

# MEETING: NTNU – GOMSPACE 28-08-2017

- Overall agenda for the meeting:
- Introduction
- NTNU introduction of missions and requirements
- GomSpace Presentation
- Lunch
- Detailed discussions\* part 1
- GomSpace HQ Tour
- Coffee break (2 pm)
- Detailed discussions\* part 2
- Wrap up (before 3.30 pm)
  
- \*Key aspects are expected to be comms/SDR, attitude control, power/energy, software.
  
- WIFI: Gomspace.Guest - Vicksblue

A satellite with two long solar panel arrays is shown in orbit above Earth. The satellite is a rectangular box with a central body and two long, thin solar panel arrays extending outwards. The Earth below is covered in white clouds and blue oceans. The sky is a deep blue gradient.

GENERAL PRESENTATION  
NTNU MEETING

## GOMSPACE AT A GLANCE

- GomSpace is a globally leading designer, integrator and manufacturer of high-end nanosatellites
- We were founded in 2007 and listed in Stockholm (GOMX) as of June 2016
- We are headquartered in Denmark, have a propulsion subsidiary in Sweden and are establishing offices in the US and Singapore
- Our positions of strength include systems integration, nanosatellite subsystems and advanced miniaturised radio technology
- Our 100+ strong international team is devoted to understanding our customer's requirements and deliver flawlessly
- We serve customers in more than 50 countries within the academic, science, defence and commercial segments



## SPACIFYING YOUR BUSINESS

Defence & Security



Communication

IoT / M2M

Science & Exploration



Tracking &  
Geolocation

Remote Sensing

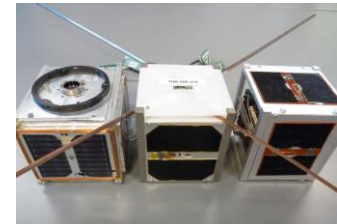
Tech. Demonstration



Intelligence  
Applications

Science

Academic Programs



Traditional Business



New Business



## OFFERINGS

### GOMSPACE

#### SOLUTIONS



- COMMUNICATIONS SOLUTIONS
- IOT / M2M
- TRACKING & GEOLOCATION,
- REMOTE SENSING
- INTELLIGENCE APPLICATIONS
- SCIENCE

#### SUBSYSTEMS



- SOFTWARE
- SOLAR PANELS
- EPS
- BATTERY
- COMMUNICATION
- COMPUTERS
- ADCS
- GROUND STATION
- STRUCTURES

#### PAYLOADS



- SOFTWARE DEFINED RADIO
- ADS-B
- AIS
- CAMERA

#### PLATFORMS



- SIZE:1-27U
- ADVANCED CAPABILITIES
- FLEXIBLE CONFIGURATIONS
- PERFORMANCE IN SPACE SECOND TO NONE

#### ORBITAL



- LAUNCH SERVICES

#### NANOSPACE



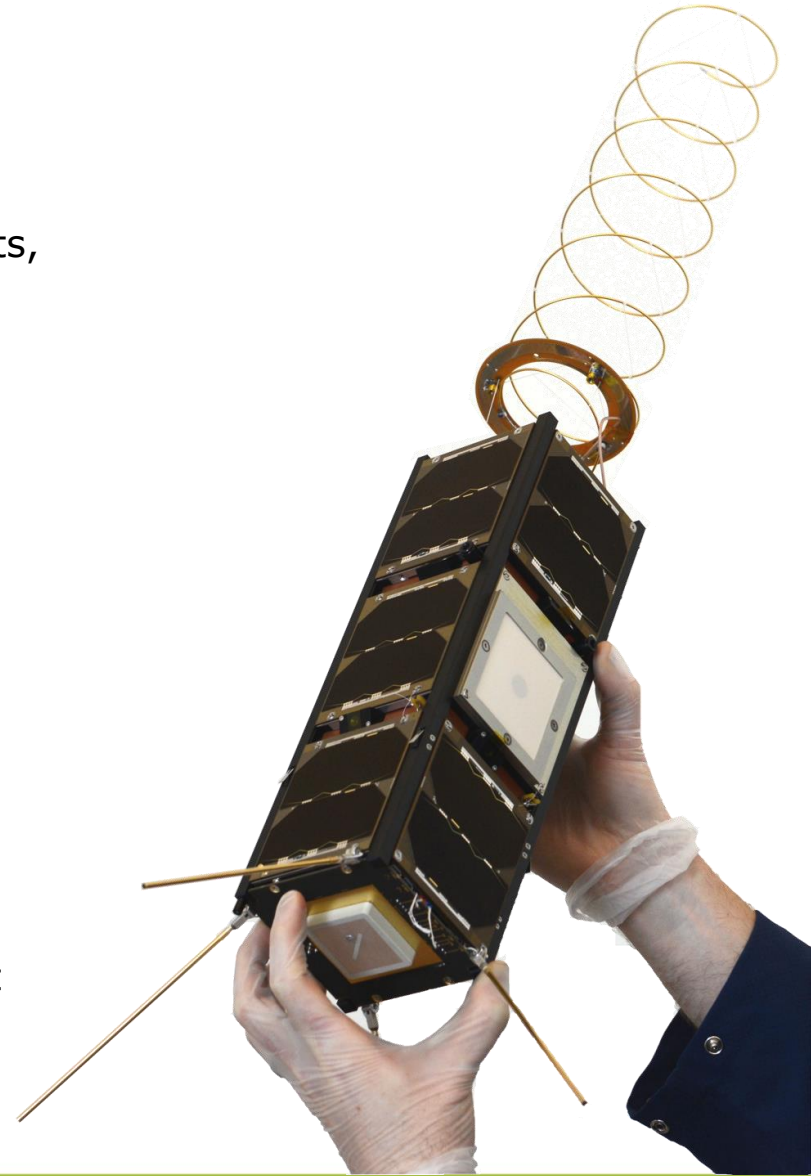
- PROPULSION SYSTEMS
- MICRO ELECTRO-MECHANICAL SYSTEMS

# BUSINESS SOLUTIONS

We provide turn-key solutions to customer requirements, including:

- Mission analysis and design
- Mission specific system developments
- Hardware manufacturing
- Software development
- Satellite and payload integration and testing
- Launch & commissioning management
- Ground station deployment
- Training and operational support

We apply space industry standard project management practices based on ESA/NASA standards.



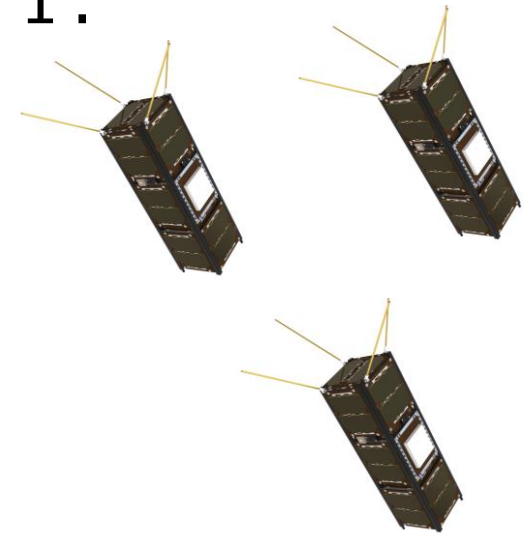
# BUSINESS SOLUTION EXAMPLE 1: SKY AND SPACE GLOBAL

“3 Diamonds” Precursor Mission of 3x 3Us:

- Sky and Space Global private commercial customer
- Nanosatellites constellation in space for providing a global communication infrastructure
- Ordered in February 2016 to be delivered 12 months after
- Next step is constellation deployment with 200+ satellites

Key Capabilities Provided:

- Capable satellite platform:
  - Inter-satellite link capability
  - Agile pointing and drag management
- Tailored payload to customer needs:
  - Powerful Software Defined Radio
  - Customized antenna and RF front-end



Communication



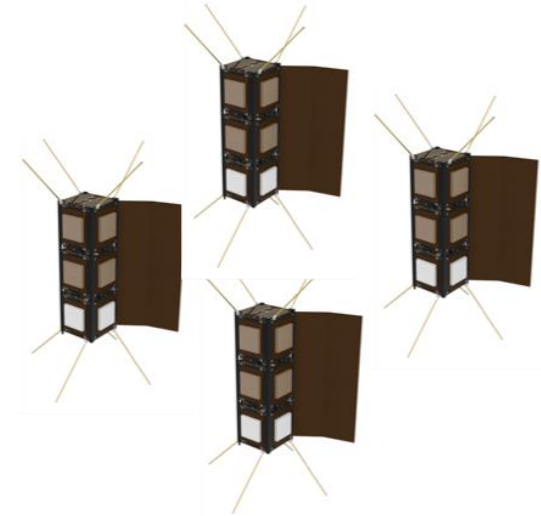
# BUSINESS SOLUTION EXAMPLE 2: AERIAL & MARITIME

## Business set-up:

- Aerial & Maritime (A&M) registered in Mauritius
- To serve 112 countries around Equator
- Aircraft and ship tracking for situational awareness
- En-route billing service for aircraft
- To be launched H1 2018 to 500km near equatorial orbit

## Key Capabilities Provided:

- 4x 3U satellites to fly in loose formation
- Operational duty-cycle and life-time requirements
- Highly sensitive AIS and ADS-B receivers
- High performance patch-array antenna configuration
- Ground segment and operations



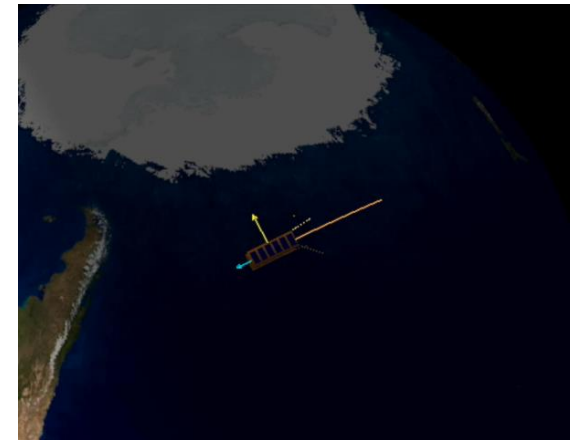
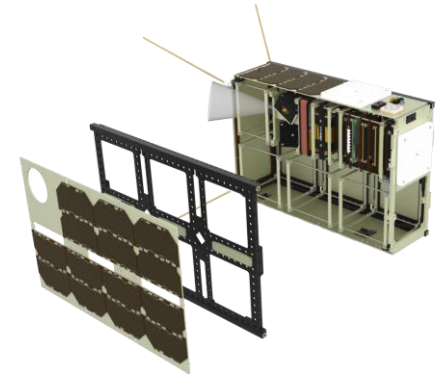
Tracking

Intelligence  
Applications



## ADVANCED PLATFORMS

- 1U to 27U – but it is not about size!
- Our products are developed, qualified and in-orbit validated through our GOMX flight test program
- Performance of our platforms demonstrated in space is second to none
- Based on our flexible in-house product portfolio we configure a specific platform design to match your requirements – because no two missions are identical
- Approaching 5 years of operational life-time



*Video: telemetry replay of GOMX-3 performing 7 attitude maneuvers during one orbit to optimally point and/or track antennas for different operational objectives*

## GOMSPACE SATELLITES

### A Glimpse Inside: GomSpace Satellites

A small camera called a star-tracker helps the satellite determine which direction it is pointing by aligning with the stars in the sky. Small sensors around the spacecraft also detect the position of the sun to help orient the satellite



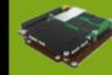
The NanoPower BPX battery pack provides a massive amount of power for critical operations while the satellite is in eclipse and the power it would normally get from the sun is blocked by the earth



The NanoMind Z7000 and NanoCom TR600 are at the heart of a powerful Software Defined Radio which gives GomSpace satellites unmatched RF flexibility, including high speed radio communication to the ground and to other satellites



The modular GomSpace system design combined with industry leading software allows customers to integrate payloads without worry



A GPS unit built into the satellite allows the spacecraft to have very accurate location knowledge, which is critical for advanced satellite control



A propulsion unit allows the satellite to reposition itself into a different orbit, or to avoid other objects in space



Advanced reaction wheels use their spin to point the satellite with pinpoint accuracy. This allows the satellite to track locations on the Earth with incredible precision



GomSpace uses the highest efficiency solar cells in the industry, giving GomSpace satellites more power from the sun



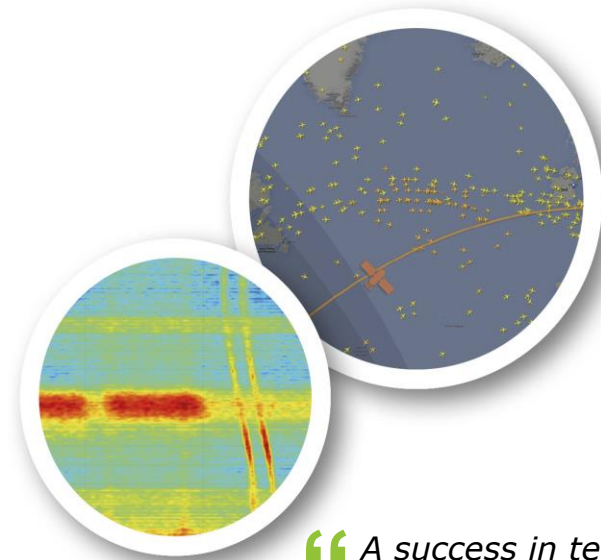
## PLATFORM EXAMPLE 1: GOMX-3

Advanced demonstration of 1X 3U:

- ESA's first nanosatellite
- New generation of GomSpace products
- Launched in Oct 2015, re-entered Oct 2016

Payloads/Demonstrations:

- ADS-B receiver for flight tracking
- L-band receiver for SATCOM signal analysis
- X-band transmitter with 3 Mbit downlink
- Robust 2 degree pointing capability (w/o star-tracker)



“ A success in terms of planning, speed of development and technical achievements - Roger Walker, ESA ”

Communications

Tracking

Intelligence Applications

## PLATFORM EXAMPLE 2: GOMX-4



Tandem Mission of 2x 6Us

- Sponsored by the Danish Defense and ESA
- Formation flying precursor for arctic surveillance constellation
- PDR completed, launch in Q3 2017

Payloads/Demonstrations:

- Inter-satellite linking
- Station keeping
- Hyperspectral imaging
- ADS-B and AIS receivers



Communications

Remote Sensing

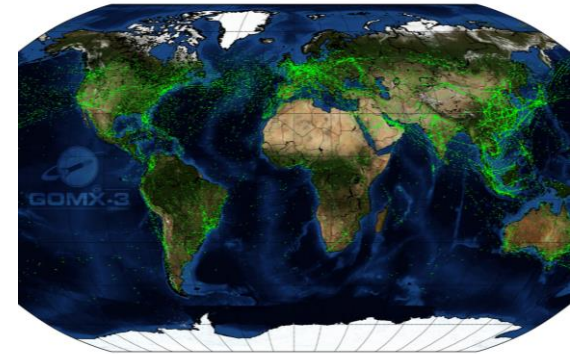
Tracking &  
Geolocation

Intelligence  
Applications

# PAYLOADS

Off-the-shelves payload modules:

- AIS receiver – ship tracking
- ADS-B receiver – aircraft tracking
- Color camera – low cost imaging



Advanced RF payloads based on building blocks:

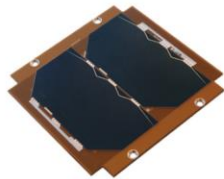
- Best RF and signals team in the industry
- Powerful software defined radio platform
- Tailored RF front-ends 0-30 GHz
- Antenna solutions 0-30 GHz; Monopole, Helical, Patch and patch-array designs



## SUBSYSTEMS OFF-THE-SHELF



SOFTWARE



SOLAR PANELS



EPS



BATTERY



COMMUNICATION



COMPUTERS



ADCS



GROUND STATION



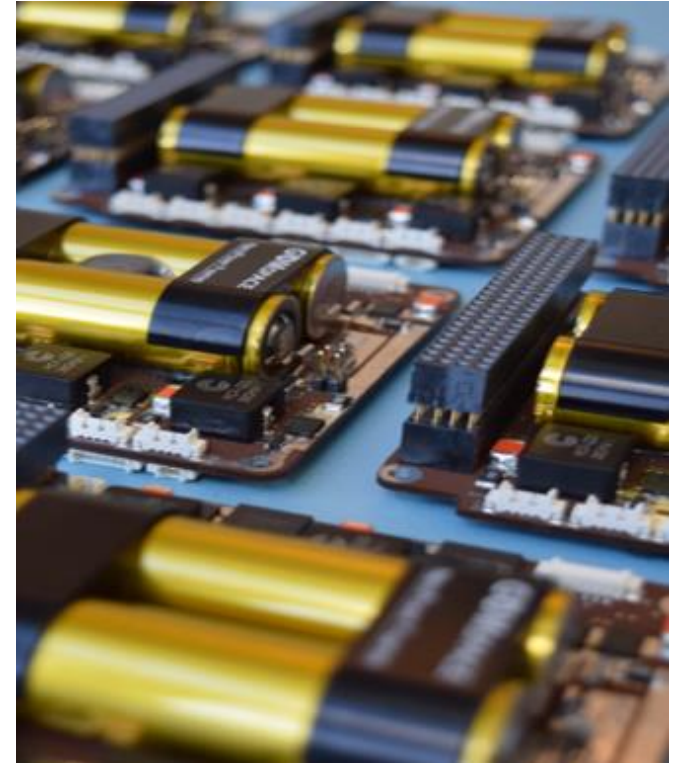
PROPULSION



STRUCTURES

## WHY CHOOSE PRODUCTS FROM GOMSPACE?

- We ship >1,500 subsystems yearly to customers in more than 50 countries
- Our products are developed, qualified and in-orbit validated through our GOMX flight test program
- Performance of our products as demonstrated in space is second to none
- Batch production ensure high quality, low lead time and attractive cost



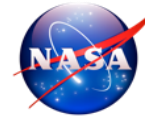
## REFERENCES

*"GomSpace is one of the best companies in the new space business. It is a great honour working with them."*

- Meidad Pariente, CTO at Spacecialist, Israel

*"A fantastic company not only in technical aspects also in customer care and help. Definitely, a team in which you can rely and trust for your space mission."*

- Alex Becerra, CEO at Aurora Space, Chile







*"WE HELP TEAMS ACROSS THE  
GLOBE ACHIEVE THEIR GOALS IN SPACE"*

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