



Connecting the North: how Brazilians are building large scale shared subfluvial fibre optic infrastructure with service operator neutrality

Eduardo Grizendi
Director of Engineering
and Operations

Brazilian Research and Education Network - RNP

Michael Stanton (presenter)
Network Scientist

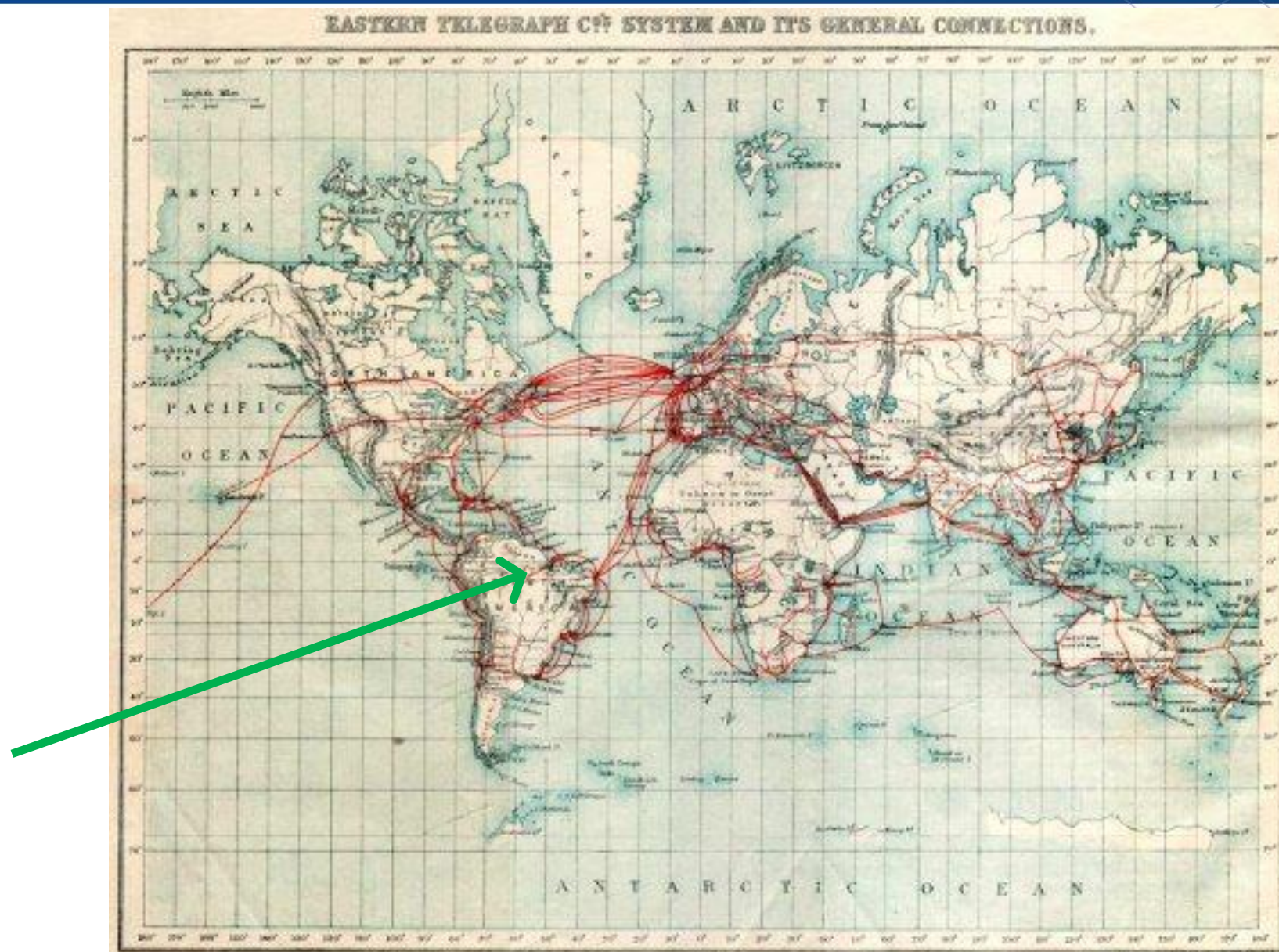
With recent maps provided by the Brazilian Communications Ministry

11th Customer Empowered Fibre (CEF) Network Workshop, Prague, April 18-19, 2023



Brazil and the Victorian Internet

- In the 1860s it finally became possible to communicate electrical telegraph signals across the oceans, forever altering how we can communicate
- Note: telegraph cable crossing Brazil in 1901





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Characteristics of the Amazon Basin

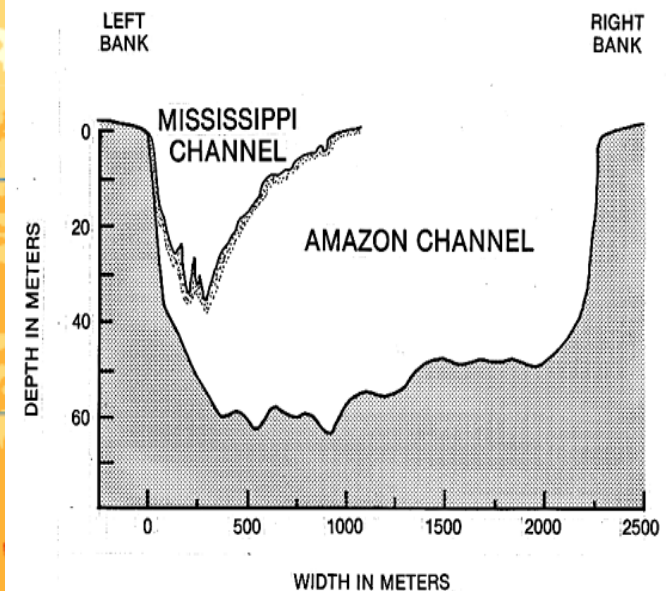


Amazon versus Mississippi At points of maximum depth:

- Obidos, AM, Brazil (2 km Wide, 60 m Deep)
- Vicksburg, MS (1 km Wide, 38 m Deep)

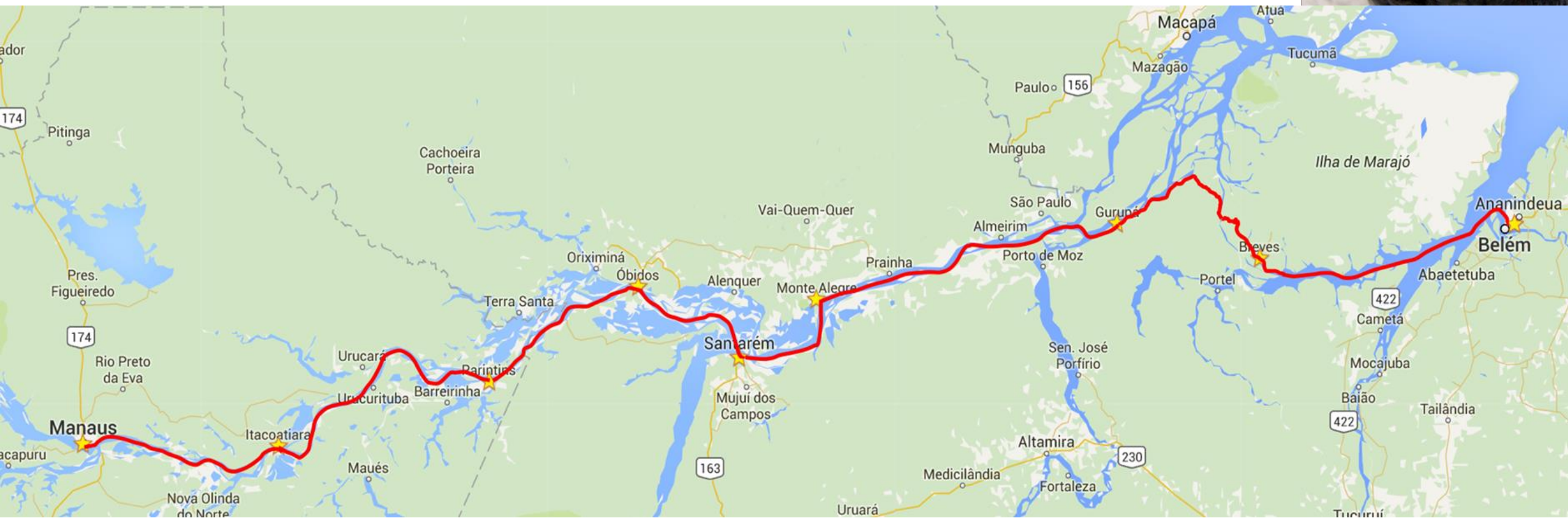
Greatest discharge:

- Amazon 14x Mississippi



A subfluvial telegraph cable to Manaus

Motivation: connect to rubber boom town Manaus
Subfluvial cable laid by ocean-going cable-ship Faraday,
under the leadership of Alexander Siemens, 1895-96



History of the Atlantic Cable & Undersea Communications
from the first submarine cable of 1850 to the worldwide fiber optic network

1895 Amazon River Cable - Para (Belem) - Manaus (Manaus), Brazil

<https://atlantic-cable.com/Cables/1895ParaManaos/index.htm>

Link opens a report presented in London in 1896

- The authors of this study first collaborated on the study of subaquatic fibre optic (FO) cables for data transmission around 2010, in search of a solution for providing connectivity solutions for coastal or river waters.
- Since then we have been documenting the evolution of these initiatives, and RNP has played an active role in accompanying and participating in the development of these initiatives.

- Brazilian Amazonia is made up of 6 states, with an estimated population of around 17,3 M in 2022
- The wide, major east-west rivers make terrestrial communication difficult, with only a single long bridge across the Negro river, and only one energy cable crossing the Amazon River (and this has to be high enough to allow ocean-going shipping).
- What North-South road traffic there is has to use ferries.
- Wireless communication has traditionally been used for long-distance communications, with relatively low capacity.
- The introduction of fibre optic subfluvial cables is making a huge impact, both for crossing rivers and following their courses.

- The **Amazon basin has many long (and deep) rivers** including many of the longest in the World.
- Fibre Optic (FO) cables have been widely used in oceanic links since before the year 2000, but **interest in cables along river beds was only first shown after 2010, in the context of the Amazon basin.**

Brazilian interest has grown significantly from 2010, involving the **Brazilian academic and research community, the Brazilian Armed Forces and government and private organisations concerned with technology and communications**, as well as the wider user community

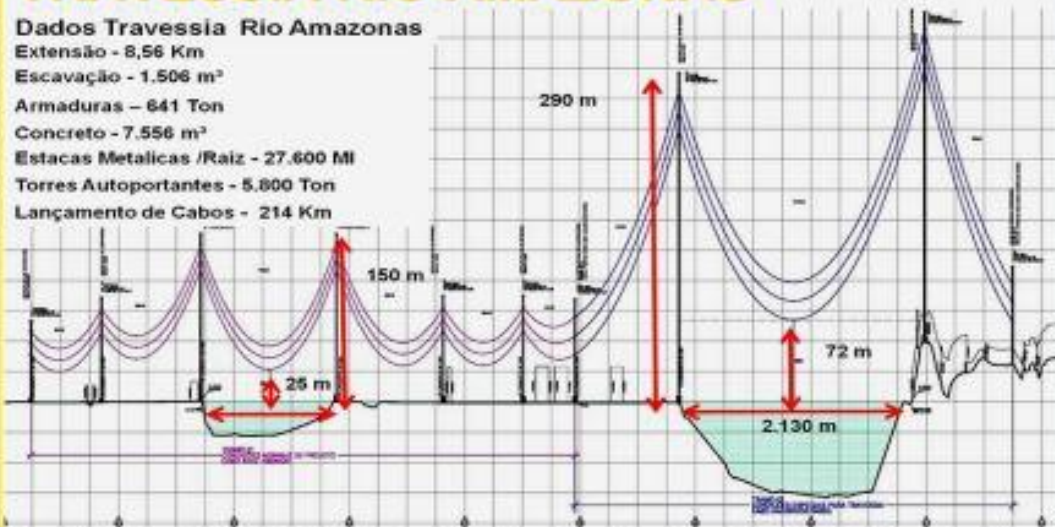
Aerial crossing of the Amazon River at Jurupari (2100m span between 300m towerts) in 2013



TRAVESSIA RIO AMAZONAS

Dados Travessia Rio Amazonas

Extensão - 8,56 Km
Escavação - 1.506 m³
Armaduras - 641 Ton
Concreto - 7.556 m³
Estacas Metálicas /Raiz - 27.600 MI
Torres Autoportantes - 5.800 Ton
Lançamento de Cabos - 214 Km



- ➔ New 2nd fibre crossing of Amazon reaches the northern capital cities **Macapa and Manaus**
- ➔ Brings competition to the 1st subfluvial link to Manaus
- ➔ RNP expects to get **multi-Gbps access** to these cities soon



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Jurupari: looking southwards

First energy link and 2nd FO link

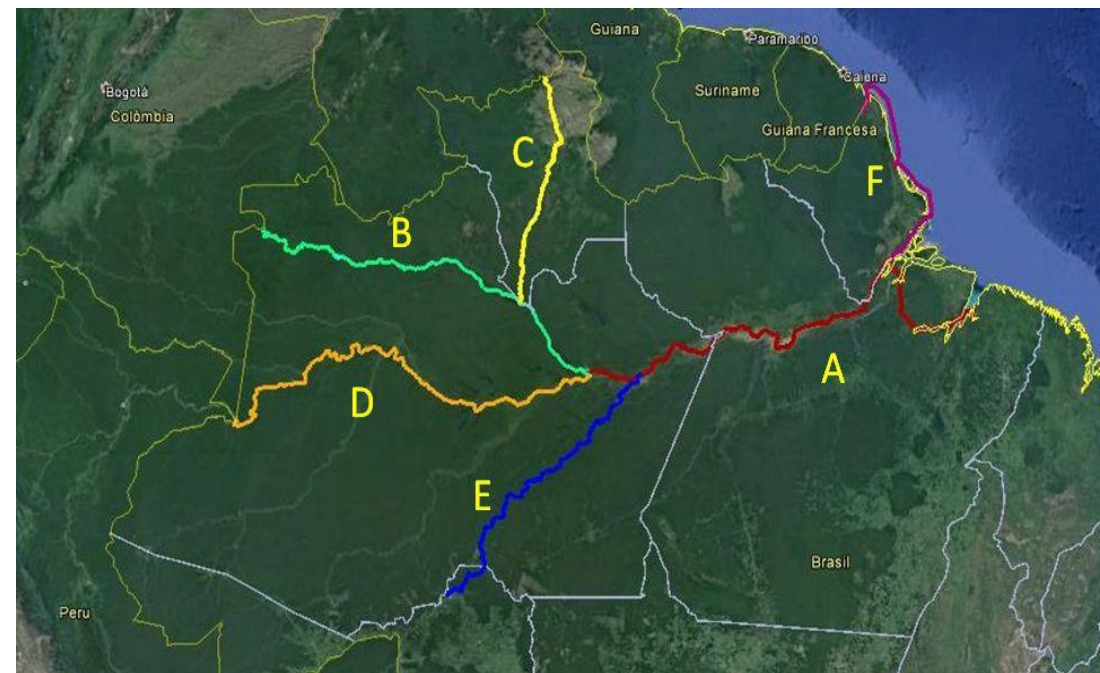


2013 context for what would later become the **Connected Amazonia project** showing existing terrestrial FO footprint (red) and major rivers

River	From	To	Distance (km)
Negro	Manaus	S. Gabriel da Cachoeira	1,000
Solimões	Coari	Tabatinga	1,182
Purus	Beruri	Boca do Acre	2,091
Juruá	Fonte Boa	Guajará	2,200
Madeira	Manaus	Porto Velho	1,170
TOTAL			7,643



- A. Belém – Macapá – Manaus: 2,030 km, (mostly) along the River Amazon (marked in red);
- B. Manaus – Iauareté (border with Colombia), 1,384 km, along the River Negro, (green);
- C. Panacarica – Pacaraima (border with Venezuela), 744 km, along the River Branco (yellow);
- D. Manaus – Tabatinga (border with Peru and Colombia), 1,696 km, along the River Solimões, (orange);
- E. Itacoatiara – Porto Velho, 1,115 km, along the River Madeira (blue);
- F. Macapá – Oiapoque (border with French Guiana), 815 km, along the Atlantic



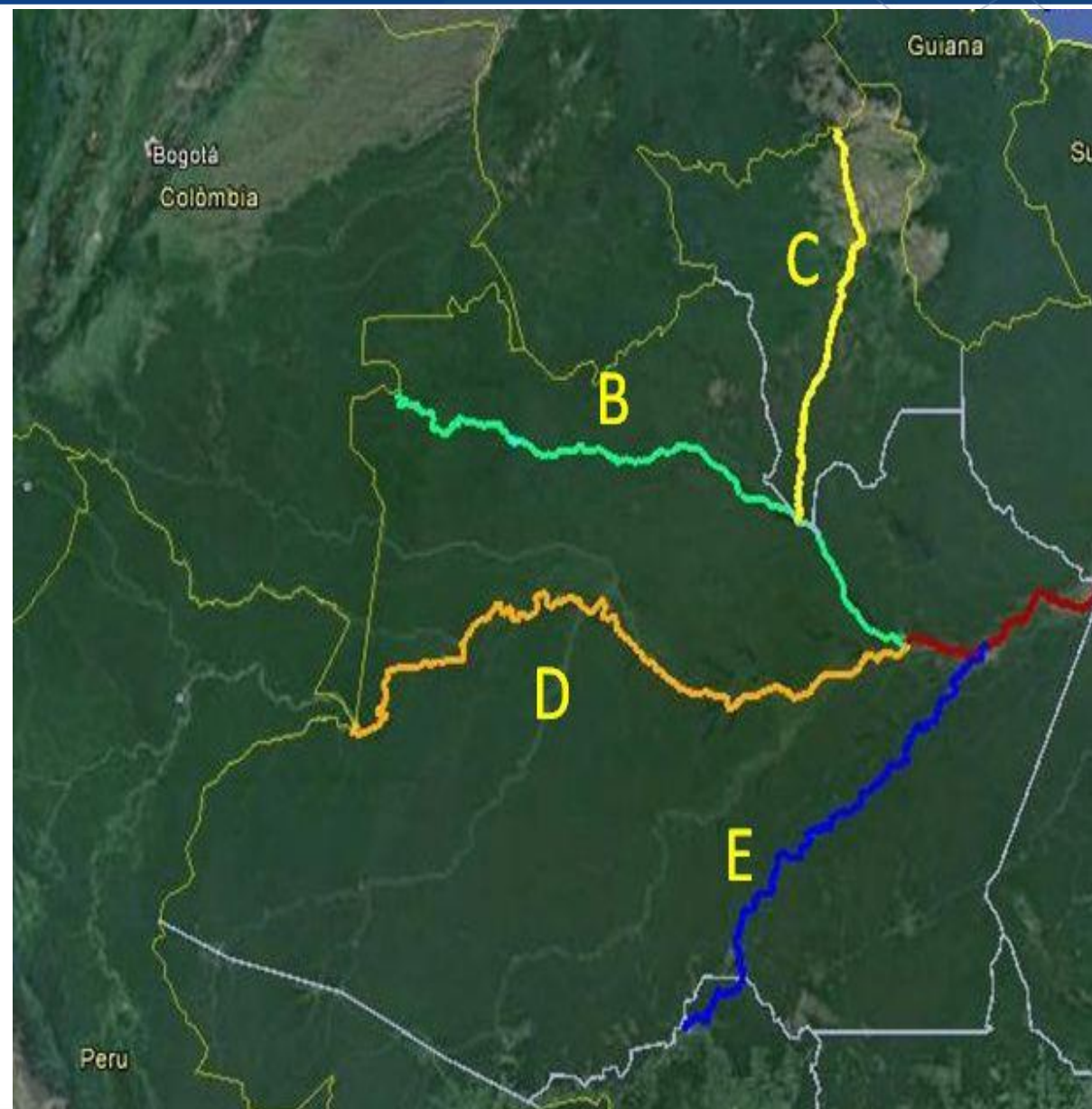
In a previous presentation to CEFnet in 2014, we included the description of a proposal to lay optical fibre cables along the beds of the great rivers of the Amazon region of northern Brazil.

This proposal was adopted and modified by the Brazilian Armed Forces, renaming it the **Connected Amazonia Programme**, and taking the first steps to make it a reality.



In two separate steps in 2016 and 2017, the Armed Forces proceeded to lay optical cable in the Solimões River between Manaus and the towns of Manacapuru, Coari and Tefé, a total of more than 450 km.

- The Brazilian Defence Ministry later continued to build subfluvial FO infrastructure upstream (towards the borders with Colombia and Peru) from the city of Manaus along two rivers:
- **River Solimões (route D) as far as Tefé | (the route is now referred to as PAC 01)**
- **River Negro (route B) as far as São Gabriel da Cachoeira (the route now referred to as PAC 02).**





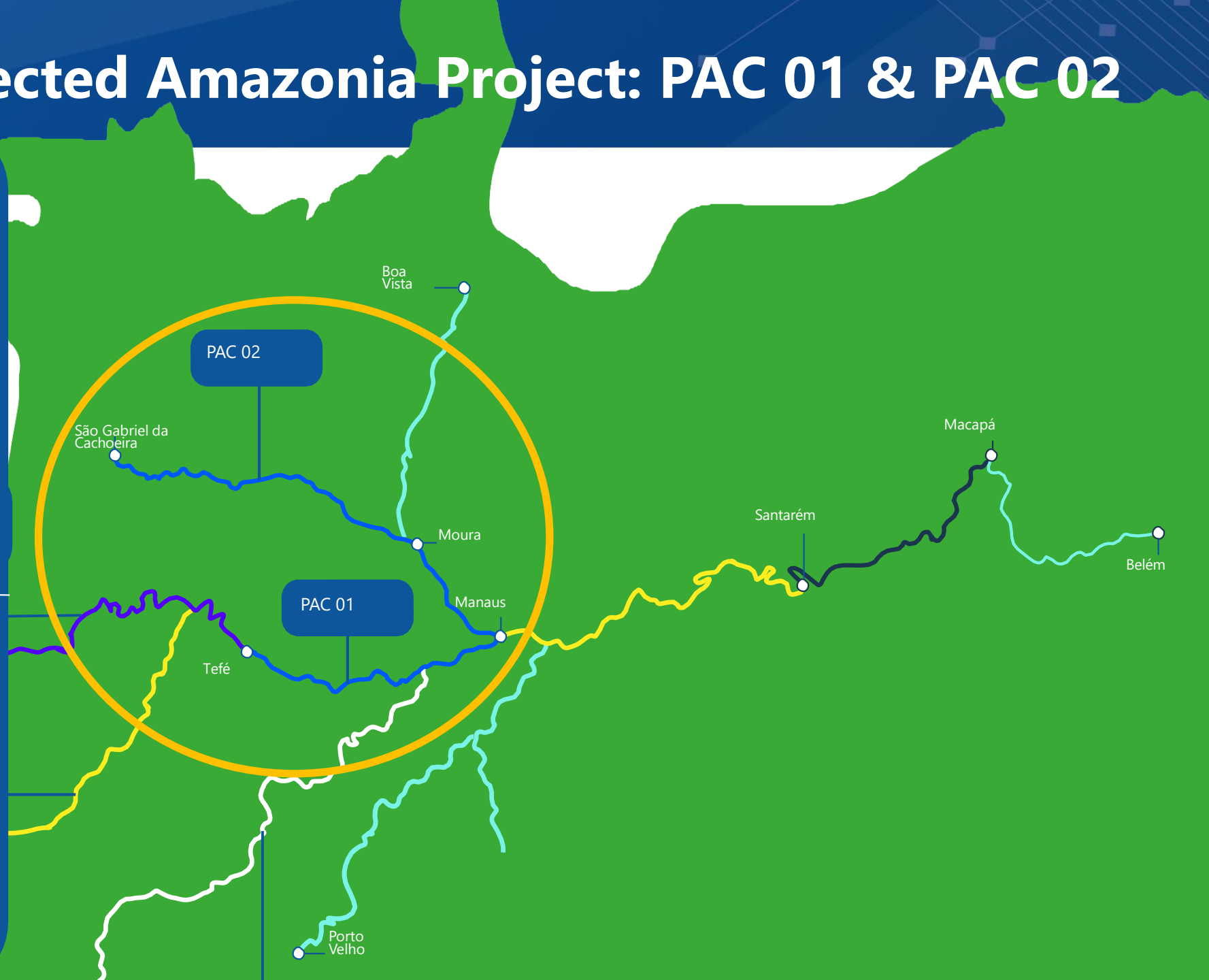
Connected Amazonia Project: PAC 01 & PAC 02

Manaus/AM – Tefé/AM
672 km PAC 01

Manaus/AM – São Gabriel da Cachoeira/AM
1,001 km PAC 02

Carried out by the Ministry of Defence (MD)

Discussions in course between MCOM (Ministry of Communications) and MD for future Integration between PAIS and PAC, after 2021



Cable laying on the River Solimões - 2015



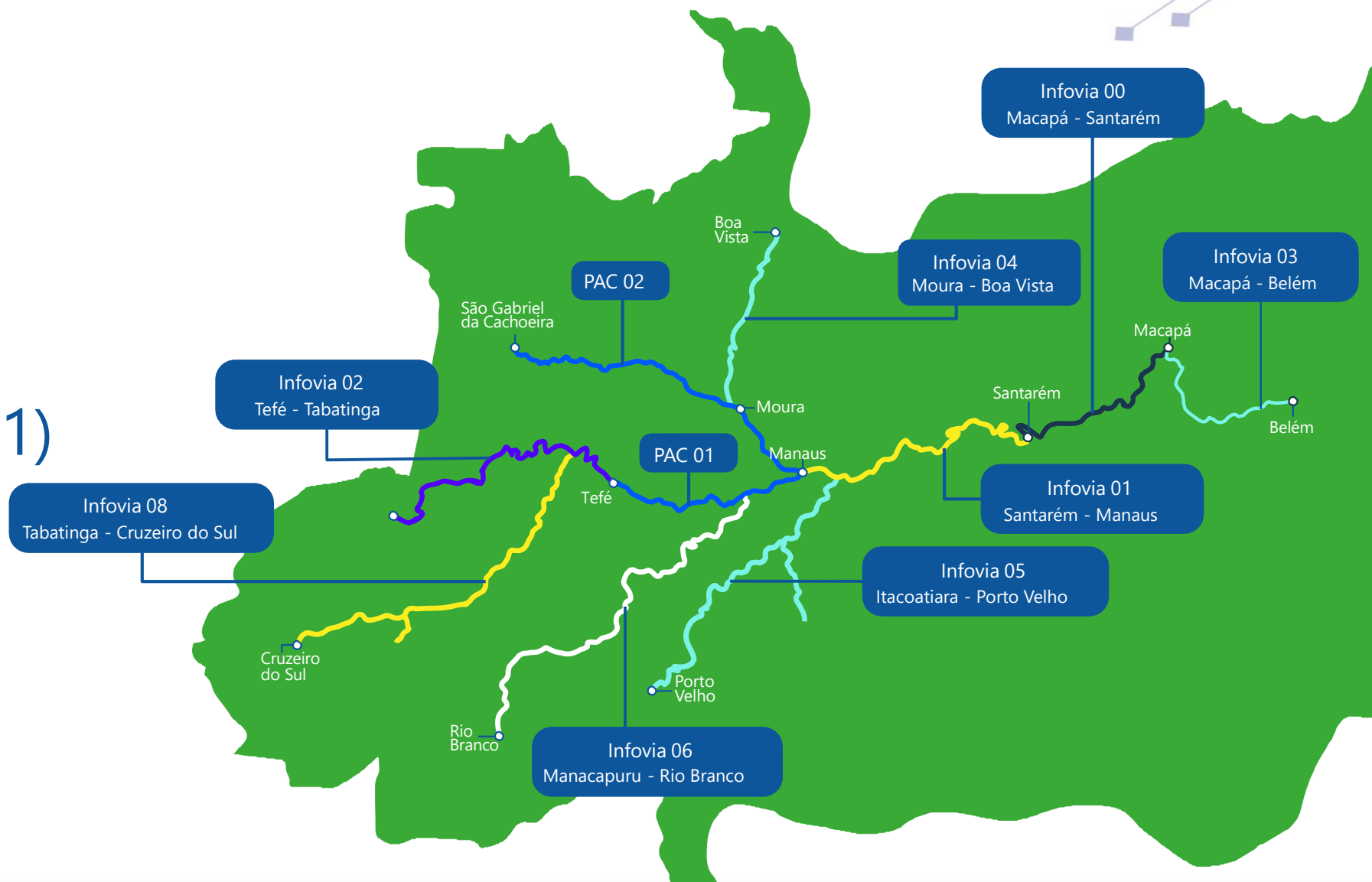
- **PAIS:** Programme Integrated and Sustainable Amazonia
- PAIS initiative seeks to create a sustainable form of bringing services to the local population.
- In particular, telecommunications services reaching the population currently ill-served by available alternatives will be provided in a sustainable way through the initiative Connected North, which is building and experience of Connected Amazon.



- **Connected North**
- This seeks to provide a variety of telecom services offered by both government and commercial providers which will share FO and communications infrastructure built by the Federal Government.

PAIS:
Programme for an
Integrated and
Sustainable
Amazonia
(Decree 10.800/2021)

Initial investment
from government
sake of 5G licences;
Afterwards,
commercial support.



PAIS

First two infovias in
2021 and 2022:

Infovia 00

Infovia 01

These link the
Connected Amazonia
initiative around
Manaus to the Atlantic
coastline.

INFOVIA 00 (built in 2022)

Macapá/AP – Santarém/PA Para State
Rio Amazon – 770 Km

Cities benefited:

Macapá/AP (Amapá) Almeirim/AP (Pará)
Monte Alegre/PA
Santarém/PA
Alenquer/PA

INFOVIA 01 (built in 2022)

Santarém/PA – Manaus/AM (Amazonas)
Rio Amazonas – 920Km

Cidades benefited:

Curuá/PA * Óbidos/PA	Parintins/AM (Amazonas)
Oriximiná/PA Juruti/PA	Urucurituba/AM
Terra Santa/PA	Itacoatiara/AM
	Autazes/AM
	Manaus/AM

Total of 10 infovias to be completed by 2026

PAC

01, 02 1,673 km

Infovias

00, 01 1,690 km

02 to 06, 08 8.275 km

Total length: 11,673 km

In comparison, recent (2021) transatlantic cable between Fortaleza, Brazil, and Sines, Portugal, is about 6,000m km long.

OTHER INFOVIAS: 02 to 06, 08

Infovia 02 – Tefé/AM – Tabatinga/AM
River Solimões – 750 Km - Built by 2024

Infovia 03 – Belém/PA – Macapá/AP
River Amazonas – 600 Km

Infovia 04 – Moura/PA – Boa Vista/RR
River Branco – 550 Km

Infovia 05 – Itacoatiara/PA – Porto Velho/RO
River Madeira – 1465 Km

Infovia 06 – Manacapuru/AM – Rio Branco/AC
Rio Purus – 2160 Km

Infovia 08 – Tabatinga/AM – Cruzeiro do Sul/AC
Rio Juruá – 2750 Km

Cidades a serem atendidas: Conforme resultado do Estudo de Viabilidade de Rota

Previsão de conclusão: 2025 (conforme previsão do Edital)

- Each optical cable contains 48 fibres, distributed among 4 tubes, each containing 12 fibres.
- One tube (12 fibres) will be reserved for exclusive use by the Public Sector (government).
- PoPs (Points of Presence in containeres) installed in the access point in each town or city served.
- Each PoP will provide an external cable connection for telecommunication service to the local service provider(s)
- DWDM systems ready for use with the possibility of up to 40 optical channels installed in one of the pairs of optical fibre reserved for public use.

Model for the Neutral Operator Open Consortium (1/2)

- The Open Consortium of each Infovia will initially be formed by a minimum of 3 consortium members and is open to further participation by new consortium members at intervals of at least 1 year.
- RNP will initially grant to each consortium member one fibre pair (potentially increasing to 2 fibre pairs) for their own use and/or commercial exploitation by the consortium member, which will light up its fibre pair(s) and adhere to the Neutral Operator Open Consortium Open.
- In return for the grant of Right of Use of the Optical Fibre Pair(s) the consortium member will be responsible and contribute, proportionally to their number of fibre pairs, e total cost of operation and maintenance of the total cost of the Infovia (destined to both to Private and Public Sectors).

Model for the Neutral Operator Open Consortium (2/2)

- Participation is welcome in the Neutral Operator Open Consortium: consortium members may be companies, associations and foundations, usually telecommunications service providers, licenced by ANATEL by concession or authorisation.
- Additionally and exceptionally, it will also be permitted for companies to form alliances

(Obs: This model was extensively discussed with interested participants)

- With the initial capital outlay provided by the government, and the expected operation and maintenance of the working service, it is expected that the resulting telecommunications service will make a significant contribution both to the population, to the the public sector and to the general economy.



Meeting at Manaus of the waters of the Rivers Solimões (yellow) and Negro (blue)



Thank you!

Comments and/or questions

Eduardo Grizendi

eduardo.grizendi@rnp.br

Michael Stanton

michael.stanton@rnp.br



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