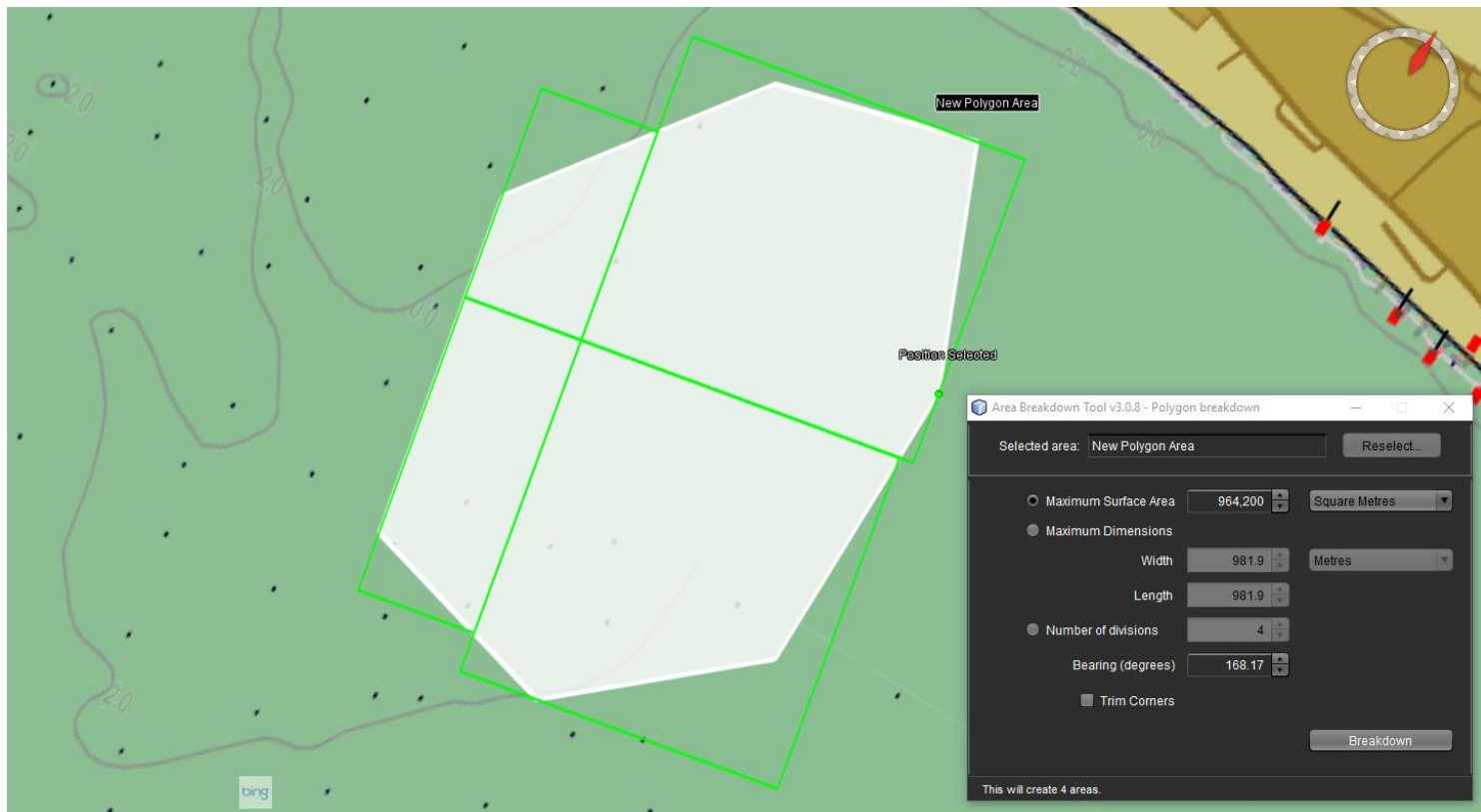
Smart tools to breakdown areas



Large-scale Planning Tools

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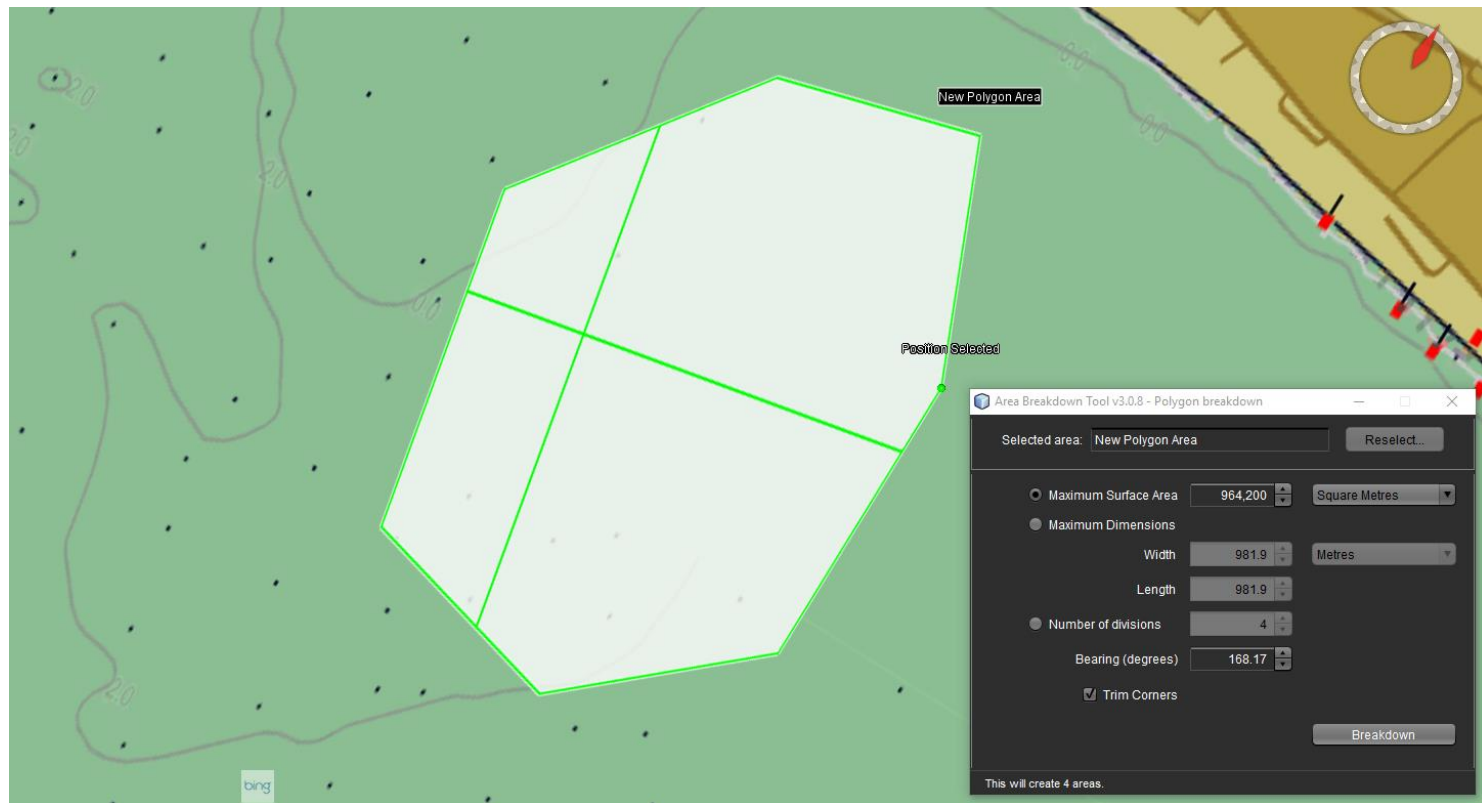
Smart tools to breakdown areas



Large-scale Planning Tools

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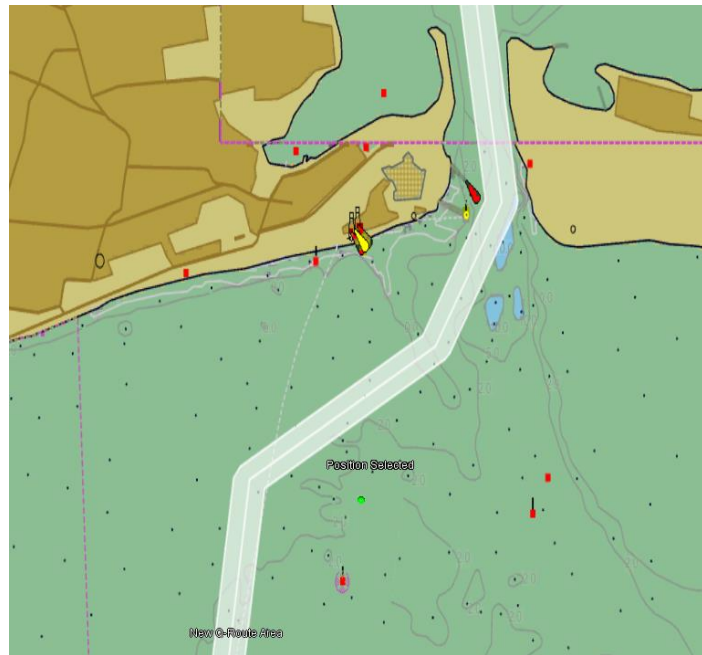
Smart tools to breakdown areas



Large-scale Planning Tools

Smart tools to breakdown areas

- Parameters to optimise
 - Area
 - Asset types, capabilities, transit speed
 - Launch area, exclusion zones
- Human oversight!!



Key Technologies

Large-scale Planning Tools

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- Smart tools to breakdown areas

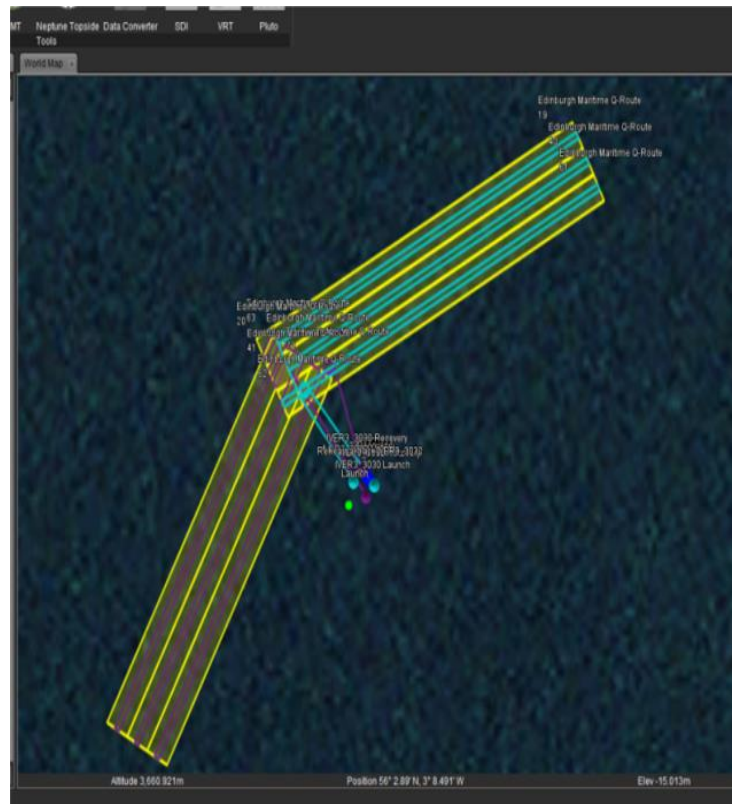
- Automated plan optimisation

- User interface for scheduling

Large-scale Planning Tools

Automated Plan Optimisation

- Current Capabilities
 - Multiple task types (inc. complex regions)
 - Multiple vehicle types
 - Time



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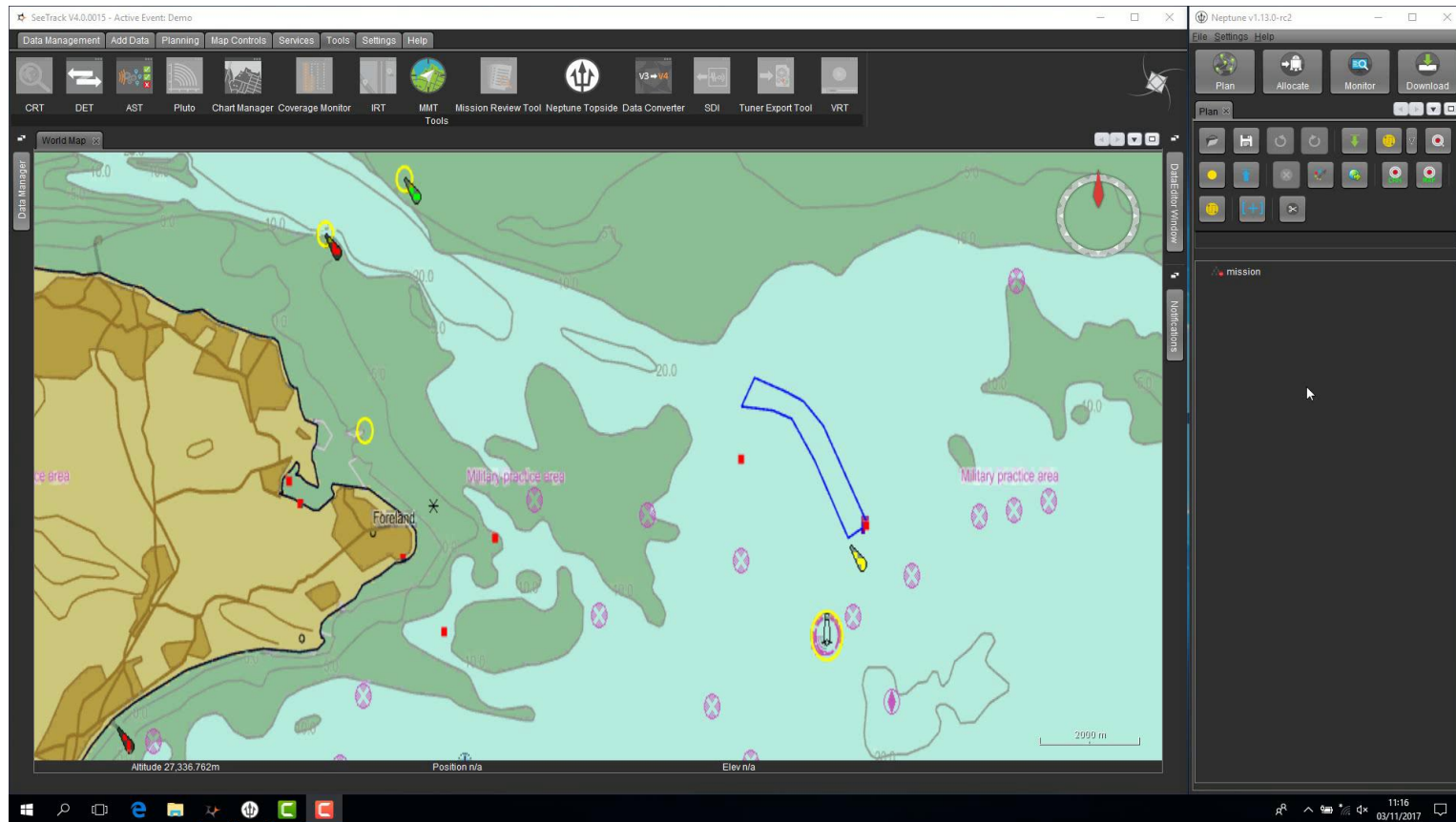
Automated Plan Optimisation

- Distributed travelling salesman
 - Mathematics well understood
 - Human review, as always, crucial
- Some more parameters?
 - Task grouping (e.g. vehicle take sector)
 - Temporal constraints

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Automated Plan Optimisation



Key Technologies

Large-scale Planning Tools

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- Smart tools to breakdown areas
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Large-scale Planning Tools

User Interface for Scheduling

- All of this could be wrapped together in entirely robotic planning... if we wanted to?
 - Fully automated re-planning in case of failure
 - Build in calculations of the down-time
 - E.g. Mission download, battery recharge, PMA
- Or allow flexibility as an assist tool?

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User Interface for Scheduling



Operation date Take from: SeeTrack

Start date: 04/04/2017

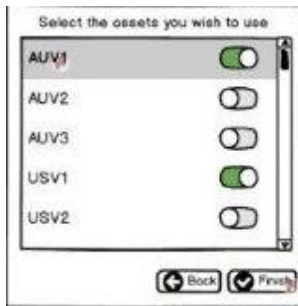
End date: 06/04/2017

Operation details

Working hours: 5:00 - 18:00

Squad creation

Operation details...



Select the assets you wish to use

- AUV1 ☒
- AUV2 ☐
- AUV3 ☐
- USV1 ☒
- USV2 ☐

Back Finish

Asset selection...



Squad 1

AUV1

USV1

Add assets

Squad 2

AUV1

Add assets

Squad 3

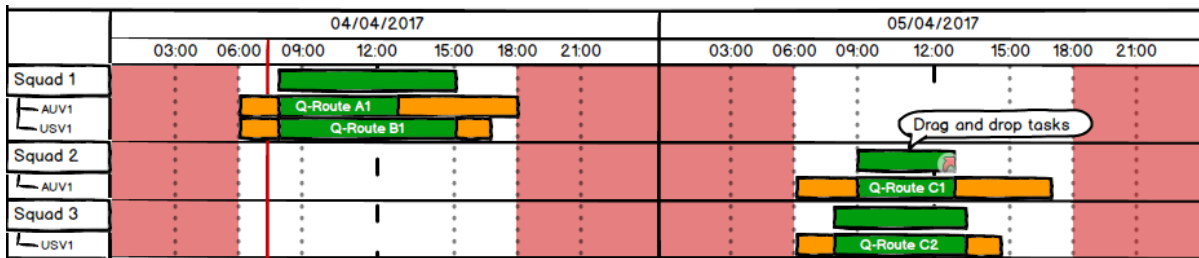
USV1

Add assets

Create new squad

Back Finish

Squad assignment...



Optimised schedule providing an overall plan with the resource usage and the targeted sorties for the day

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Conclusions

- Mathematics are accurate and consistent
- But plans don't last very long
- An over complicated work-flow is a danger
- Ensure humans have tools to assist, but humans retain control

Questions ?

Please visit SeeByte at stand A42



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