
Consortium
GARR

Into the White Rabbit hole

Packets are not all: first results for the field trials by GARR and INRIM for transporting a time and frequency signal over the R&E network.

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The old dichotomy between circuit and packet switching does not tell the whole story of possible uses of optical networks: fibre-optics are far more flexible and allow the transport of all sorts of information. With INRIM, the Italian National Institute of Metrology, we tested a very specific application: the distribution of a synchronisation signal over a WAN.

Synchronising time and frequency is a requirement for all scientific and industrial applications where high levels of accuracy in time measurement are critical. Italian research in this domain is top-notch, also thanks to the implementation of LIFT, a dedicated fibre-optic backbone interconnecting INRIM to facilities that require very accurate time reference in Italy for the specific purpose of delivering a synchronisation signal.

Implemented with GARR support, LIFT is owned and managed by INRIM which is quite a unique institute in Europe. It serves research users with the highest requirements in this field, including some CNR facilities, INAF, ASI, Alenia Space and Telespazio, and its accuracy is so high that it's also used for metrological research.

However, reaching users with fibre solely dedicated to synchronisation applications is costly, and it is only viable for large facilities with very demanding requirements.

But what if we used an infrastructure that is already there? That's how we started our Proof-of-Concept to test whether we could convey the synchronisation signal over the GARR optical network to other potential users.

With INRIM we designed field trials for the definition of a time and frequency distribution service over R&E networks, based on the White Rabbit protocol and alien wavelengths. Developed at CERN, White Rabbit is based on an open framework which facilitates further developments and performs well in comparison with competing technologies offered by telcos.

We tested this technology on Dense Wavelength Division Multiplexing (DWDM) equipment, first in laboratory conditions and then on a geographical path over the GARR production network. We used alien wavelengths to transport the signal, as we consider it the most promising technology in terms of performance, and results did not disappoint. In the field trials, accuracy was below a nanosecond, which would suit typical scientific applications in physics, electronics, robotics, and IoT where atomic clocks are used. Typically, their calibration is done by using GPS, but with our approach these applications could refer directly to UTC-IT (official Italian time), while using a more open, robust and not easily jammable technology.

While these results are promising, some issues are still open, the most relevant being one-way transmission. White Rabbit needs a symmetric channel, thus if we use two fibres, as we should for the GARR infrastructure, we need to account for any small differences between them and recalibrate if changes to the infrastructure occur.

The upcoming evolution of the GARR network towards a partially disaggregated model based on Open Line System (OLS) is however expected to offer new opportunities to overcome this problem and implement transport on a single fibre.

See also:

www.garr.it

www.inrim.it