

GSAW 2019

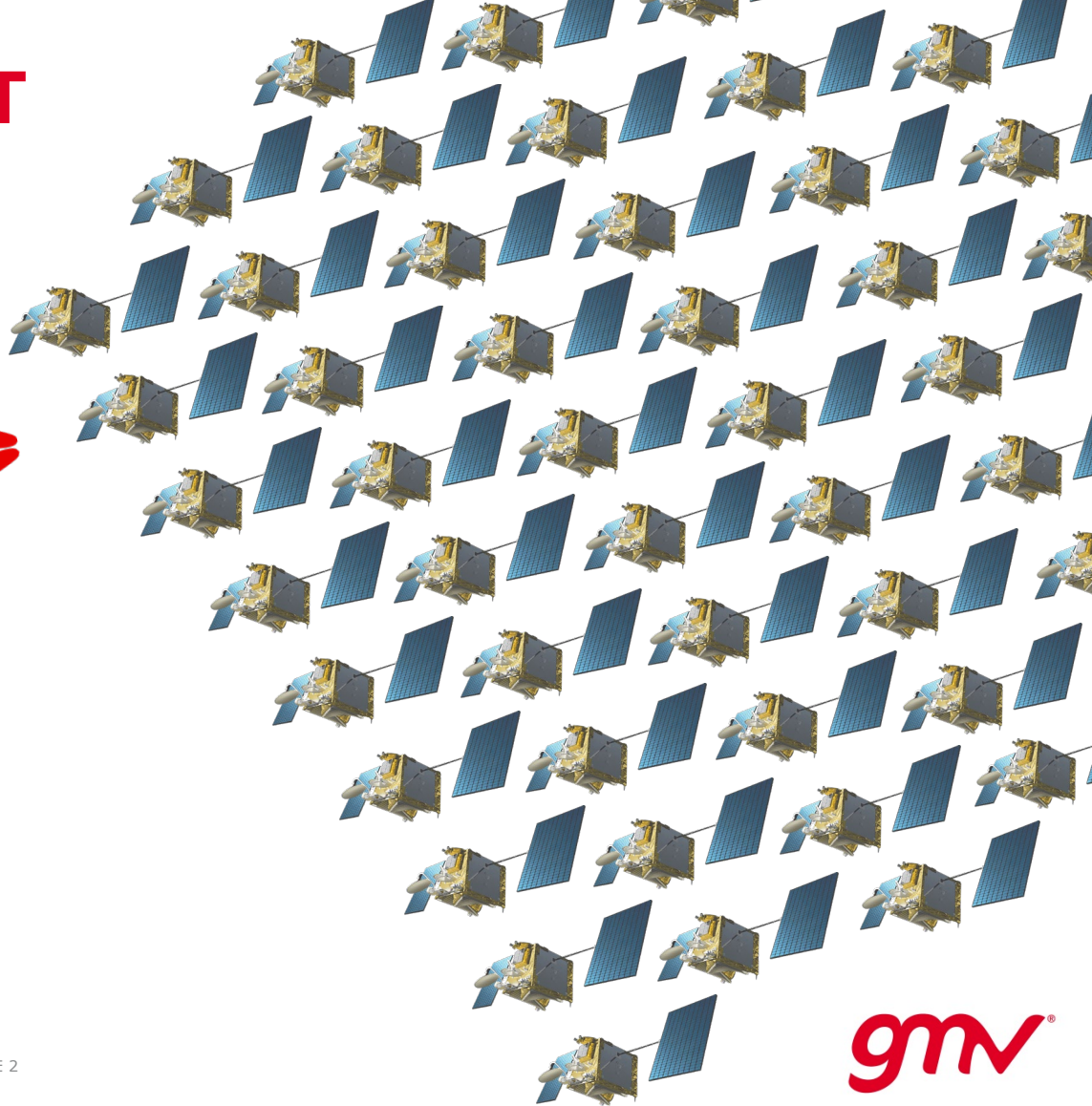
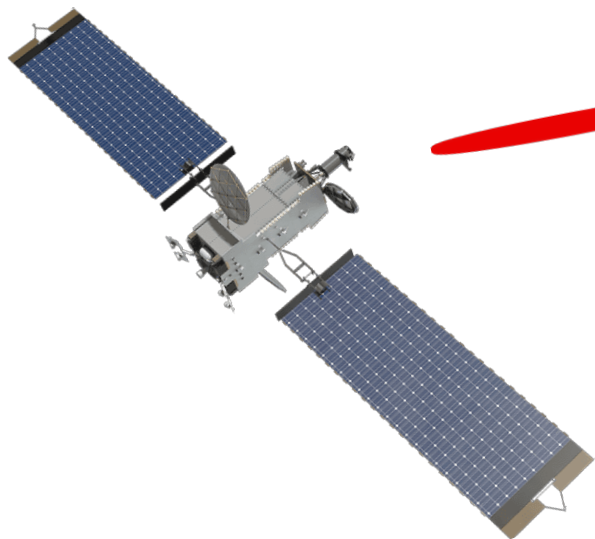
MEGA- CONSTELLATION CONTROL CENTRES

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INNOVATING SOLUTIONS

PARADIGM SHIFT



MEGA-CONSTELLATION?

ORBCOMM™ ≈ 60

iridium® ≈ 70

planet. ≈ 20 /flock

spire ≈ 80



Telesat® ≈ 200

SAS ≈ 200
ANYONE | ANYWHERE | ANYTIME

OneWeb ≈ 900

SPACEX ≈ 4.400

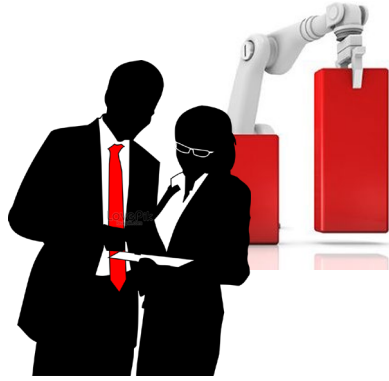
gmv®

WHAT IS IN A CONSTELLATION?

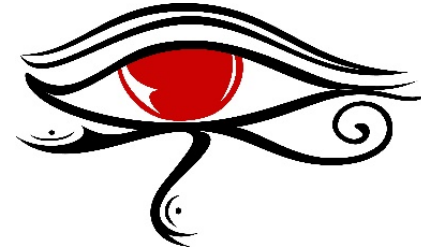
Constellation > Σ *Satellites*



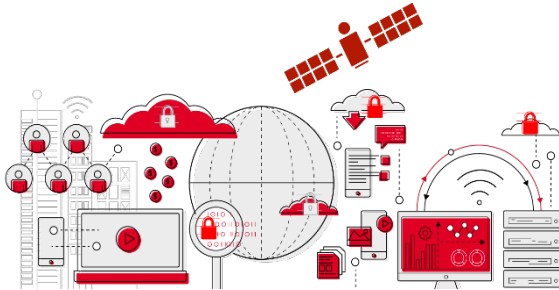
ENABLERS



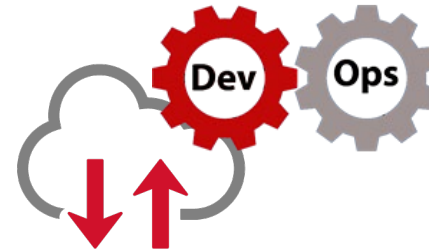
Manning & automation



Situational awareness



Data analytics



Etherealization

MANNING & AUTOMATION (I)



With 100+ satellites, to automate or not to automate is **NOT the question**

Do aim towards end-to-end **unattended automated operations**

Have an **intervention team** and **automate** the recovery actions

Automatically learn from the constellation data and **automate** the exploitation of the patterns found



MANNING & AUTOMATION (II)

A single, constellation wide, ground segment wide **automated operations orchestrator**



Able to deliberately follow a plan...

...as well as reactively **replan**



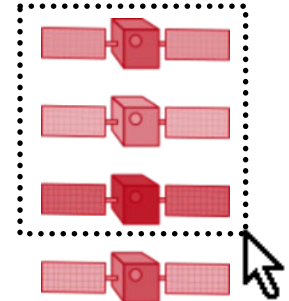
SITUATIONAL AWARENESS (I)



Clean, filtered, aggregated,
summarized, **relevant semantic KPIs**...

...with **drill-down**

Add, remove, **group satellites**



SITUATIONAL AWARENESS (II)

Status Board

10/64 satellites

SL0001 	SL0002 	SL0003 	SL0004
SL0005 	SL0006 	SL0007 	SL0008
SL0009 	SL0010 		

Events Errors&Warnings

Sev	Ack	Time	Module	Domain
15/1/2018				
		15/1/2018 13:18:13.381	XRTS2	SL0004
		15/1/2018 13:16:50.962	RTS1	SL0007
		15/1/2018 13:15:34.453	XFDS	SL0008
		15/1/2018 13:13:30.371	RTS1	SL0003
		15/1/2018 13:12:09.040	XFDS	SL0001
		15/1/2018 13:11:20.183	XRTS2	SL0005
		15/1/2018 13:10:26.375	FDS	SL0005

Spreadsheets

A_ST_AQ2

	A	B	C
1	ASW_335S	0.0000000	ASWae_L
2	ASW_335S	0.000.000	ASWae_L
3	ASW_335S	0.000.000	ASWae_L
4	ASW_335S	-45360001092	ASWae_L
5	ASW_335S	0.000.000	ASWae_L
6	ASW_335S	0.000.000	ASWae_L
7	ASW_335S	0.000.000	ASWae_L
8	ASW_335S	0.000.000	ASWae_L

DATA ANALYTICS

Your **constellation data** is your best asset: put it to **work**



Big Data



Data mining, machine learning, artificial intelligence...

Don't wait until it happens: **predict**



Capitalize the **knowledge** as the **constellation grows**



ETHERREALIZATION



Easy replication
Improved scalability



LESSONS LEARNT (I)

What we thought we had to do

What we ended up doing

Take our classical solution and...

...thin it somewhat



Down to microservices

...virtualize



Containers + mixed cloud

...add a constellation layer



...scale SQL historical databases



NOSQL + Timeseries

...scale HMIs adding groups/facets



Constellation semantic +
satellite detailed HMIs

LESSONS LEARNT (II)

What we thought we had to do

Situational awareness through aggregation and filtering **X**

Enhance somewhat our usual installation and deployment model **X**

Enhance our waterfall cycle with some Agile/LEAN **X**

What we ended up doing

Machine learning

Software/configuration split + per-satellite software instantiated from template

DevOps



THANK YOU