Reducing ROV Operating Costs and Enhancing Reliability with Monitoring Technology

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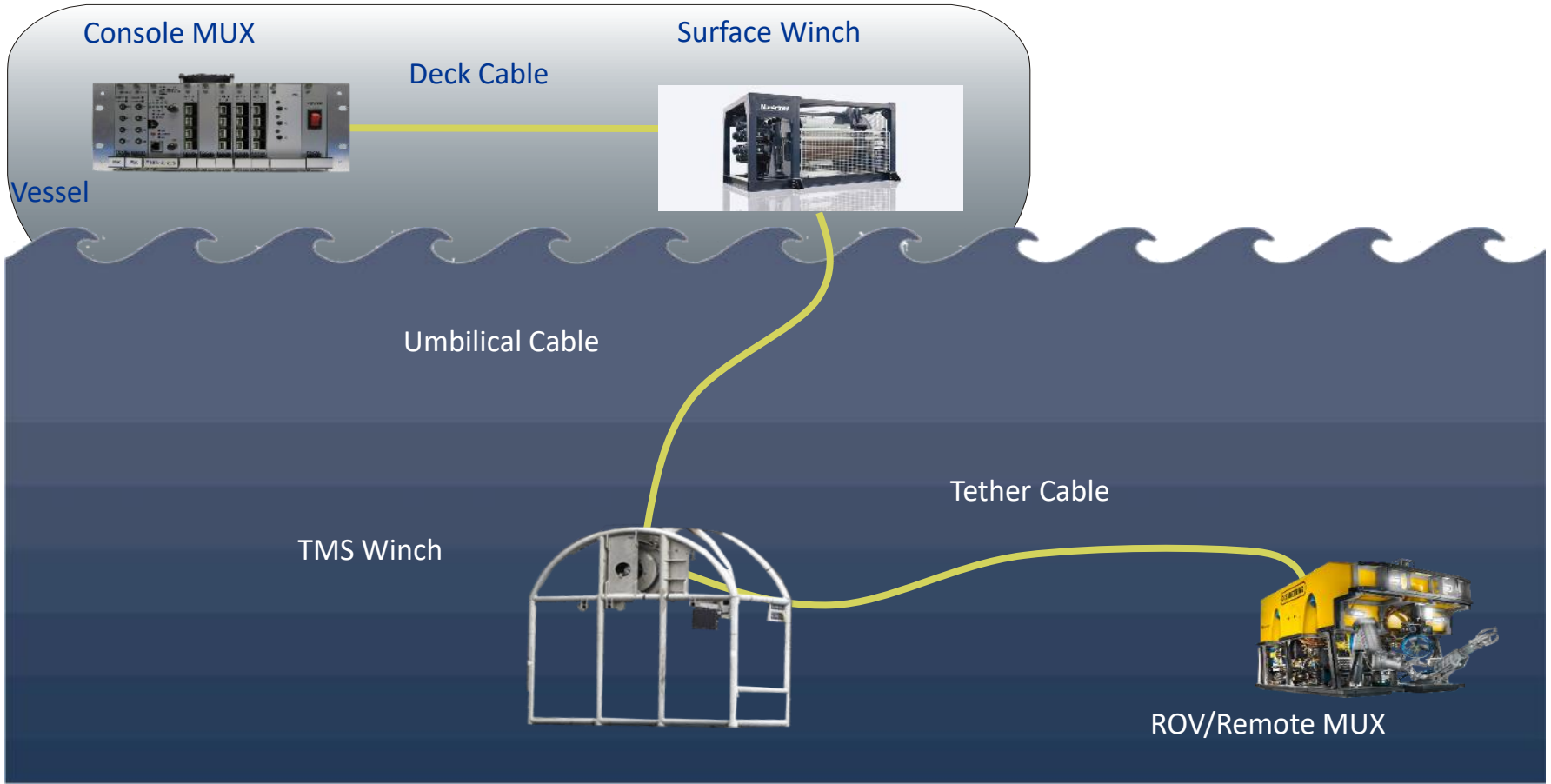
通过监控技术降低ROV运营成本并提高可靠性

Tōngguò jiānkòng jìshù jiàngdī ROV yùnyíng chéngběn bìng tígāo kěkào xìng

ROV Health Monitoring Systems: 健康监测技术

Reducing Downtime by Live Health Monitoring in Three Areas:

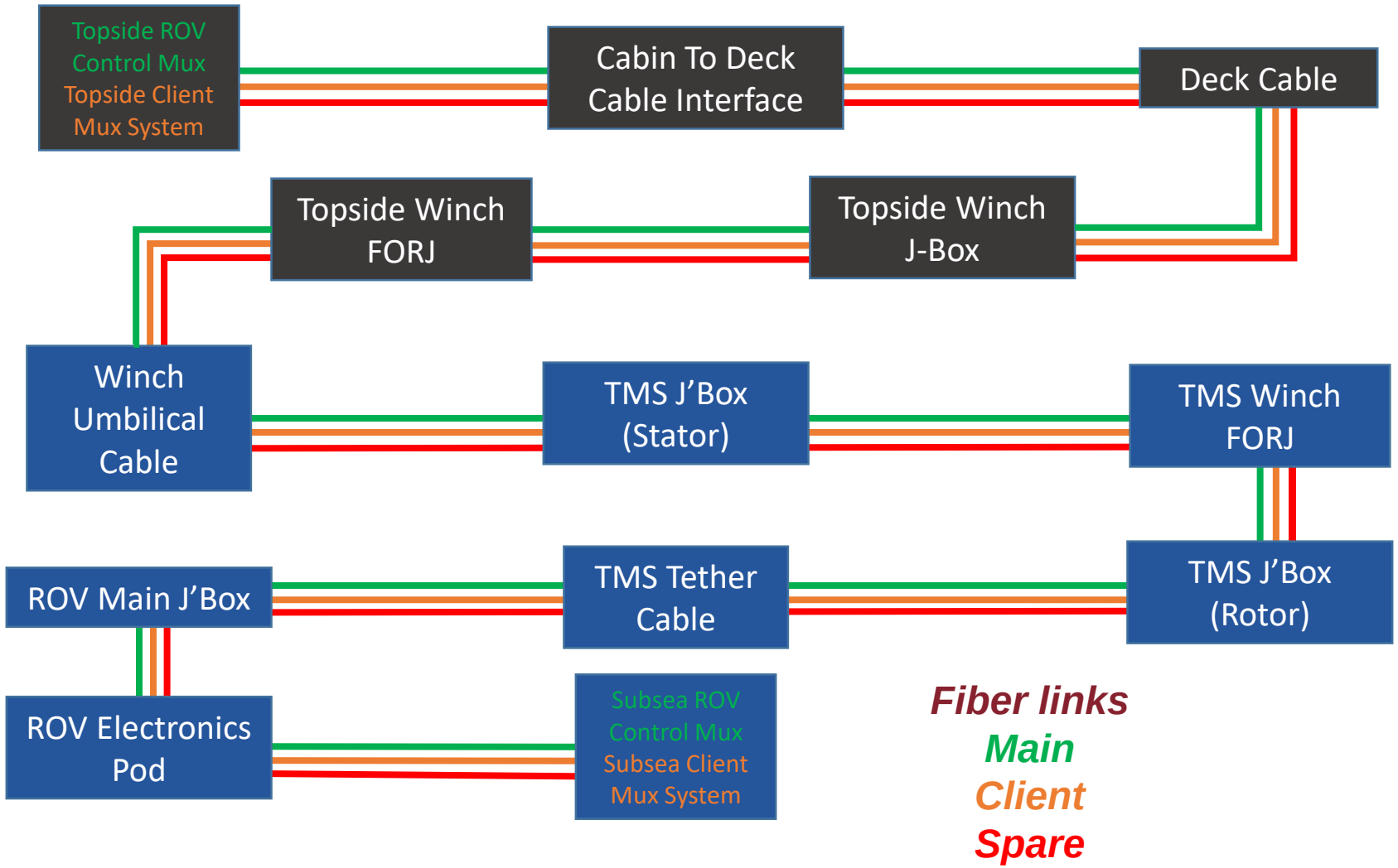
- **Optical multiplexer monitoring within the ROV, TMS and control van**
- **Slip Ring Sensors embedded within the surface winch and TMS winch**
- **Monitoring of the entire optical cable system from Control van to ROV**



Optical Cabling System Health Monitoring

健康监测技术（health monitoring technology）

Sample WROV Optical Communication Path

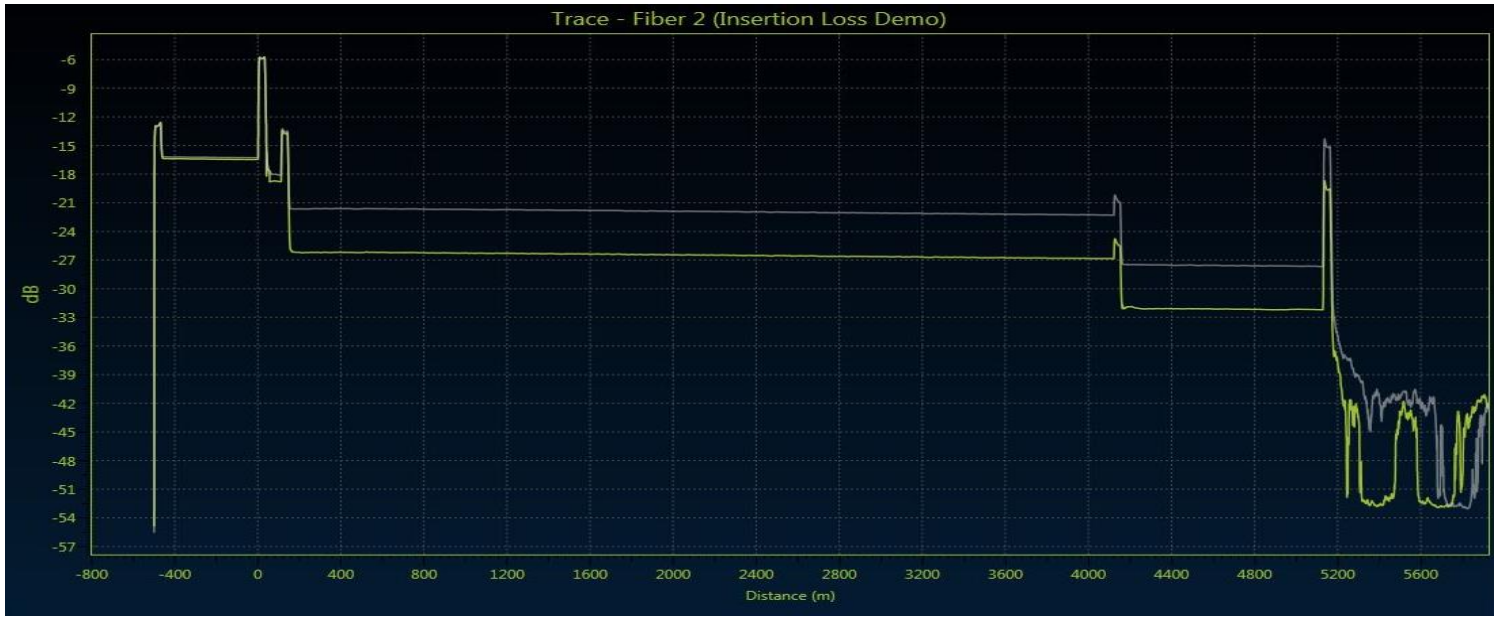


Optical Cabling System Health Monitoring

健康监测技术（health monitoring technology）

What happens when optical links fail…present day?

- **Dig out the expensive Optical Time Domain Reflectometer (OTDR)**
  - **Requires OTDR trained ROV technicians**
  - **Offline system…need to break into optical channels**
  - **Difficult to interpret results, many pitfalls**
  - **Difficult to locate subsea faults when ROV deployed**
  - **Fault diagnosis is slow… more downtime!**



Optical Cabling System Health Monitoring

健康监测技术 (health monitoring technology)

New Capabilities with the Optical Monitoring System (OMS):

新功能 (new capabilities)

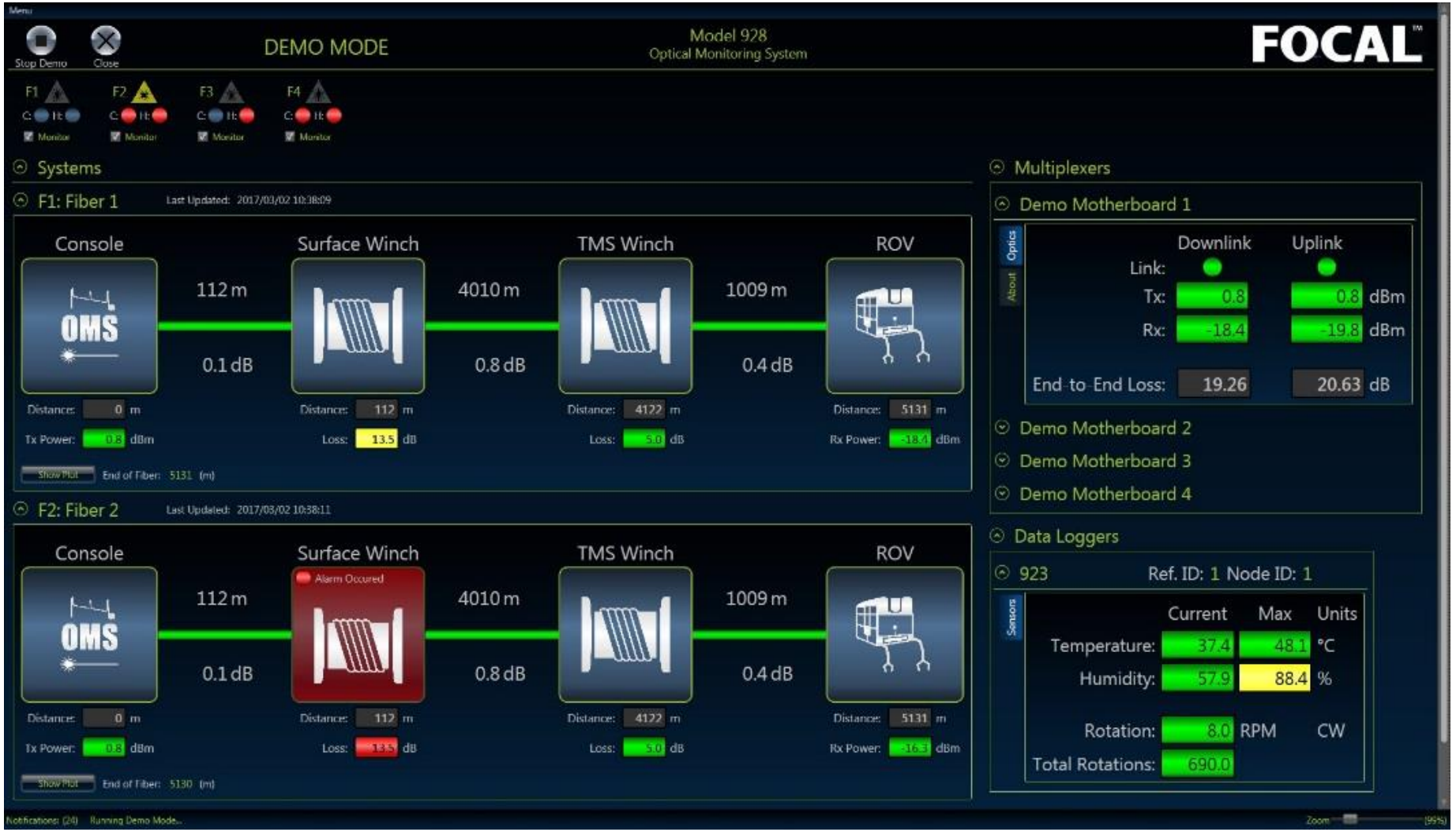
- **Real time monitoring** of up to 4 optical links at the same time
- **Operates inline with live telemetry data** and on spare fibers
- **Simple and easy to use**…no special training required, HMI style GUI, automatically runs on power up
- **User configurable alarms and warnings** in GUI and panel LEDs
- **Up to 32 fibers** supported for subsea control applications
- **Central diagnostic hub** integrates with Focal mux diagnostics, slip ring sensors, and 3rd party data, e.g. NMEA-0183, with local data logging
- **Network interface available** for remote access and remote data transfer, e.g. cloud

Optical Cabling System Health Monitoring

健康监测技术（health monitoring technology）

User configurable GUI: OMS, Multiplexer, Slip Ring Diagnostics

(User Configurable): 用户可配置



Optical Cabling System Health Monitoring

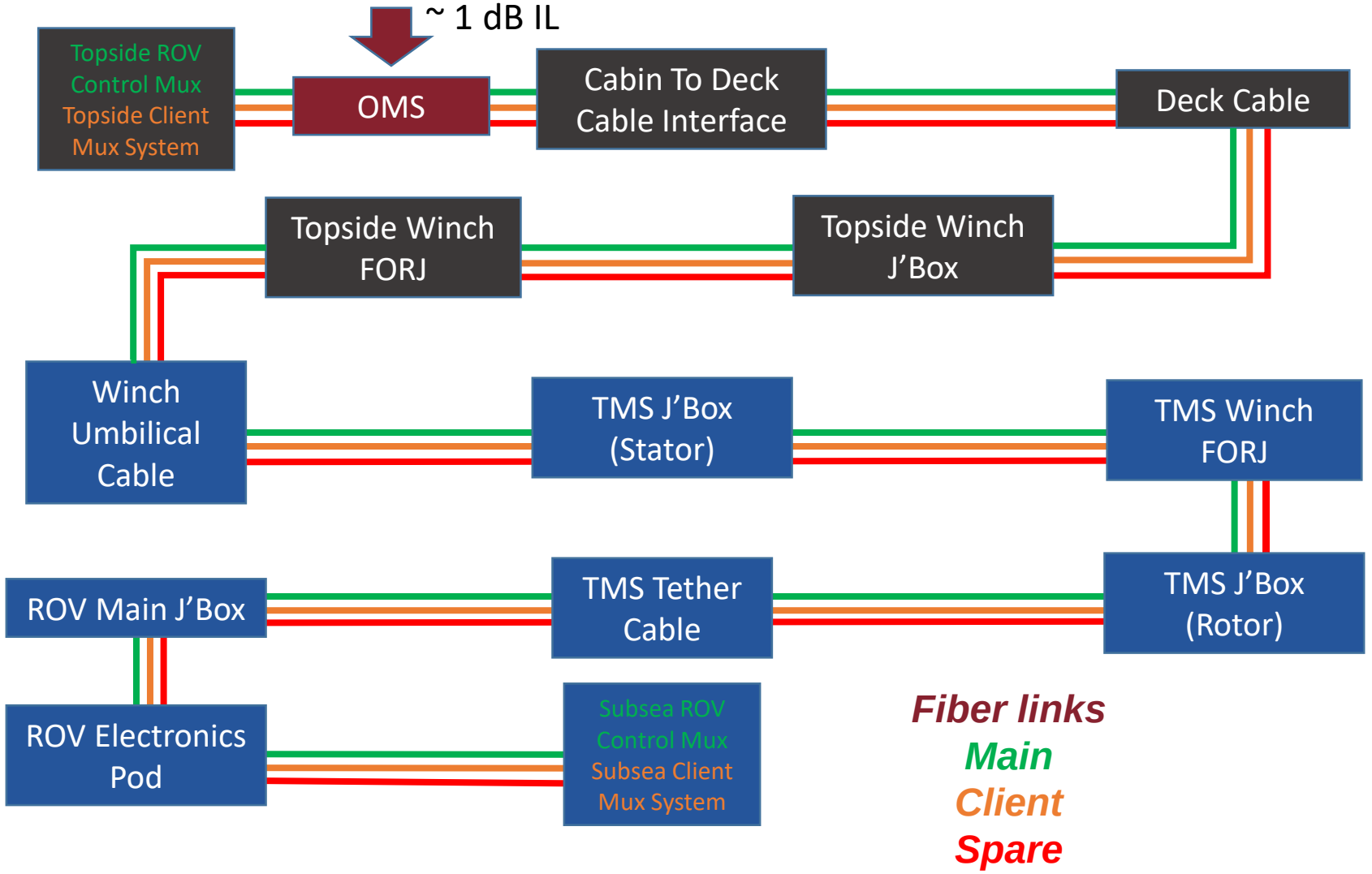
健康监测技术（health monitoring technology）

Traditional OTDR traces with saved reference

Optical Cabling System Health Monitoring

健康监测技术 (health monitoring technology)

Sample WROV Optical Communication Path – OMS Added To Circuit



Optical Cabling System Health Monitoring

健康监测技术（health monitoring technology）

User interface showing system operational.

Optical Cabling System Health Monitoring

健康监测技术（health monitoring technology）

User interface showing insertion loss failure on fiber 2 in surface winch.

Optical Cabling System Health Monitoring

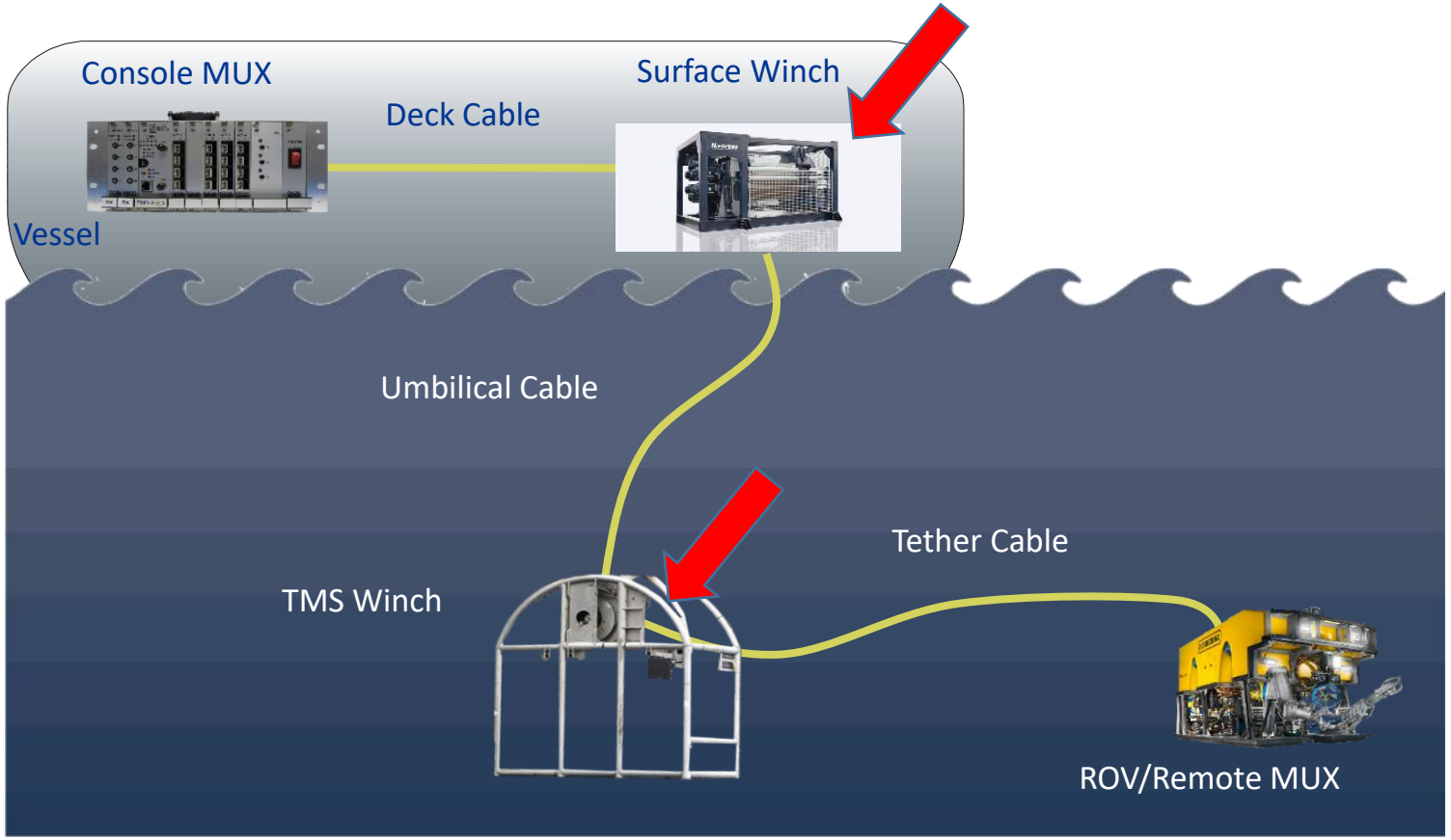
健康监测技术（health monitoring technology）

User interface showing open circuit on fiber 4 in tether.

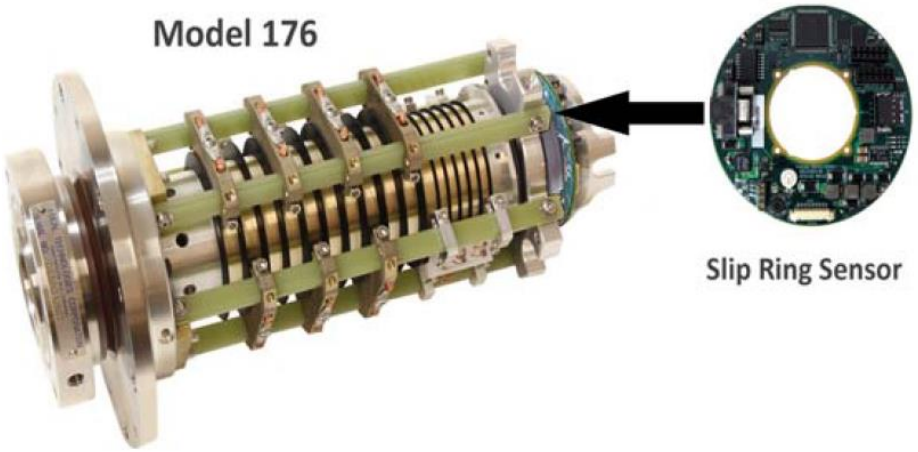
Expected tether length is 1300m

ROV Slip Ring Health Monitoring (ROV滑环健康监测)

- **Focal Slip Rings typically installed in Surface and TMS winches**
- **Rated up to 7.2kV at 20A for power lines and 600V at 7A for signal lines.**
- **Electrical slip ring usually combined with Fiber Optic Rotary Joint (FORJ)**
- **TMS slip ring usually immersed in oil and pressure compensated.**



ROV Slip Ring Health Monitoring (ROV滑环健康监测)



- Real-time health monitoring from inside the slip ring assembly
- Improves uptime and guides planned maintenance activities
- Designed for new configurations or retrofit into existing slip-rings with minimal impact
- Optional external sensors including water ingress, current, pressure, voltage, etc.
- Qualified for use in surface and subsea slip rings (up to 4,000m depth rated)
- “Black Box” onboard data storage, min. 5 years recording life

Sensors	
Temperature	Onboard -20 to +70 °C
	2 channel T/C, K type
Relative Humidity	5 to 95% RH
Accelerometer (3-Axis)	± 200 g per axis with shock event detection
Ambient Light	300 to 1000 nm
Turns Counter	Direction, speed, total turns (10 degree resolution typical)

Diagnostics Serial Link	
Signal Type	RS485
Speed	115.2 kbps
Protocol	Modbus RTU

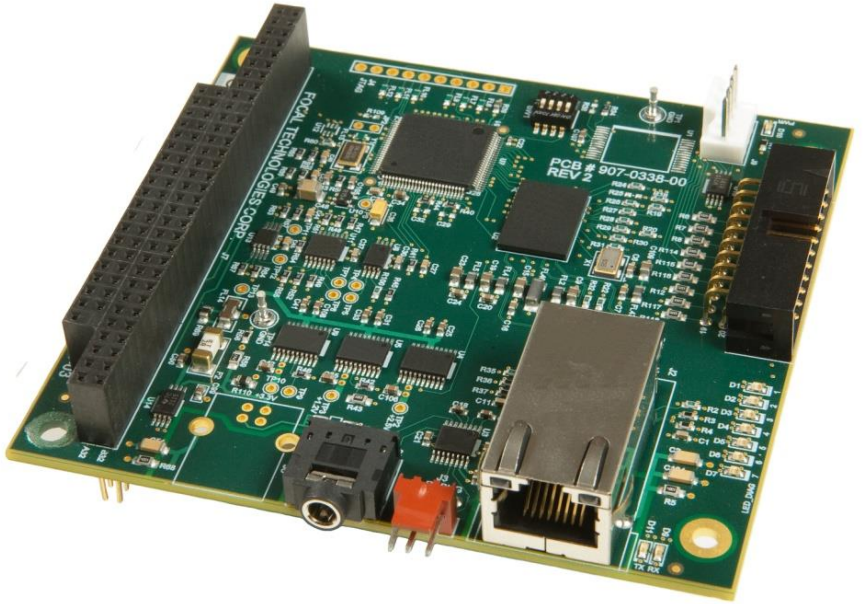
ROV Slip Ring Health Monitoring (ROV滑环健康监测)

User Interface…all electrical slip ring operating parameters good

ROV Telemetry Health Monitoring (ROV滑环健康监测)

Diagnostics

- Health monitoring of topside and subsea communication data links
- Temperature, laser bias current, power-rail voltage, Tx/Rx optical power
- Remotely configure switch settings without opening bottle
- Integration into health monitoring software



ROV Telemetry Health Monitoring (ROV遥测健康监测)

User Interface…serial data and optical links status

Health Monitoring System – Hub and Gateway(枢纽和网关)

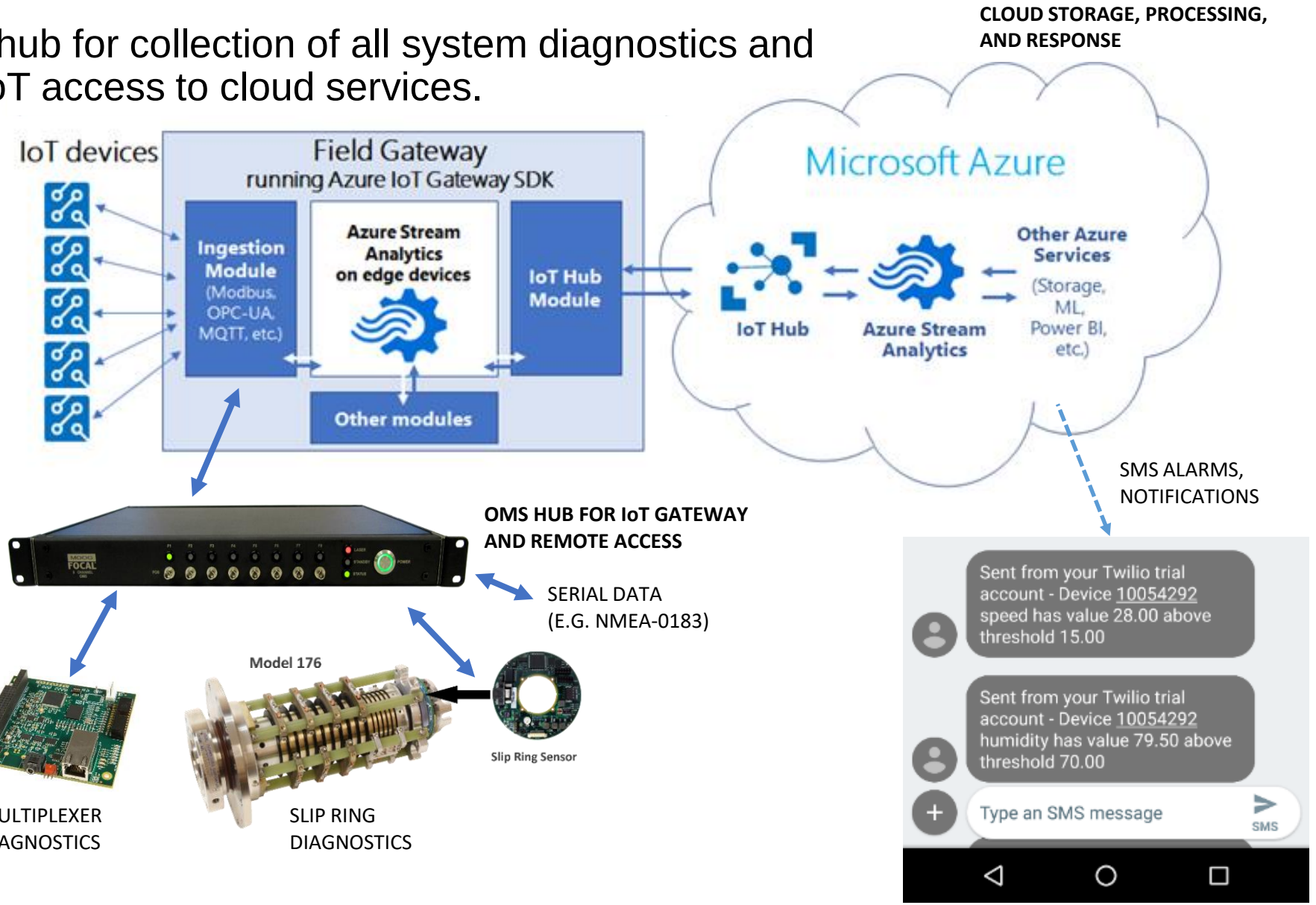
Comprehensive Condition Monitoring System:
Diagnostics + Optical System Monitoring + Slip Ring Sensors

- ✓ *Linked hardware to collect and manage data*
- ✓ *One easy-to-use software platform and API*
- ✓ *Remote access and cloud-based data*

Health Monitoring System – IoT and the Cloud

健康监测技术 (health monitoring technology)

OMS acts as hub for collection of all system diagnostics and gateway for IoT access to cloud services.



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