

Sustainability on carrier transport networks

Activities from Telefónica

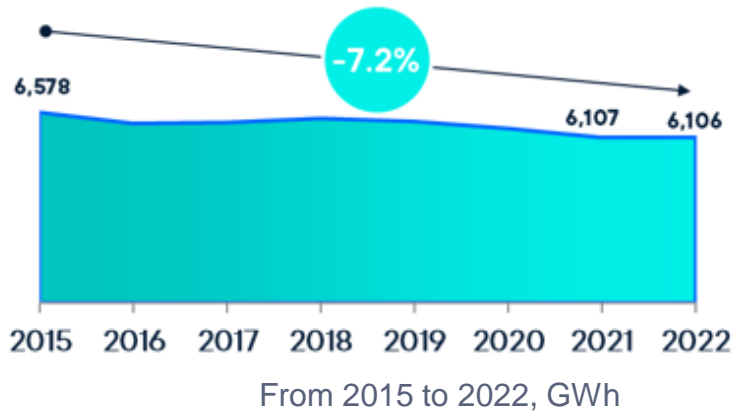


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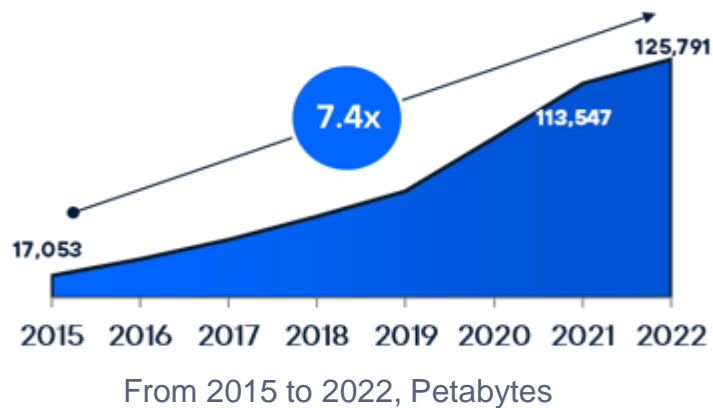
Telefónica efforts for reducing energy consumption

Electricity context at Telefónica

Electricity consumption continues to decrease



While data traffic is increasing exponentially



Telefónica's objective

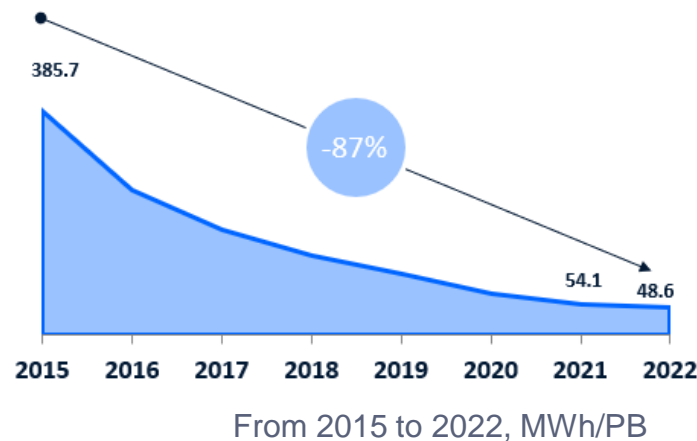
Our main objective is to be "Net Zero Emissions":

Technology strategy:

- Fiber Deployment
- 5G Deployment
- Virtualization

Energy strategy:

- Renewable energy



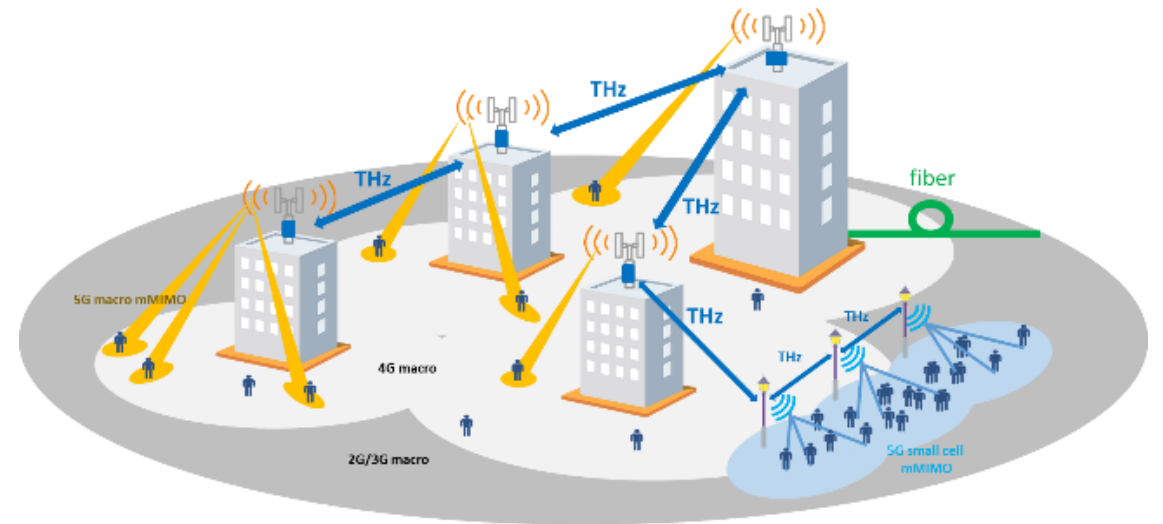
Sustainability on transport networks

Pathway for reducing energy consumption

1. Reduction of network elements
2. Rationalization on the need of cloud facilities
3. Programmable adaptation of energy consumption
4. Enabling the design of novel optimization algorithms
5. Introduction of more efficient platforms

Our work

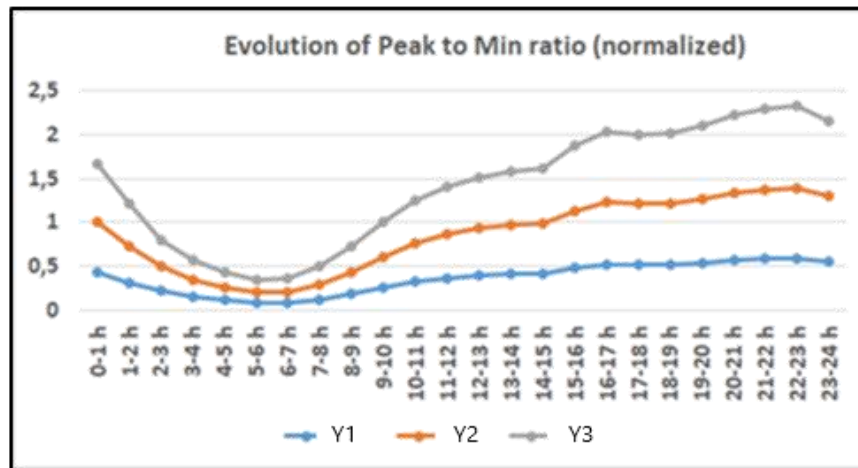
- Energy driven decisions
- Non-uniform network usage



Transport Networks: Energy driven decisions

Network control today is unaware of energy consumptions

We are not making decisions based on energy consumption.



Energy consumption will change throughout the day and depending on the device and traffic.

Solution

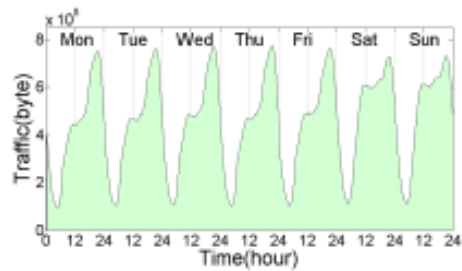
Energy metrics, and use them in paths decision making

- Monitor real time device power consumption.
- Upgrade paths algorithms.
- Find best paths based on energy consumption

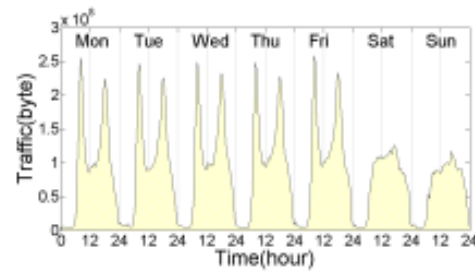
Transport Networks: Non-uniform network usage

Unbalanced usage of the network

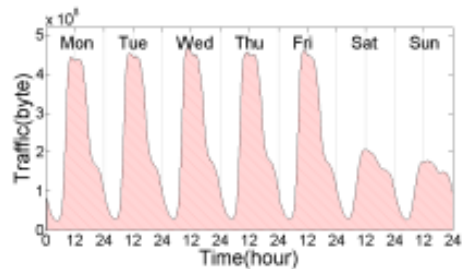
Network is prepared always for worst demand case.



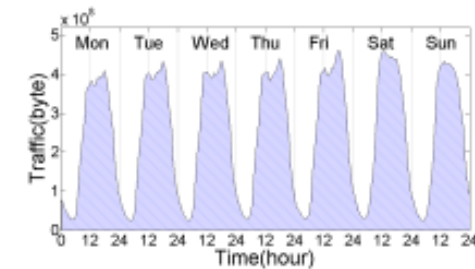
(c)



(d)



(e)



(f)

Source: F. Xu, et al., "Understanding Mobile Traffic Patterns of Large Scale Cellular Towers in Urban Environment", IEEE TON, April 2017

But most of the time this is not the case, so we're wasting resources, and therefore energy

Solution

SDN control and common standardization

- Handling energy consumption with SDN controller
- Be able to turn on/off devices in real time or predictions
- Create a homogeneous control of all the network, with different vendors, versions, etc

Energy driven decisions

Telemetry to monitor real time device power consumption



Source: Cisco, IOS-XR power consumption monitoring: an ephemeral telemetry stack use case, <https://xrdocs.io/telemetry/tutorials/ios-xr-telemetry-power-consumption-docker-compose/>

Based on that, create cost map, and find low energy paths.

```
Cost map
{'pid0:03030302': {'pid0:03030302': 0, 'pid0:04040402': 45
3, 'pid0:04040401': 877, 'pid0:05050503': 933}, 'pid0:040404
01': {'pid0:04040401': 0, 'pid0:05050503': 424, 'pid0:040404
02': 424, 'pid0:03030302': 877}, 'pid0:04040402': {'pid0:040
40402': 0, 'pid0:04040401': 424, 'pid0:03030302': 453, 'pid
0:05050503': 480}, 'pid0:05050503': {'pid0:05050503': 0, 'pi
d0:04040401': 424, 'pid0:04040402': 480, 'pid0:03030302': 93
3}}
```

Non-uniform network usage

Moving into standardization common, vendor-agnostic YANG models allowing a homogeneous control of all the network.

Switch-off ports, concentration of traffic reducing the number of active paths but ensuring sufficient protection, etc

```
| | +--rw air-interface:air-interface-pac
| | +--ro air-interface:air-interface-capability
| | | +--...
| | +--rw air-interface:air-interface-configuration
| | | +--rw air-interface:air-interface-name?
| | | +--rw air-interface:remote-air-interface-name?
| | | | +--...
| | | +--rw air-interface:power-is-on?
| | | +--rw air-interface:transmitter-is-on?
| | | +--rw air-interface:receiver-is-on?
| | | +--rw air-interface:tx-power?
| | | + ...
| | +--ro air-interface:air-interface-status
| | | +--...
```

Open config models.

Project work: 6GREEN & 6G-XTREME



6G-XTREME

Acknowledgement

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This presentation reflects only the author's view and the Commission is not responsible for any use that may be made of the information it contains.

Conclusions and future work

Conclusions

Improve sustainability in transport networks

- Make energy driven decisions
 - Using energy metrics and algorithms
- Improve decision making with network controller.
 - Turn on/off devices
 - Homogeneous control

Out future work

- Using/Creating AI to predict.
- Include this work in a sophisticated planning tool
- Create more complex metrics of topology energy consumption



