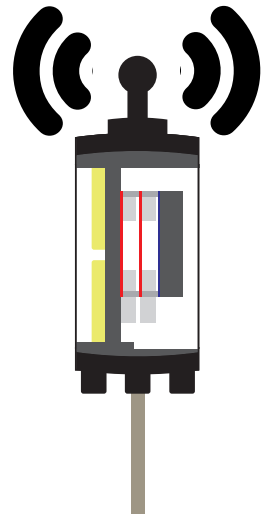
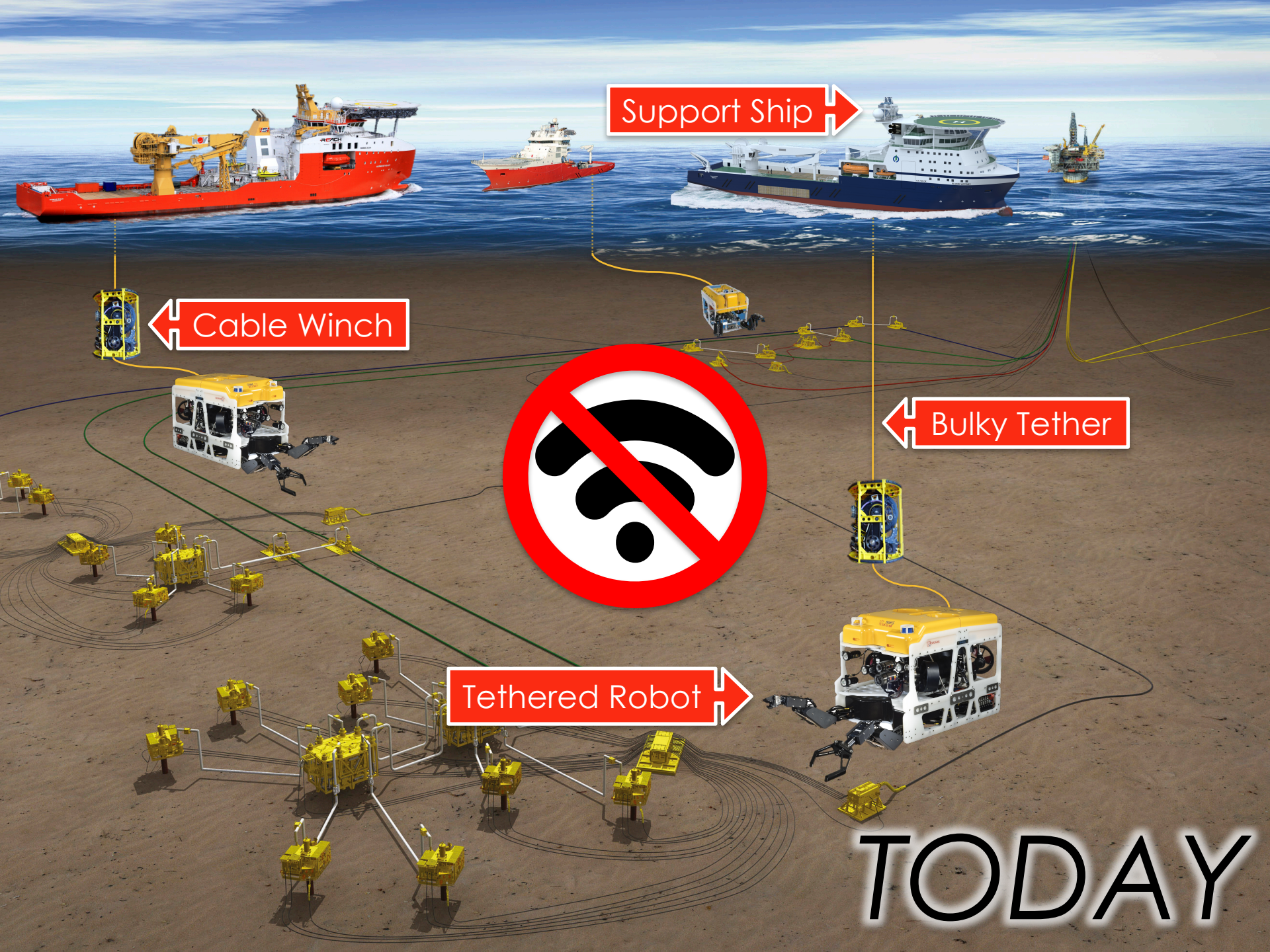




*High-Speed Wireless Communications
for the Subsea Industry*





Support Ship

Cable Winch

Bulky Tether

Tethered Robot

TODAY

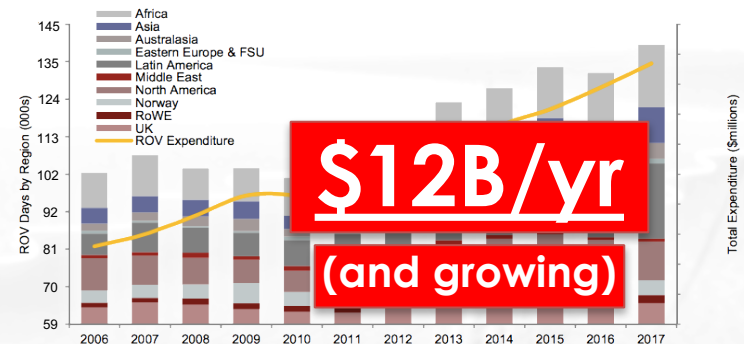
Undersea Communication Pains

- Tethered links require expensive surface vessels!



Douglas - Westwood

Global ROV Expenditure



- Wireless today is too slow!

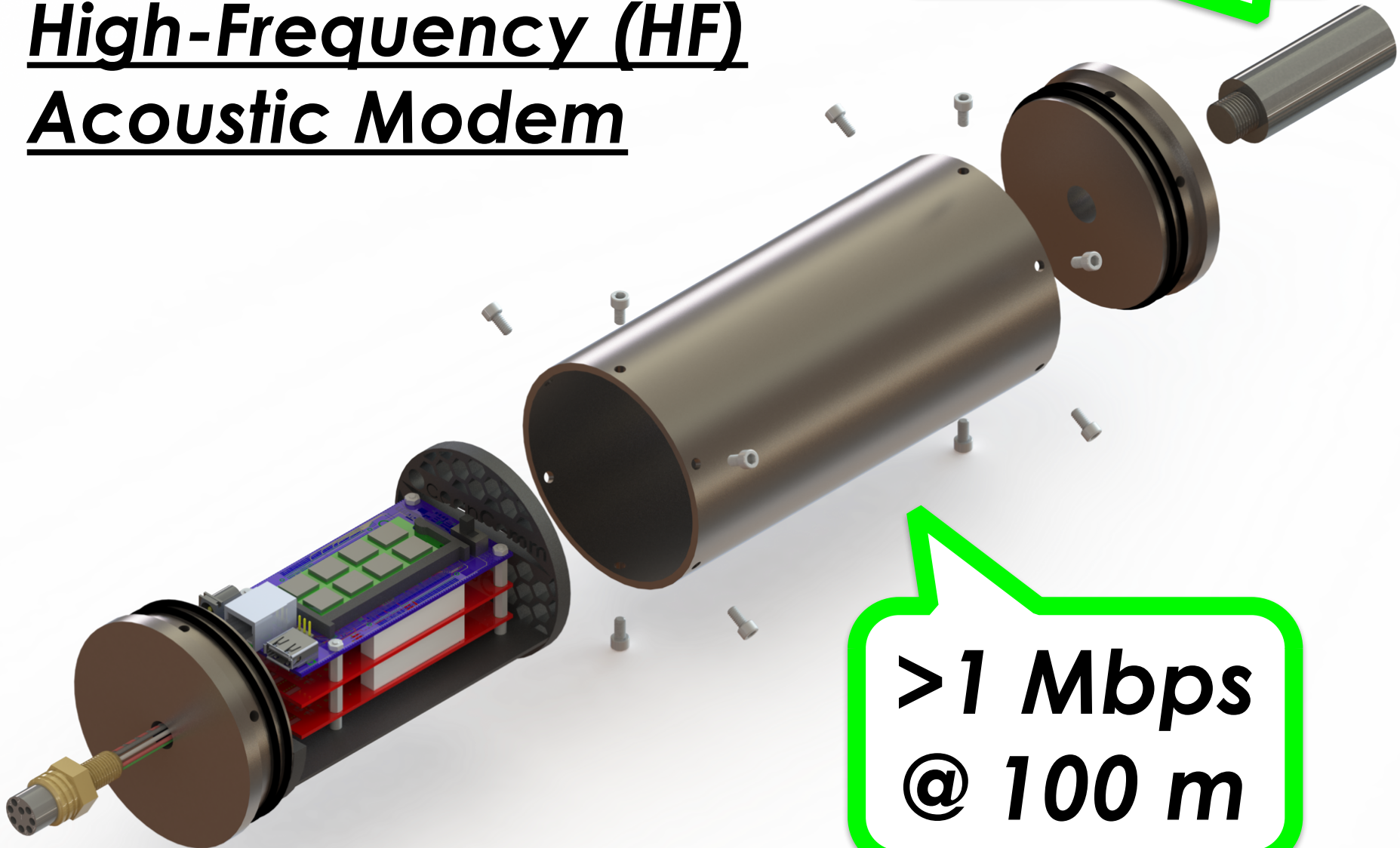


Transfers only
~1 picture/min

Can't stream
video!

Our Solution: High-Frequency (HF) Acoustic Modem

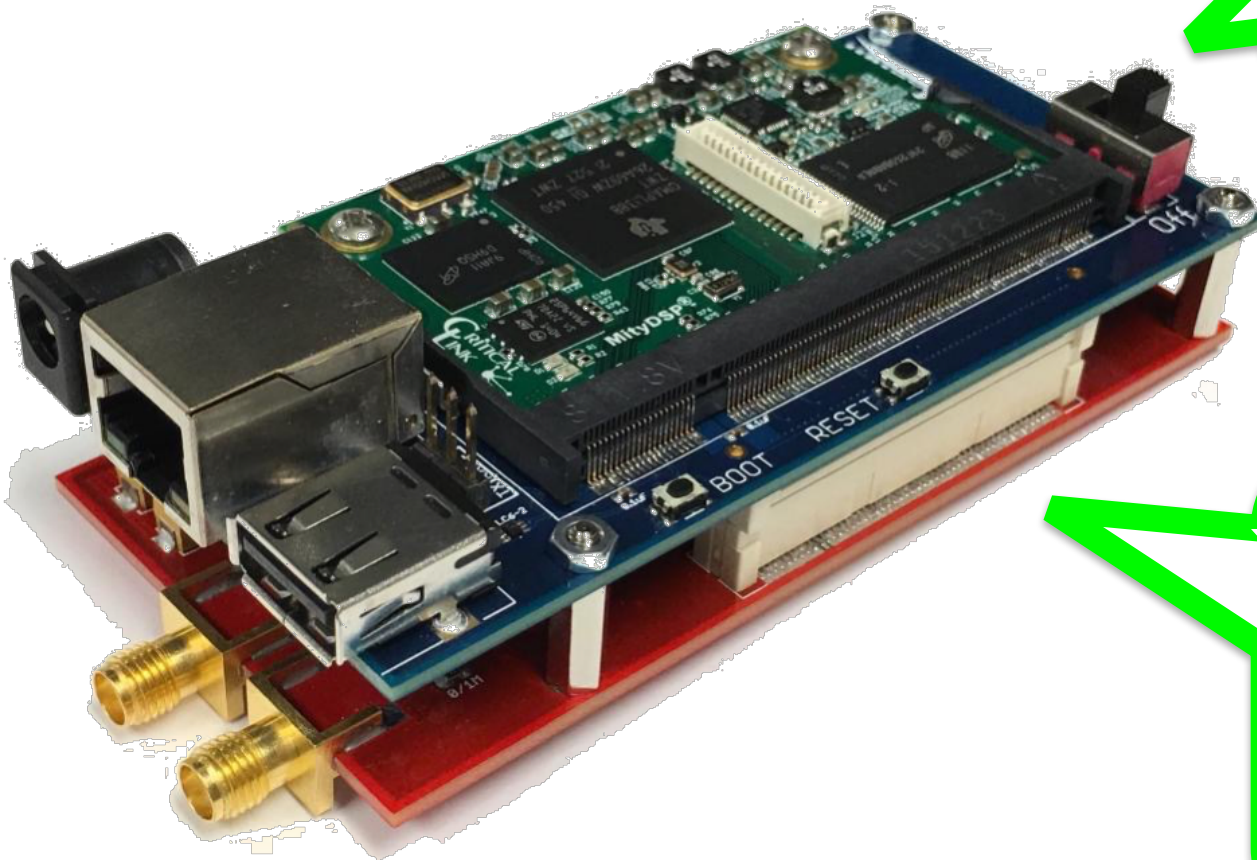
HF Transducer



>1 Mbps
@ 100 m

Our Solution: High-Frequency (HF) Acoustic Modem

**Modem
Electronics**



Connectors
for **24 VDC**,
Ethernet
and **USB**.

Internet
Connection

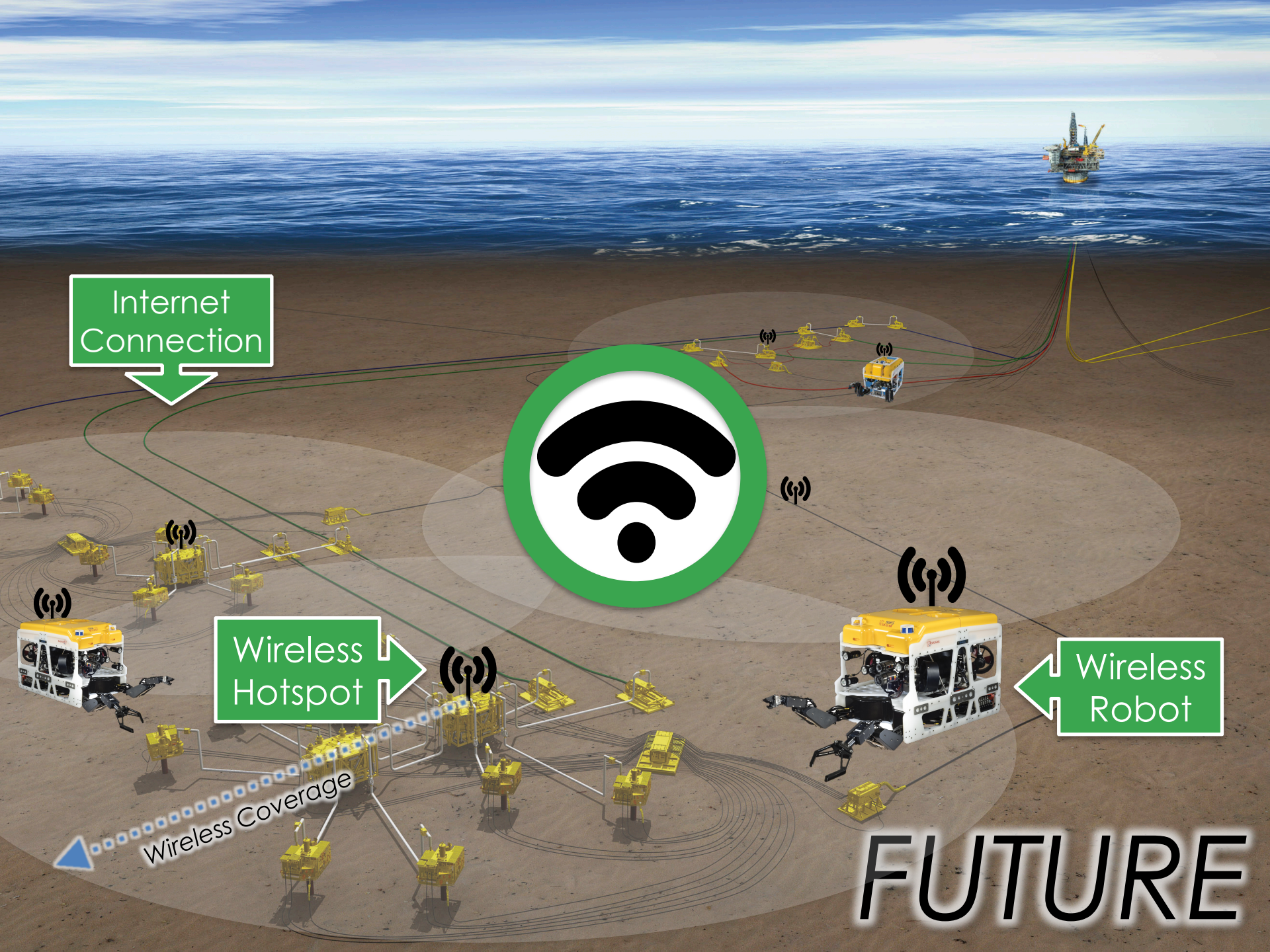


Wireless
Hotspot

Wireless
Robot

Wireless Coverage

FUTURE



Competitor Analysis

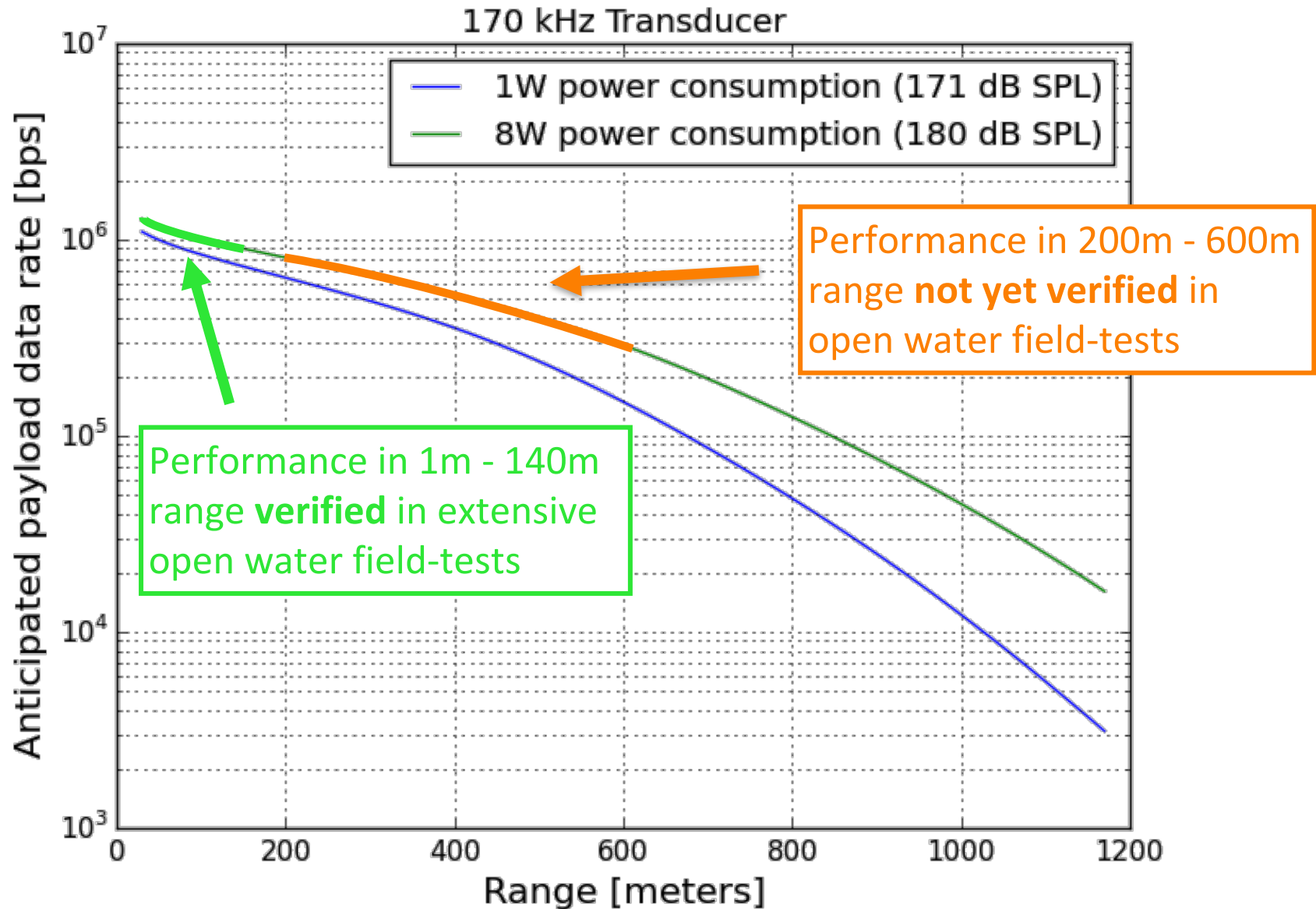
Cannot support video streaming

Cannot support 100 m range

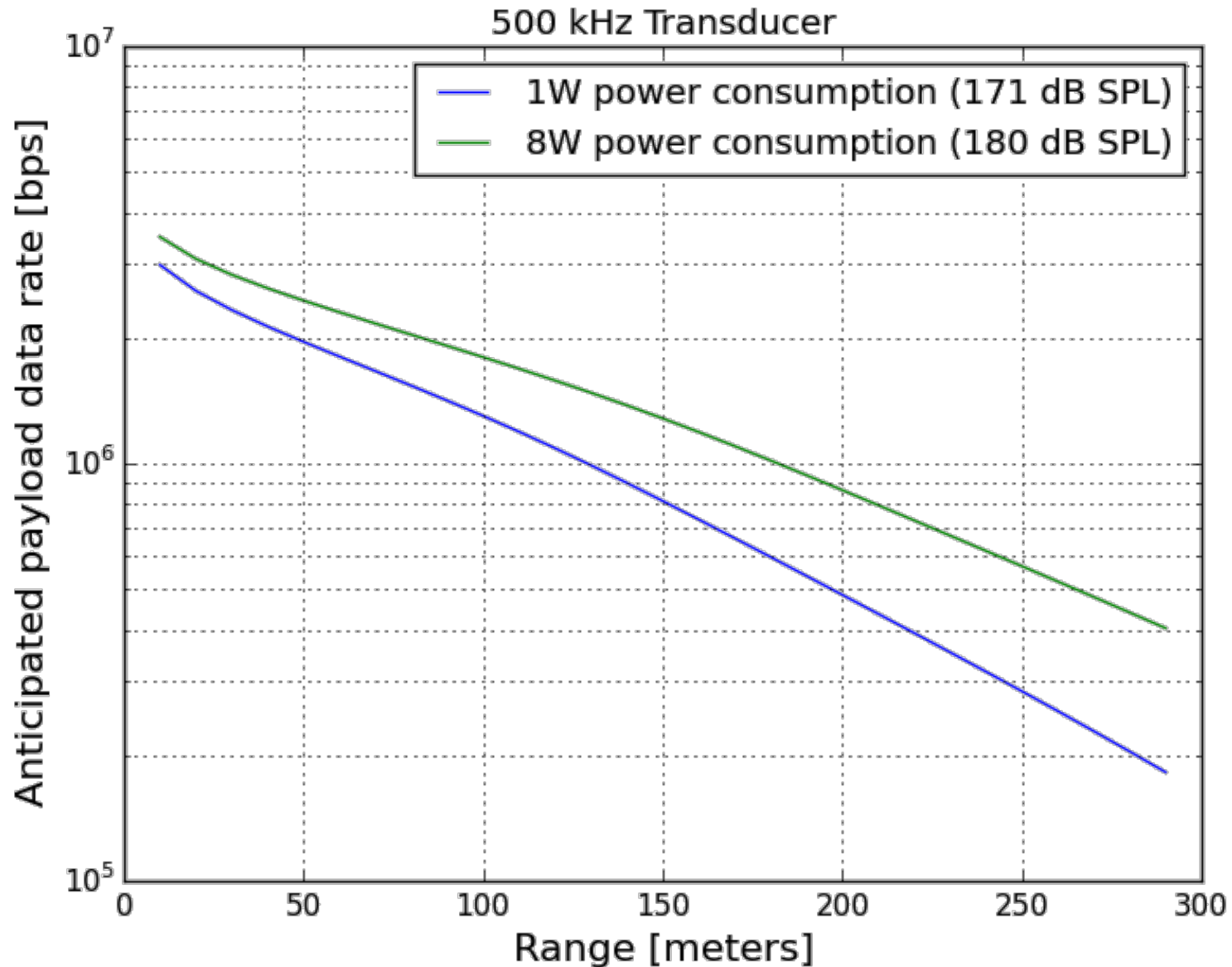
Company Name	Benthos	EvoLogics	OceanComm	Sonardyne BlueComm	WFS
Technology	Acoustic	Acoustic	Acoustic	Optical	RF
Omnidirectional	Yes	Yes	Yes	No	Yes
Turbid water	Yes	Yes	Yes	No	Yes
Ambient light tolerant (sun, work lights, etc.)	Yes	Yes	Yes	No	Yes
Data rate [kbps] @ 1 m distance	15.4	62.5	2,500	20,000	156
Data rate [kbps] @ 100 m distance	15.4	62.5	1,000	1,000	0
Data rate [kbps] @ 1 km distance	15.4	31.2	40	0	0
Commercially available	Yes	Yes	No	Yes	Yes

■ Excellent
 ■ Fair
 ■ Poor

Our Modem: Medium range version



Our Modem: Short range version

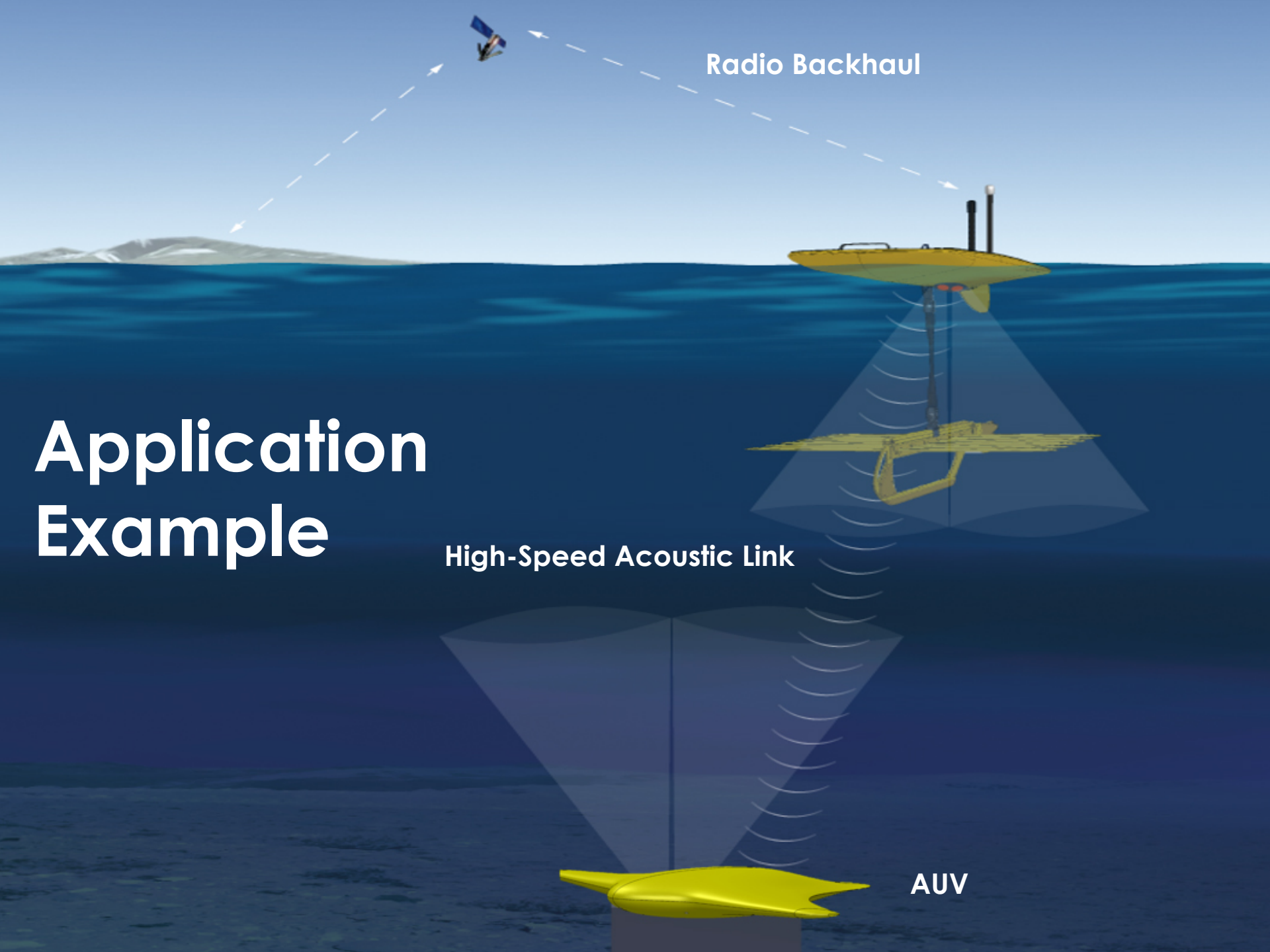


Application Example

High-Speed Acoustic Link

Radio Backhaul

AUV



How did we get here?

Technology based on 18 years of development and more than \$50M in research funding. Thomas Riedl's PhD research addressed the key remaining barrier to Mbps data rates in underwater wireless communications: Doppler effects - 100,000X worse in underwater acoustics than in RF communications.



Thomas Riedl, Founder

- UIUC PhD in Electrical and Computer Engineering
- Developed algorithms for down-hole mud-pulse acoustic communications at Schlumberger
- Several patent-pending algorithms for robust wireless communication underwater at data rates between 1 Mbps and 1 Gbps (> 1,000X improvement over state-of-the-art)



Andrew Singer, Founder & former PhD advisor

- MIT PhD, UIUC Professor of ECE
- Founder/CEO, Intersymbol Communications acquired by Finisar (FNSR)
- Developed the underwater acoustic modems for the Navy in the 1990s at Lockheed Martin



FINISAR®



Schlumberger

LOCKHEED MARTIN



Passed Milestones

2010

Successful **US Navy field tests**
in Woods Hole, Maui, ...



System and method for broadband doppler compensation

US 20140071793 A1

ABSTRACT

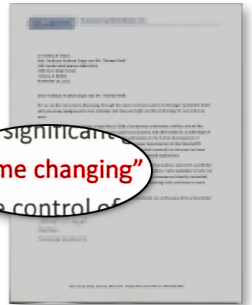
A Doppler compensation system includes a transmitter unit for transmitting a signal, wherein the transmitted signal being associated with an emission time-

Doppler Compensation
patent filed

2011

Customer Discovery:
300+ interviews

... significant
"game changing"
... control of



2013

\$180k NSF SBIR grant

2014

"Most promising company"
award at **OTC, Houston**



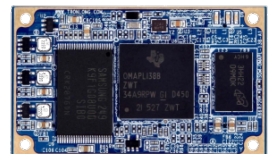
2015

\$750k NSF SBIR grant

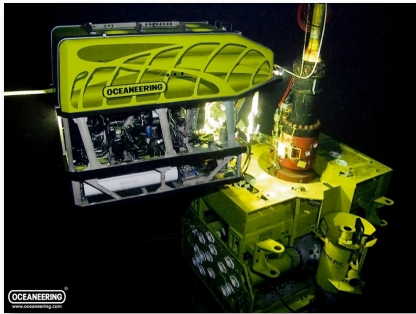
2016

\$1.7M DoD grant

Ported modem code
to **tiny computer**



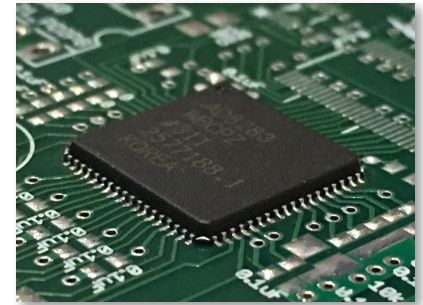
Planned Milestones



Open water testing
with integration
partners

2017

Miniaturized transmit
and receive
electromechanical
modules



2018

Beta version
available



**Customer
trials**



Commercialization Plan

"Sometimes we want a remote presence but no extra ROV."

- VP Operations, ROVs

"Hybrid AUV/ROV are the future. Video-capable wireless communication will be integral there."

- Chief Engineer, ROVs

"Cables have common modes of failure. Wireless networks boost reliability."

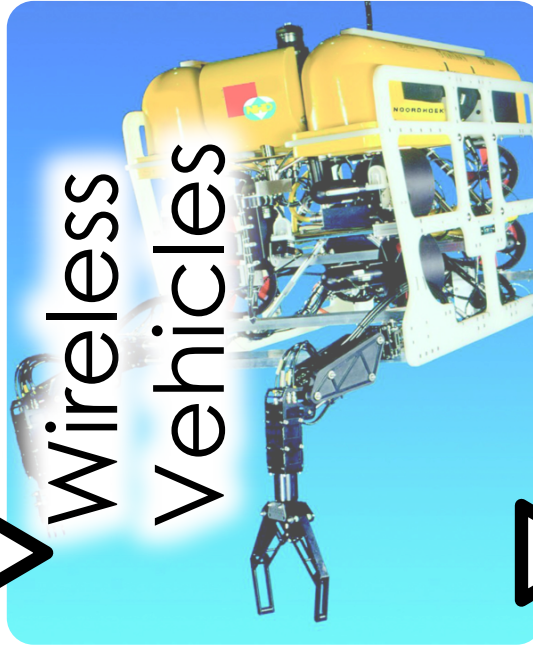
- Principal Research Engineer, Subsea Systems

Wireless Cameras



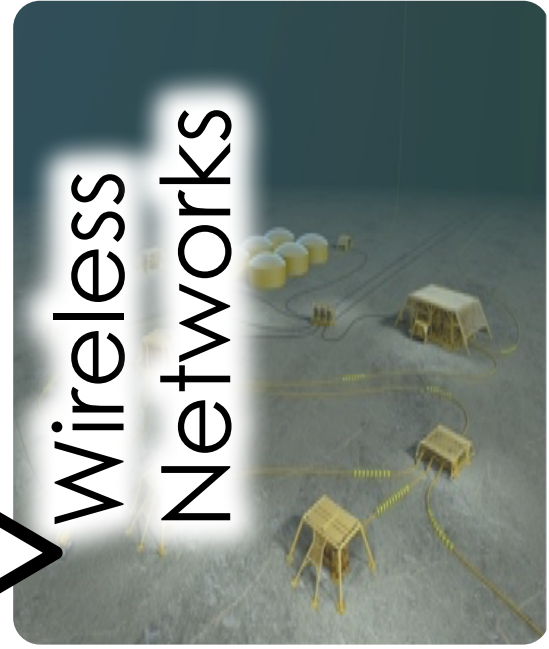
- Low risk
- Promote technology

Wireless Vehicles



- Driver: ROV vessel cost
- All-subsea installations need resident ROV.

Wireless Networks



- Driver: Availability and reliability requirements
- Huge market