Background

▼ Details

Rapid.Space is a JV between Nexedi and Amarisoft. Rapid.Space produces an autonomous 4G/5G base station with RAN (eNodeB, gNodeB), embedded core network (epc, 5gc, ims) and edge computing services (local messaging, push-to-talk, video streaming, proxy, education library, IoT buffering, etc.). This autonomous 4G/5G base station, called "Open Radio Station", can operate outdoor with low power (32W) using batteries. It weights only 2.4 kg which simplifies deployment with low construction cost infrastructure (roof, wooden pole, telescopic mast on vehicle, etc.). This is ideal for constrained environments such a remote villages in tropical areas, farms in low density areas, disaster relief areas, etc

Problem: no Internet for 20% of population

▼ Details

About 20% of the global population can not access Internet. We can see here a typical example of area without proper Internet access in a tropical country. The village has about 1,000 inhabitants, a city hall, a school, motorbikes, cars, etc. but not proper Internet access.

Credit: this picture was taken in the Philippines in a village part of the community network operated by HI-SEAS company.

Why?

- Average revenue per user (ARPU) is very low: 2€-4€ per month
- Traditional FTTH infrastructure is too expensive for telcos
- Traditional 4G/5G infrastructure (ex. Huawei base station and 20m tower construction) is too expensive for telcos
- Starlink is too expensive for a single family (50€ per month)
- Sharing Starlink Internet with Wifi has poor range, especially in tropical areas, and incurs potentially high maintenance cost

▼ Details

The reason is simple: the cost of Internet infrastructure (FTTH, 4G/5G) is too high compared to the average revenue per user of the population. Telcos will thus exclude small and unprofitable villages from their coverage plan.

Starlink itself is too expensive for a single family in such villages. Imagine paying 500€ per month in Europe or Japan for a 200 Mbps Internet access.

Using Wifi to share Starlink Internet access can be a solution. It is actually done in this way in some HI-SEAS communities with dozens of access points covering the village. But this can be expensive in terms of initial infrastructure setup or maintenance cost. Also, Wifi has poor range as soon for farmers who need to work on nearby fields or for fishermen on nearby seashore.

Solution: 4G/5G + satellite

Access Internet via satellite and share access via 4G/5G base station

▼ Details

An efficient solution to provide Interner everywhere consists of combining a low-cost 4G/5G infrastructure with a low-cost satellite Internet access. The satellite provides Internet access. The low-cost 4G/5G infrastructure shares the satellite Internet to smartphones and home gateways of villagers.

We will show how Rapid.Space open source hardware and Starlink satellite can implement this idea and remain profitable even with an average revenue per user (ARPU) as low as 1€ per month. This could have a major impact for education, farming, fishing and inclusion.

Credit: this picture was taken in Rio state (Brazil) in a farm where ORS and satellite are used to compensate for the lack of 4G/5G coverage.

4G/5G: Open Radio Station

All-in-one: eNb • gNB • core network • messaging • video • digital library
2.4 kg: wooden pole • rooftop • telescopic mast • vehicle mount
32 W: powered by batteries or solar panel

TCO: under 100€ / month for 300 Mbps and 512 active users

▼ Details

The Open Radio Station is a low-cost 4G/5G infrastructure. It can fit in 2.4 kg all the components of a public network: RAN (eNodeB, gNodeB), embedded core network (epc, 5gc, ims) and edge computing services (local messaging, push-to-talk, video streaming, proxy, education library, IoT buffering, etc.). It is plug-and-play with only a single cable to connect. It only requires 32 W operate, which is less than most laptops. It provides up to 320 Mbps download speed in 5G and up to 220 Mbps in 4G. A typical deployment using 20 MHz radio spectrum will provide about 100 Mbps download.

Thanks to its low power, ORS can be operated entirely autonomously with low-cost batteries and solar panel. This is very useful during tropical storms which can destroy electricity infrastructure during days. It is also more environment friendly fuel-based generators in areas with no infrastructure at all.

ORS open source hardware design can be produced anywhere. It is for now produced by Accton (Taiwan), Geeflex (China) and Nexedi (France). Its software is entirely open source with the exception of Amarisoft 3GPP stack. Amarisoft provides an extremely efficient, pure software implementation of carrier-grade 4G/5G radio supporting more than 512 active users (2000+ in some tests). It has no equivalent on the market with unparalleled energy efficiency and stability.

The overall TCO of an ORS with antenna, software support and hardware maintenance is under 100€ per month. ORS is already deployed commercially in tropical areas (Brazil).

Satellite: Starlink

TCO: under 100€ / month for 200 Mbps

▼ Details

In areas where optical fibre is not available, Starlink can provide 200 Mbps download at low cost with low latency. Starlink download speed is a bit less than the ORS maximum download speed which is consistent for a radio infrastructure.

The overall TCO of Starlink with hardware maintenance and monthly data subscription is about 100€ per month.

Other satellite vendors can provide similar service at, usually, higher price.

Credit: this picture was taken in the Philippines in a village part of the community network operated by HI-SEAS company.

Impact: free Internet for teachers

▼ Details

Once villages have Internet access, school teachers usually get a free subscription to help them in their education tasks.

Credit: this picture was taken in the Philippines in a village part of the community network operated by HI-SEAS company.

Impact: Internet everywhere

▼ Details

Everyone in the village can start using smart phones, especially younger educated teenagers and adults. Only one ORS is enough to start.

Credit: this picture was taken in the Philippines in a village part of the community network operated by HI-SEAS company.

Impact: farmers and fishermen

▼ Details

Farmers or fishermen can access Internet at work, nearby the village. This is possible thanks to the better range of 4G/5G in low frequencies compared to Wifi, and to the better scheduling algorithm of 4G/5G compared to Wifi.

The typical range of ORS in band 28 (700 Mhz) with an omnidirectional antenna is 10 km in line of sight or 2 km inside a village.

The typical range of ORS in band 39 (1900 Mhz) with an omnidirectional antenna is 5 km in line of sight or 1 km inside a village.

The typical range of ORS in band 38 (2600 Mhz) with an omnidirectional antenna is 2 km in line of sight or 500 m inside a

village.

The lower the frequency, the better the range.

If more range is needed, semi-directional sector antenna can be used with multiple ORS, each of which covering a specific area in the village (ex. village center, field, seashore).

Credit: this picture was taken in Rio state (Brazil) in a farm where ORS and satellite are used to compensate for the lack of 4G/5G coverage.

Business model

	Monthly	**Yearly**
Income: prepaid voucher revenue	1,000€	12,000€
Expense: ORS + Starlink TCO	200€	2,400€
Cash flow shared by sales channel, radio spectrum, staff and shareholders	800€	9,600€

Assuming 3.3€ per month ARPU and 300 smartphones for 1,000 people in a village

▼ Details

The business model is very profitable because the infrastructure TCO is low with low maintenance.

If we suppose that the average revenue per user (ARPU) is 3.3€ in a village of 1,000 people with 300 smartphones, the monthly revenue is 1,000€.

The TCO of ORS and antenna is about 100€ per month. The TCO of Starlink is about 100€ per month.

This leaves 800€ per month or 9,600€ per year to pay for sales channel, radio spectrum access, staff in charge of repairing infrastructure and shareholders.

Overall yearly profit per village is estimated between 3,000€ and 6,000€.

Financials

	Small quantity	**Large quantity**
Total investment (ORS, Starlink and construction)	6,000€	3,000€
Return on investment (300 subscribers, 3.3€ ARPU)	12 to 24 months	6 to 12 months
Minimum ARPU for profitability (300 subscribers)	2€	1€
Minimum subscribers for profitability (3.3€ ARPU)	200 UEs	110 UEs

▼ Details

The investment for one village is between 3,000€ and 6,000€ depending on quantity and conditions. It can be paid back with the operating cash flow in 6 to 24 months depending on the quantity and revenue sharing scheme with other parties (ex. cost of radio spectrum access). The model is still profitable with lower ARPU (1€ to 2€) or less villagers (112 to 200) depending on the ability to produce large quantities of Open Radio Station (more than 5,000).

This is a profitable business model with quick return on investment and great social impact. It opens the possibility of financing Internet access in villages by non profit organisations.

Once operation with a single ORS is profitable, it is possible too add more ORS in different areas of a village. This will either extend coverage or increase available bandwidth for each user.

There are more than 100,000 villages in the world waiting for this solution.

Legal requirements

- Option 1: spectrum allocation by government (band 28, 38, 39, 40, 41, etc.)
- Option 2: spectrum sharing with telco (band 28, 38, 39, 40, 41, etc.)
- Option 3: unlicensed spectrum (band 39 in certain countries)
- Availability of cost efficient satellite (ex. Starlink)

▼ Details

The use of ORS requires legal access to radio spectrum.

First option is to obtain spectrum from government, ideally in bands 28, 38, 39, 40, 41. Other bands may also be supported by ORS.

Second option is to share spectrum with a telco through an agreement. Ideal bands are 28, 38, 39, 40, 41. Other bands may also be supported by ORS.

This option is to use B39 which is an unlicensed band in many countries.

Regarding the satellite access, Starlink is cost efficient and is available in many countries. In some countries (ex. Indonesia), it is only available for government, which may require an agreement.

In other countries, other satellites should be considered.

FAQ

What is the range?	From 10 km line of sight (700 MHz in line of sight with omni antena) to 100 m (3800 MHz in dense area with omni antena)
What kind of back-haul can be used?	Satellite, fiber, 4G/5G with directional antenna, point-to-point microwave, etc.
What kind of UE is used?	Smartphones, home gateways and in, some cases, IoT for agriculture.
Are 4G or 5G UEs used?	For now, 4G with dual carrier is cheaper and used in priority. However, 5G UEs are becoming more affordable. We foresee a combination of 4G and 5G using dynamic spectrum sharing (DSS). After some years, we foresee complete migration to 5G.
Can 2G be used?	If needed, yes. However this reduces the choice of spectrum and probably does not make sense in most regions where 4G feature phones are already extremely affordable (under 20€).

▼ Details

Feel free to send more questions by email to sales (at) rapid (dot) space.