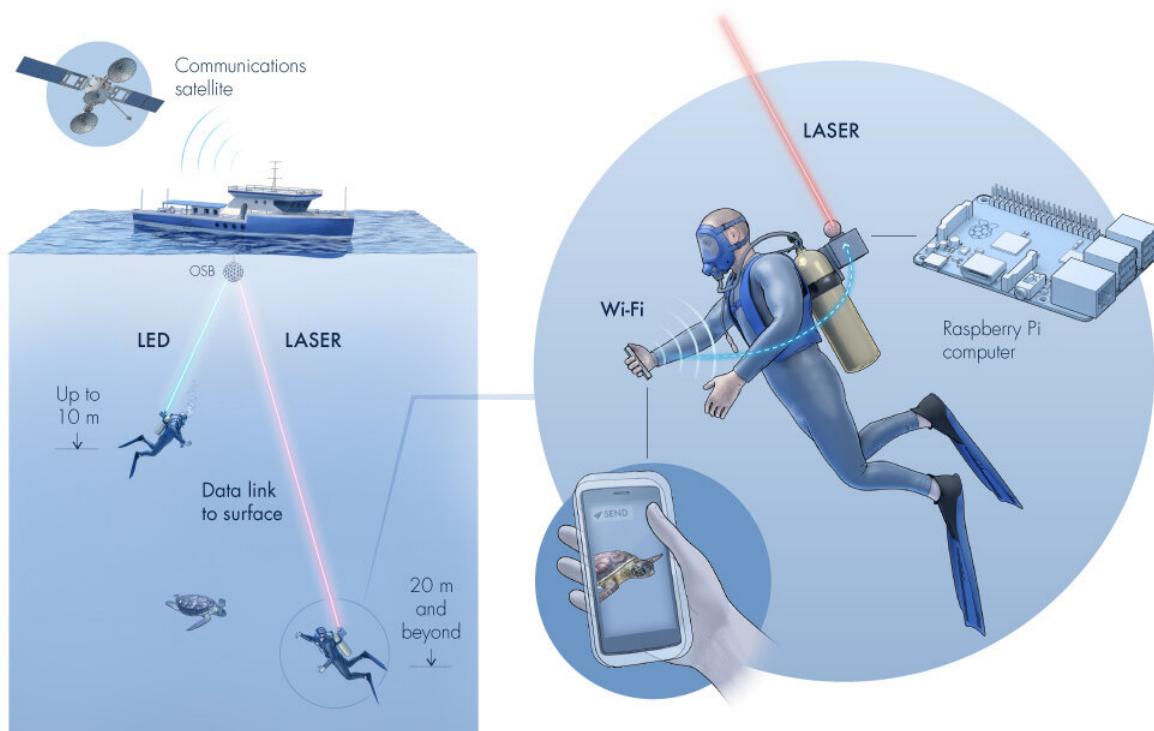


Aqua-Fi: Underwater WiFi developed using LEDs and lasers

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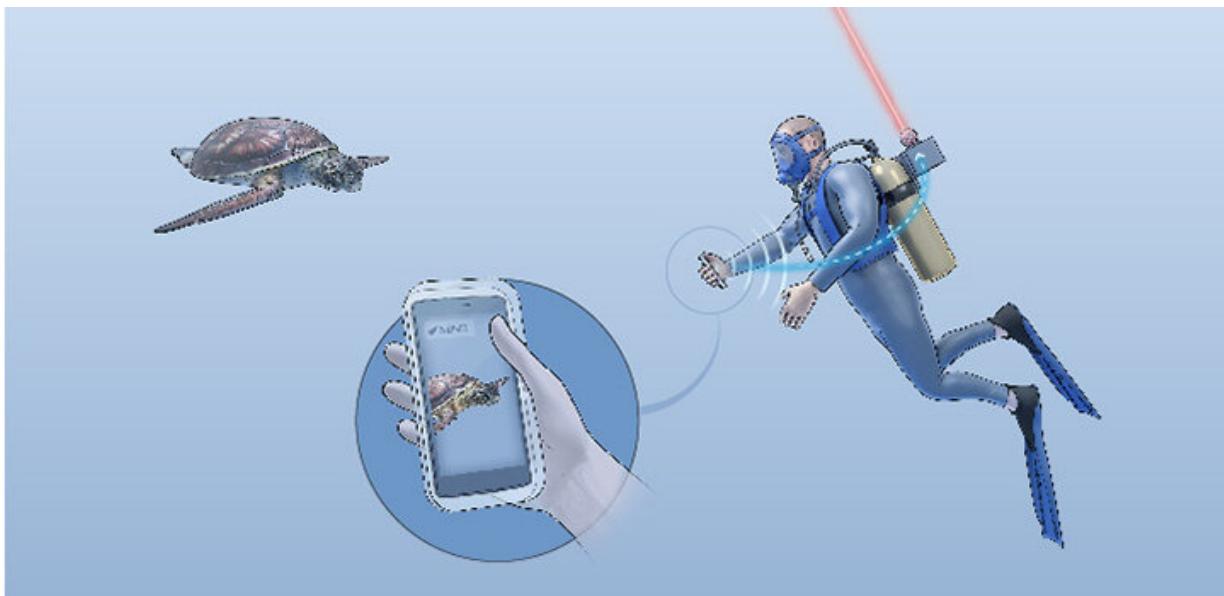
Aqua-Fi would use radio waves to send data from a diver's smart phone to a "gateway" device attached to their gear, which would send the data via a light beam to a computer at the surface that is connected to the internet via satellite.
Credit: KAUST; Xavier Pita

Aquatic internet that sends data through light beams could enable divers to instantly transmit footage from under the sea to the surface.

The [internet](#) is an indispensable communication tool, connecting tens of billions of devices worldwide, and yet we struggle to connect to the web from under water. "People from both academia and industry want to monitor and explore underwater environments in detail," explains the first author, Basem Shihada. Wireless internet under the sea would enable divers to talk without hand signals and send live data to the surface.

Underwater communication is possible with radio, acoustic and [visible light](#) signals. However, radio can only carry data over [short distances](#), while acoustic signals support long distances, but with a very limited data rate. Visible light can travel far and carry lots of data, but the narrow light beams require a clear line of sight between the transmitters and receivers.

Now, Shihada's team has built an underwater wireless system, Aqua-Fi, that supports [internet services](#), such as sending multimedia messages using either LEDs or lasers. LEDs provide a low-energy option for short-distance communication, while lasers can carry data further, but need more power.



Scuba divers could send sea life shots in real time using an aquatic internet service. Credit: KAUST; Xavier Pita

The Aqua-Fi prototype used green LEDs or a 520-nanometer laser to send data from a small, simple computer to a light detector connected to another computer. The first computer converts photos and videos into a series of 1s and 0s, which are translated into [light beams](#) turning on and off at very high speeds. The light detector senses this variation and turns it back into 1s and 0s, which the receiving computer converts back into the original footage.

The researchers tested the system by simultaneously uploading and downloading multimedia between two computers set a few meters apart in static water. They recorded a maximum data transfer speed of 2.11 megabytes per second and an average delay of 1.00 millisecond for a round trip. "This is the first time anyone has used the internet underwater completely wirelessly," says Shihada.

In the [real world](#), Aqua-Fi would use radio waves to send data from a diver's smartphone to a "gateway" device attached to their gear. Then, much like a booster that extends the WiFi range of a household internet router, this gateway sends the data via a light beam to a [computer](#) at the surface that is connected to the internet via satellite.

Aqua-Fi will not be available until the researchers overcome several obstacles. "We hope to improve the link quality and the transmission range with faster electronic components," explains Shihada. The light beam must also remain perfectly aligned with the receiver in moving

waters, and the team is considering a spherical receiver that can capture light from all angles.

"We have created a relatively cheap and flexible way to connect underwater environments to the global internet," says Shihada. "We hope that one day, Aqua-Fi will be as widely used underwater as WiFi is above water."

More information: Basem Shihada et al. Aqua-Fi: Delivering Internet Underwater Using Wireless Optical Networks, *IEEE Communications Magazine* (2020). [DOI: 10.1109/MCOM.001.2000009](https://doi.org/10.1109/MCOM.001.2000009)

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