



2ND ANNUAL DUAL USE MARINE TECHNOLOGIES WORKSHOP

# CONTROS Sensor Systems

15/10/2019

Daniel Esser, Managing Director Mathias Meyer, Product Manager Sensor Systems



KONGSBERG PROPRIETARY: This document contains KONGSBERG information which is proprietary and confidential. Any disclosure, copying, distribution or use is prohibited if not otherwise explicitly agreed with KONGSBERG in writing. Any authorised reproduction in whole or in part, must include this legend. © 2018 KONGSBERG – All rights reserved.



#### **Portfolio overview about CONTROS® SENSORS**

Products

TA & pH **CO**<sub>2</sub> 0, Flow through CH₄ HydroC CH<sub>4</sub> HydroC CO<sub>2</sub> HydroFlash O<sub>2</sub> HydroC CH<sub>4</sub> FT and CO<sub>2</sub> FT HydroFIA TA & pH Dissolved methane sensor Dissolved carbon dioxide sensor Total alkalinity and pH Dissolved oxygen sensor Flow-through applications 3000 meters 6000 meters Autonomous analyzer 6000 meters User-friendly High accuracy Fast response time Easy setup Maintenance interval of 12 High accuracy Long-term stability High versatility High accuracy Very fast response time months



#### 2. Measuring principle & Customer Benefits

**Underwater Gas Sensors CH4 and CO2** 





WORLD CLASS – Through people, technology and dedication

KONGSBERG PROPRIETARY - See Statement of Proprietary information



WORLD CLASS - Through people, technology and dedication

KONGSBERG PROPRIETARY - See Statement of Proprietary information



#### **Overview**





# Building blocks





# **CONTROS® DPU 2.0**

#### Sensor integration for monitoring solutions

- "Brain" of the K-Lander and sensor systems (e.g. MELDS & Geodesy)
- Interfaces:
  - 2 10+ RS-232 interfaces
  - or RS-485 interface
  - 1+ x 100 Mbit Ethernet
  - 2 x 16 bit analog
- Sensor Scheduling
- Event detection
- Data uplink via cNode acoustic modem





#### **CONTROS® DPU 2.0**

Data Processing Unit

Benefits



Highly flexible and adaptable subsea data logger

→ Fully automated data storage from serial, analogue and ethernet sensors

- Capable of processing the sensor values into key data
  - →In-situ processing of data into e.g. min/mean/max and triggering of events

- Optimized for low power consumption
  - →Advanced sensor scheduling allows to reduce power usage of each sensor and to extend operation time and reduce costs (batteries) of the system
- Titanium housing, 4.000m depth rating (6.000 optinal)



#### DPU 2.0 Hardware

#### MLB Main Linux Board



Central control unit connected to all DSBs

- Transfer raw data into SQLite database
- Web Interface for system control and configuration
- data post-processing
- alarming

#### DSB Datalogger Switch Boards



Sensor raw data logger and power switch

- Connected to up to two sensors (serial, analogue)
- Power management
- Ultra lower power design
- Adjustable output voltage per sensor





KONGSBERG PROPRIETARY - See Statement of Proprietary information



#### **Measurement Parameters**

Integrated into DPU

#### Deformation

- Detection of elevation or subsidence through measurement of Absolute pressure, Inclination, Triaxial acceleration
- Relative position through acoustic sys (LBL)



#### **Environmental conditions**

- General characterization required for correct interpretation (i.e. leakage, sediment movement, environmental model)
- Physical parameters (CTD, sound velocity), Currents (ADCP, current profiler)
- Turbidity, particle size
- Biological parameters (i.e. through fluorescence)

#### Methane and (dissolved) gases

- Point sensors for gas content in the water column (CH<sub>4</sub>, CO<sub>2</sub>, O<sub>2</sub>)
- Active and passive acoustics (hydrophones, sonars, echo sounders)



Cameras









# **CONTROS® DPU 2.0**

Features

#### Available now:

- Fully customer configurable
- Advanced scheduler
- Sensor routines (sensor specific command lists)
- Scalable and modular electronic
- Redundant internal sensor data storage (Raw data on DSBs + SQLite data on MLB)
- Low power system design
- Power monitoring and control per sensor
- Serial, analogue and ethernet interfaces

#### Introduced step by step until Q1 2020:

- Web GUI running on DPU 2.0 for full system control
- On system data visualization
- Customer can run his own code
- Integrated network storage system (NAS) up to 4TB data

	③ 1921683.1	15000/#/home/FwUpdate		🖂 👌 🔍 Suchers	IN E
	ыл				LOS CONFIG UP
					—
	MI D Simurana unde	ate			
	neo mininare opa				
	Upload successful	K8C0N-0P0-1-20190827084216.KA0C8			
	MLB update complete	8			
	DGB firmware updz	oto Fill.E			
	Ban adds	Version Build dat displaymenta/low/2019-07-19-22-g4x8b6ex9 2219-08	11 1442,59		
	2	diploymenta/low/2015/37/15/2/g4/db6ex9 2215/08 diploymenta/low/2015/07/19/23/g12965653 2215/08	11 14642-58 26 11547-26		
	254	diploymenta/low/2015-07-19-22.gMdb6ex9 2015-08-	11 14642.58		
\\file01\047	)7\Projects_running	\External\452-10001_UiT_Redeploy	yment_2019\16 DPU\fin	al scheduling\etc\schedu	ule_xml.txt - Notepad++
File Edit Se	arch View Enco	ding Language Settings Too	Is Macro Run Plu	gins Window ?	
3 🗁 🖽 🦷	1 😼 🖓 🖨 🕷	• • • • • • • • • • • • • • • • • • •	* • • • • • • • • • • • • • • • • • • •	1 🐺 🖉 💹 🙆	💌 🖻 🖻 🖻 🛍
🔚 schedule_tes	.xml 🗵 🔚 schedule	_xml.txt 🛛 🔚 schedule.proposed.xn			
1 8<	3chedules>				
2	tin</td <td>espan including no</td> <td>otBefore but</td> <td>excluding not</td> <td>After; if no ti</td>	espan including no	otBefore but	excluding not	After; if no ti
3	zlsta	art the DPH every r	midnight for	maintenance -	->
5 🕀	<schedul< td=""><td>le notBefore="2019</td><td>-07-11" notAf</td><td>ter="2020-08-</td><td>01"&gt;</td></schedul<>	le notBefore="2019	-07-11" notAf	ter="2020-08-	01">
9					
10	Pos</td <td>st-Deployment (star</td> <td>rting 2020-01</td> <td>/-01&gt;</td> <td></td>	st-Deployment (star	rting 2020-01	/-01>	
11 =	<schedul< td=""><td>.e notBefore="2019-</td><td>-07-10 08:00:</td><td>00" notAfter=</td><td>"2019-07-11"&gt;</td></schedul<>	.e notBefore="2019-	-07-10 08:00:	00" notAfter=	"2019-07-11">
	<schedul< td=""><td>e notBelore="2019-</td><td>-07-10 08:00:</td><td>00" notAlter=</td><td></td></schedul<>	e notBelore="2019-	-07-10 08:00:	00" notAlter=	
56 8	<schedul< td=""><td></td><td></td><td>00" notAfter=</td><td>"2019-07-11"&gt;</td></schedul<>			00" notAfter=	"2019-07-11">
49 56 79 ₽	<schedul <schedul< td=""><td>e notBefore="2019-</td><td>-07-10 08:00:</td><td>00" notAfter=</td><td>"2019-07-11"&gt; "2019-07-11"&gt;</td></schedul<></schedul 	e notBefore="2019-	-07-10 08:00:	00" notAfter=	"2019-07-11"> "2019-07-11">
56 E 79 E	<schedul <schedul< td=""><td>le notBefore="2019</td><td>-07-10 08:00:</td><td>00" notAfter= 00" notAfter=</td><td>"2019-07-11"&gt; "2019-07-11"&gt;</td></schedul<></schedul 	le notBefore="2019	-07-10 08:00:	00" notAfter= 00" notAfter=	"2019-07-11"> "2019-07-11">
49 ⊞ 56 ⊞ 79 ⊞ 88 89	<schedul <schedul <!-- Sta</td--><td>te notBefore="2019 art icListen every</td><td>-07-10 08:00</td><td>00" notAfter= 00" notAfter= each day&gt;</td><td>"2019-07-11"&gt; "2019-07-11"&gt;</td></schedul </schedul 	te notBefore="2019 art icListen every	-07-10 08:00	00" notAfter= 00" notAfter= each day>	"2019-07-11"> "2019-07-11">
499 ⊕ 56 ⊕ 79 ⊕ 88 89 90 ⊕	<schedul <schedul <!-- Sta<br--><schedul< td=""><td>le notBefore="2019 art icListen every .e notBefore="2019</td><td>-07-10 08:00 60 mintes, e -07-11" notAf</td><td>00" notAfter= 00" notAfter= each day&gt; ter="2020-08-</td><td>"2019-07-11"&gt; "2019-07-11"&gt; •01"&gt;</td></schedul<></schedul </schedul 	le notBefore="2019 art icListen every .e notBefore="2019	-07-10 08:00 60 mintes, e -07-11" notAf	00" notAfter= 00" notAfter= each day> ter="2020-08-	"2019-07-11"> "2019-07-11"> •01">
4 9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<schedul <schedul <!-- Sta<br--><schedul busid</schedul </schedul </schedul 	le notBefore="2019 art icListen every .e notBefore="2019- damed Gredon	-07-10 08:00 60 mintes, e -07-11" notAf timestamp	00" notAfter= 00" notAfter= each day> [ter="2020-08-	"2019-07-11"> "2019-07-11"> 
49 ⊞ 56 ⊞ 79 ⊞ 88 89 90 ⊟ Fiter	< <u>Schedul</u> < <u>Schedul</u> Sta<br < <u>Schedul</u> busid =1 <b>()</b> =1	Le notBelore="2019 Le notBefore="2019- art icListen every .e notBefore="2019- dannel directon © Filter Filter	-07-10 08:00 60 mintes, e -07-11" notAf tmestamp	:00" notAfter= :00" notAfter= each day> :ter="2020-08-	"2019-07-11"> "2019-07-11"> 
4 9 m 5 6 m 7 9 m 8 8 8 9 9 0 m id Filter 1 1297861	<schedul <schedul <!-- Sta<br--><schedul busid =1 0 =1 1 1</schedul </schedul </schedul 	le notBefore="2019 art icListen every le notBefore="2019- dame dredon 0 Filer Filter 1 2019-06-23 16:0	-07-10 08:00 60 mintes, e -07-11" notA1 tmestamp Fi 00:11+00:00 \$0	<pre>:00" notAfter= :00" notAfter= each day&gt; fter="2020-08- ter :00056,0,0,0,1000</pre>	"2019-07-11"> "2019-07-11"> "01"> context
4 9 0 0 8 8 8 9 9 0 0 id Filter 1 1297861 2 1297862	<schedul< th=""> <schedul< td=""> <!--</td-->           Schedul           busid           =1           1           1           1           1</schedul<></schedul<>	le         notBefore="2019"           art icListen every           le         notBefore="2019"           demed         decton           ©         Filter           1         2019-023 160           0         2019-0423 160	-07-10         08:00           60         mintes, e           -07-11"         notAf           tmestamp         Fi           00:11+00:00         \$0           00:11+00:00         \$0	00" notAfter= 00" notAfter= each day> fter="2020-08- her 00056,0,0,W,10r0a r0a	"2019-07-11"> "2019-07-11"> .01"> .context
4 9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<schedul <schedul <!-- Sta<br--><schedul buid =1 0 =1 1 1 1 1 1 1 1 1</schedul </schedul </schedul 	Item inotberiore="2019"           le notBefore="2019"           art icListen every           le notBefore="2019"           damed           freton           I 2019-04:23 16:0           0         2019-04:23 16:0           0         2019-04:23 16:0           0         2019-04:23 16:0	-07-10         08:00           60 mintes, e         -07-11" notAf           tmestamp         Fi           00:11+00:00         \$0           00:11+00:00         \$0	00" notAfter=           00" notAfter=           each day>           Eter="2020-08-	"2019-07-11"> "2019-07-11"> .01"> .cotet 33@r@n
4 9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<schedul <schedul <schedul buid =1 0 =1 1 1 1 1 1 1 1 1 1</schedul </schedul </schedul 	Open of the sector         Sector           art icListen every         enotBefore="2019"           dame         dreton         filter           int         2019-08-23 16:           0         2019-08-23 16:           0         2019-08-23 16:           0         2019-08-23 16:           0         2019-08-23 16:           0         2019-08-23 16:	-07-10         08:00           60 mintes, e         -07-11" notAf           timestamp         FI           00:11+00:00         \$0           00:11+00:00         \$0           00:11+00:00         \$0	00" notAfter= 00" notAfter= each day> fter="2020-08- ber cocs6,0,0,%10*09 rfm cocs0,0,0,0,12010042401_2013, cocs0,0,0,0,25T on T-CTR, #10	"2019-07-11"> "2019-07-11"> 01"> context 330rDen ren
1         3         2         5         6         0         7         9         0	<schedul <schedul <schedul buid =1 0 =1 1 1 1 1 1 1 1 1 1 1 1 1</schedul </schedul </schedul 	Operation         Operation         Operation           art icListen every         enotBefore="2019"           dame         dretton         filter           1         2019-04-23 16:         0           0         2019-04-23 16:         0           0         2019-04-23 16:         0           1         2019-04-23 16:         0           1         2019-04-23 16:         0           1         2019-04-23 16:         0	07-10 08:00         60 mintes, €           -07-11" notAf         imestamp           Fil         No.11+00:00         80           No.11+00:00         0         No.11+00:00         80           No.11+00:00         80         No.11+00:00         80           No.11+00:00         80         No.11+00:00         80           No.12+00:00         80         No.12+00:00         80	00" notAfter= 00" notAfter= each day> iter="2020-08- ter 00%0,0,0,0,000 ter 00%0,0,0,0,000 ter 00%0,0,0,0,000 ter 00%0,0,0,000 ter 00%0,000 ter 00%0,0000 ter 00%0,0000 ter 00%0,0000 ter 00%0,0000 ter 00%0,0000 ter 00%0,0000 ter 00%0,0000 ter 00%0,0000 ter 00%0,0000 ter 00%0,0000 ter 00%0,0000 ter 00%0,0000 ter 00%0,000000000000000000000000000000000	"2019-07-11"> "2019-07-11"> 01"> context 33@r@n
1 257661 2 1257662 3 1257662 3 1257665 4 1257865 4 1257865 5 1257865 6 1277865	<schedul <schedul <schedul bud =1 0 =1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1</schedul </schedul </schedul 	Open of the sector         Part icLister every           e notBefore="2019"         art icLister every           e notBefore="2019"         filter           filter         filter           0         pilter           0         2019-06-23 16:           0         2019-06-23 16:           0         2019-06-23 16:           0         2019-06-23 16:           0         2019-06-23 16:           0         2019-06-23 16:	-07-10         08:00           60         mintes, e           -07-11"         notAf           Woll+000         F           Woll+000         \$	0.0" notAfter: 0.0" notAfter: sach day> ter:"2020-08- br DDGGAAW.1eten rep DDGGAAW.1eten DDGGAAW.1eten DDGGAAW.1eten DDGGAAW.1eten DDGGAAW.1eten	"2019-07-11"> "2019-07-11"> 
Image: system         Image: system           7.9         Image: system           8.9         Image: system           9.0         Image: system           1         1237861           2         1237862           3         1237863           4         1237864           5         1237855           6         1237865	<schedul <schedul <schedul bust =1 0 =1 1 1 1 1 1 1 1 1 1 1 1 1 1 1</schedul </schedul </schedul 	Image: Provide and the second secon	-07-10         08:00           60         mintes, e           -07-11"         notAi           imestamy         FI           00:11+00:00         \$1           00:11+00:00         \$1           00:11+00:00         \$1           00:12+00:00         \$1           00:12+00:00         \$1           00:12+00:00         \$1	00" notAfter= 00" notAfter= each day> fter="2020-08- ter ter ter ter ter ter ter ter ter ter	"2019-07-11"> "2019-07-11"> .01"> context 330r@n r@n
5 6 9 7 9 8 8 9 9 0 1 1 1237861 2 1237861 2 1237863 4 1237864 5 1237865 6 1237865 6 1237865	<schedul <schedul <!-- Sta<br--><schedul busi =1 © =1 1 1 1 1 1 1 1 1 1 1 1 1 1 1</schedul </schedul </schedul 	Item InotBefore="2019"           art icListen every           le notBefore="2019"           art icListen every           le notBefore="2019"           demel decton           0           2019-06-23 16:           0           2019-06-23 16:           0           1           2019-06-23 16:           0           1           2019-06-23 16:           0           1           2019-06-23 16:           0           2019-06-23 16:           0           0           2019-06-23 16:           0           2019-06-23 16:           0           2019-06-23 16:	-07-10         08:00           60         mintes, €           -07-11"         notAi           Imedany         ??           00:1140:00         \$0           00:1140:00         \$0           00:1140:00         \$0           00:1140:00         \$0           00:1240:00         \$0           00:1240:00         \$0           00:1240:00         \$0           00:1240:00         \$0	00" notAfter= 00" notAfter= sach day> ter="2020-08- ter to cosMADAD 20842411_2013_ cosMADAD 20842411_000_0000_0000_0000_000_000_000_0000_0000	"2019-07-11"> "2019-07-11"> .01"> cotet 330r@n r@n
1         1	<schedul <schedul <!-- Sta<br--><schedul busd  Sta  Sta </schedul </schedul </schedul 	Operation         Operation           0         2019-00           0         2019-00           0         2019-00           0         2019-00           0         2019-00           0         2019-00           0         2019-00           0         2019-00           0         2019-00           0         2019-00           0         2019-00           0         2019-00           0         2019-00           0         2019-00           0         2019-00           0         2019-00           1         2019-00           1         2019-00           1         2019-00           1         2019-00           1         2019-00           1         2019-00           1         2019-00           1         2019-00	-07-10         08:00           60         mintes,           -07-11"         notA:           tmestamp         Fi           00:11:00:00         \$2           00:11:00:00         \$0           00:11:00:00         \$2           00:11:00:00         \$2           00:11:00:00         \$2           00:12:00:00         \$2           00:12:00:00         \$2           00:12:00:00         \$2           00:12:00:00         \$2           00:12:00:00         \$2	00" notAfter= 00" notAfter= %aCh day> ter="2020-08- % % % % % % % % % % % % % % % % % % %	"2019-07-11"> "2019-07-11"> .01"> .01"> .01"> .01"> .01"> .01"> .01"> .01"> .01"> .01"> .01"> .01"> .01"> .01"> .01"> .01"> .01"> .01"> .01"
Image: system         Image: system           79         1           88         9           90         1           1237661         1237663           1237663         1237664           5         1237665           6         1237666           7         1237667           8         1237668           9         1237669	<schedul <schedul <schedul busi =1 0 =1 1 1 1 1 1 1 1 1 1 1 1 1 1 1</schedul </schedul </schedul 	Operation         Operation           0         2019-06	-07-10         08:00           60         mintes, e           -07-11"         notA1           tmestamp         Fi           00:11400:00         \$4           00:11400:00         \$6           00:11400:00         \$6           00:11400:00         \$6           00:11400:00         \$6           00:11400:00         \$6           00:11400:00         \$6           00:11400:00         \$6           00:11400:00         \$6           00:11400:00         \$6           00:11400:00         \$6           00:11400:00         \$6           00:11400:00         \$6           00:11400:00         \$6	0.0" notAfter: 0.0" notAfter: ach day> fter:"2020-08- br DOGGAAWIe@n DOGGAAWIE@n DOGGAAWIE@n DOGGAAWIE@n DOGGAAWIE@n DOGGAAWIE@n	"2019-07-11"> "2019-07-11"> 
Image: system         Image: s	<pre><schedul <="" <schedul="" pre=""> </schedul></pre> ei      1	Open of the second se	-07-10         08:00           60         mintes, e           -07-11"         notA:           00:1140:00         \$           00:1140:00         \$           00:1140:00         \$           00:1140:00         \$           00:1140:00         \$           00:1140:00         \$           00:1140:00         \$           00:1140:00         \$           00:1140:00         \$           00:1140:00         \$           00:1140:00         \$           00:1140:00         \$           00:1140:00         \$           00:1140:00         \$           00:1140:00         \$	00" notAfter: 00" notAfter: sach day> iter:"2020-08- iter:"2020-08- iter: 00%0,00,72084241_2032 00%0,00,72084241_2032 00%0,00,72084241_2032 00%0,00,72084241_2032 00%0,00,72084241_2032 00%0,00,72084241_2032 00%0,00,72084241_2032 00%0,00,72084241_2032 00%0,00,72084241_2032 00%0,00,72084241_2032 00%0,00,72084241_2032 00%0,00,72084241_2032 00%0,00,72084241_2032 00%0,00,72084241_2032 00%0,00,72084241_2032 00%0,00,72084241_2032 00%0,00,7208441_2032 00%0,000000000000000000000000000000000	"2019-07-11"> "2019-07-11"> .01"> .cotlert 
1         1         1           7         9         1           8         8         9           8         8         9           1         1237861         1           2         1237863         1           4         1237864         1           5         1237865         1           6         1237867         1           8         1237867         1           9         1237867         1           10         1237871         1	<pre><schedul <="" <schedul="" pre=""></schedul></pre>	Operation         Operation           0         2019-06           0         2019-06           0         2019-06           0         2019-06           0         2019-06           0         2019-06           0         2019-06           0         2019-06           0         2019-06           0         2019-06           0         2019-06           0         2019-06           0         2019-06           0         2019-06           1         2019-06           0         2019-06           1         2019-06           1         2019-06           1         2019-06           1         2019-06           1         2019-06           1         2019-06           1         2019-06           1         2019-06           1         2019-06           1         2019-06           1         2019-06           1         2019-06           1         2019-06           1         2019-06	-07-10         08:00           60         mintes, €           -07-11"         notA;           imestamp         ??           00:1140:00         \$0           00:1140:00         \$0           00:1240:00         \$0           00:1240:00         \$0           00:1240:00         \$1           00:1240:00         \$2           00:1340:00         \$2           00:1340:00         \$2           00:1340:00         \$2           00:1340:00         \$2	0.0" notAfter: 0.0" notAfter: 0.0" notAfter: sach day> fter:"2020-08- ter 00%0.0,0/201842401_2013, 00%0.0,0/201842401_2013, 00%0.0,0,0/201842401_2013, 00%0.0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0	"2019-07-11"> "2019-07-11"> .01" .01"> .01" .01" .01" .01" .01" .01" .01".01" .01".01""> .01".01""> .01".01"" .01""> .01".01"" .01""" .01""" .01""" .01""" .01""" .01""" .01""" .01"""" .01""""""""""



Standard depth rating: 150 bar Available depth rating: Up to 350 bar Voltage: 14.4 / 28.8 V Material: titanium / carbon fiber Diameter: Ø 300 mm



#### **Battery Pack** UN transport certified





# Lithium primary packs 2 packs per section



Nominal voltage:	14.4	V
Nominal capacity:	342	Ah
Nominal energy:	4925	Wh
Peak current:	10.8	Α



KONGSBERG PROPRIETARY – See Statement of Proprietary Information

15.10.2019



# **CONTROS® K-Lander MK2**

Benefits

- Modular & scalable design
  - → Standardized building blocks allow for easy and fast assembly
  - → Configuration can be tailored to each project by adding/removing building blocks
- Long-term deployments 2+ years
  - → Durable and corrosion resistant materials: Titanium, POM & syntactic foam
  - → DPU based advanced sensor scheduling, control and storage
- Versatile payload
  - ightarrow Payload area can be used for battery or



- Open sensor integration policy
  - → All serial, analogue and ethernet sensors can be integrated and operated within the system







#### **CONTROS MELDS**

Mobile Early Leakage Detection System

Benefits

- Early and reliable detection
  - ightarrow Detection, localization and qualification oil and gas leakages
- Detection of polycyclic aromatic hydrocarbon (PAH) and CH<sub>4</sub>
  - → Combination of three completely independent methods for direct and indirect detection of hydrocarbons and associated anomalies
- Easy ROV / AUV integration
  - → Quick and reliable detection, localization and qualification of oil and gas leakages from moving platforms





#### **Application** ROV based early leakage detection

- Mainly industrial customers
- Pipeline inspection and oil & gas production site monitoring
- MELDS system components:
  - 1. CONTROS HydroC CH<sub>4</sub>
  - 2. PAH sensor (polycyclic aromatic hydrocarbon)
  - 3. CTD
  - 4. CONTROS DPU
- Option to add additional sensors to the DPU interface:
  - CO<sub>2</sub>, O<sub>2</sub>, Redox, pH, etc.











19

K-Lander Project Impressions





WORLD CLASS – Through people, technology and dedication

KONGSBERG PROPRIETARY - See Statement of Proprietary information



#### Natural Methane Release Monitoring - Svalbard





#### Natural Methane Release Monitoring - Svalbard

- Offshore Svalbard operated by UiT
  - Deployment Depth: 90-370 meters
  - Deployments:
    - 1<sup>st</sup> 2015 Mai 2016
    - 2<sup>nd</sup> Oct 2016 July 2017
    - 3<sup>rd</sup> Q3 2019
- Natural methane release area on the seafloor, study to investigate impact towards natural greenhouse emissions
- →Full environmental monitoring package consisting of: CONTROS HydroC CH<sub>4</sub> & CO<sub>2</sub>, ADCP, CTD, pH, Hydrophone, Mesotech M3, O<sub>2</sub>, Fluorometer, Turbidity, etc.







Mammal Monitoring - Halifax





Mammal Monitoring - Halifax

- Halifax Harbor
  - Deployment Depth: 10 meters
  - System Demo in Q2 2019
- Acoustic monitoring and mammal detection
- System demonstration and presentation to customer





#### Environmental Monitoring- Rostock/Baltic Sea





# **Coastal/Riverbed Monitoring System**

Example Configuration

- Baltic Sea/inland rivers operated by IOW
  - Deployment Depth: 3-30m
  - Deployments:
    - 1<sup>st</sup> July 2019 (3 weeks)
    - 2<sup>nd</sup> 04.09.2019 (6 weeks)
- Essential nutrient distribution in regards to seasonal cycles and 37SMP-ODO primary production
- $\rightarrow$ Full environmental monitoring package consisting of:

**CONTROS HydroC CH<sub>4</sub> & CO<sub>2</sub>**, CTD, PO<sub>4</sub>, NO<sub>3</sub>, O<sub>2</sub>, Fluorometer, etc.











KONGSBERG

# **Geodesy module**



#### **Geodesy Sensor Module**



KONGSBERG

System components:

- 2 Digiquartz<sup>®</sup> Absolute Pressure Gauges (APG)
- 1 Triaxial Quartz Accelerometer
- I Digiquartz<sup>®</sup> Barometer
- 3 Nano-resolution Processing Electronics
- 1 Three-way Ball Valve for A-O-A Calibration







KONGSBERG PROPRIETARY - See Statement of Proprietary information

#### Geodesy – A-O-A calibration



- Digiquartz<sup>®</sup> Pressure Sensors can be recalibrated in-situ by periodically switching from ocean pressures (A) to the ambient pressure (0) within the system housing
- ➤Temperature readings from each APG
- ➢Interior Housing Barometric Pressures (0) and Barometer Temperature
- ➢All sensors can be synchronized and timestamped using PPS inputs
- ➢ Triaxial Quartz Accelerometers can be recalibrated in-situ relative to Earth's 1 G gravity vector



WORLD CLASS – Through people, technology and dedication



#### **Tsunami Warning System**



- Geodesy Electronics
- Data & power management
- cNode modem interface
- A0A mechanism
- Pressure sensors

- Lithium primary
- 6x Battery pack
- Up to 4 year operation



#### **Tsunami Warning System**



- 2x cNode Maxi
   c/w releaser
  - o Modem function



- Redundant release
- Redundant communication

# **Geodesy Monitoring – Tsunami Early Warning**





#### K-Lander 1S1H - Geodesy Package (SOS Module)

cNode based communication Buoyancy Power & Control Releaser Anchor SOS module Releaser



Triaxial accelerometer is used to distinguish between **pressure events originating from sea level changes** (wave/stunami) **and seafloor movement** (subsidence/earthquake).

The integrated datalogger uses the accelerometer data to remove seafloor movement events from the pressure measurements.

The triaxial accelerometer can also be used as a **seismometer** to get more detailed information about the earthquake that caused the tsunami.

The module is calibration free and requires very low maintenance ( $\rightarrow$  A-0-A correction).

WORLD CLASS – Through people, technology and dedication

# **Geodesy Monitoring**



Transmission buoy -

Geodesy Lander with SOS module ~ (with triax)

15.10.2019

#### Subsea Geodesy Solutions





KONGSBERG SRSC ATHENS 2019

WORLD CLASS – Through people, technology and dedication

KONGSBERG PROPRIETARY - See Statement of Proprietary information

#### Subsea Geodesy Solutions



KONGSBERG

Name	LBL	LBL + Depth
Components	cNode with autonomous LBL functionality	+ Digiquartz <sup>®</sup> (Absolute Pressure Gauge) depth sensor
Function	Relative lateral movement between nodes	Vertical movement of seafloor and/or sea level changes
Key specs	< 1cm horizontal	+ ppb resolution <b>vertical</b> (< <b>1 mm/5000 m)</b> , <0.008% typ. acc. vertical (~40 cm/5000 m), <0.002% stability (~10 cm/y)

WORLD CLASS – Through people, technology and dedication

KONGSBERG PROPRIETARY - See Statement of Proprietary Information











- New battery solutions enabler for smaller and integrated lander systems
  - UN Certification ightarrow world wide delivery
- MK3 Lander concept as base for compact and application driven lander solutions
- DPU 2.0 new standard for multi-sensor integrations and complex sensor systems
- Geodesy Module as foundation for new lander applications
  - Tsunami Warning
  - Geodesy Lander and lander networks









SRSC

**KONGSBERG** 





#### **Questions?**

daniel.esser@km.kongsberg.com mathias.meyer@km.kongsberg.com

KONGSBERG PROPRIETARY - See Statement of Proprietary information