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Public Administration owned Regional Telecommunication Networks as strategic asset during 2012 earthquake in Emilia- Romagna

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Abstract

Telecom is the domain where innovation and spread of usage registered the quickest and most consistent growth in the latest ten years.

Seismic event dated May 2012 in Emilia-Romagna region was a significant example of how spread and diffused presence of two PA (Public Administration) regional telecommunication networks (ERretre Regional Mobile Network for radio emergency and Lepida broadband Network) substantially contributed to address such a catastrophic situation, providing the right premises to its quick overcoming and a strategic criterion for the following reconstruction of the territory.

In this situation the importance and the effectiveness of a flexible, modular and configurable regional emergency mobile network such as ERretre has been proved, but at the same time the synergies with Lepida broadband network have emerged, showing a new potential in building an enabling infrastructure not only for new services, but also for new networks.

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1. Introduction

The word resilience has been borrowed from materials science and refers to the property of reverting to the original shape after stress or deformation.

Antifragile is a neologism from Nicholas Taleb referring to those entities that benefit from shocks; they thrive and grow when exposed to volatility, randomness, disorder, and stressors and love adventure, risk, and uncertainty. In this paper resilience and antifragility are considered in an anthropologic vision where resilience is related to the time requested by the community (system) to revert to its initial status after a shock and antifragility is related to reaching a quicker and better evolution of the system following the depth and urgency of its restore after the shock. Seismic event dated May 2012 in Emilia-Romagna region was a significant example of how spread and diffused presence of two PA (Public Administration) regional telecommunication networks (ERrete Regional Mobile Network for radio emergency and Lepida broadband Network) substantially contributed to the resilience of the territory by addressing the reaction and restore the normal activities after such a catastrophic situation. But even more than that, it is not inappropriate to highlight the antifragile function performed by regional telecommunication networks in the following evolutions, when the deep and urgent reconstruction works after the quake not only have generated an opportunity for stronger and denser networks, but also for introducing their native integration, which have been successfully tested during the event, showing a new potential in building an enabling infrastructure not only for new services, but also for new networks.

The example presented in this paper is also a case study of resilience based on collective strategies and of its advantages in a social context¹.

2. State of the art

2.1. *Emergency mobile networks*

Until last decade, police corps and entities acting for security enforcement or public benefit (Local Police Corps, Fire Fighters, Forester, Civil Protection Agency, First Aid Central, etc.) adopted their mobile communication systems at different time and with no coordination at all. Still today, most of these organizations are using analog networks not connected, or related, to each other, and having different functionalities and geographical coverage. TETRA technology is currently a de facto standard in emergency-related digital radio systems². Worldwide, more than hundreds Tetra mobile systems are present, spread across more than 30 countries. In Europe several countries, such as UK, Netherlands, Belgium, Norway and Finland, have already chosen TETRA for their public security network. In Italy, the Public Security Department of Ministry of Internal Affairs has decided in 2008 to create, gradually and on a regional basis, a single “interforze” TETRA network, for the main 5 Italian Police. The project has been started with the funds made available in 2005-2006 from EU Regional Structural Funds and involving only Italian Southern regions (Campania, Puglia, Basilicata, Calabria, Sicilia and Sardegna). While waiting for more funds to extend the project to the rest of Italy, TETRA solution has been unilaterally adopted by some areas, such as Lombardia, Val d'Aosta, Veneto, but only in Emilia Romagna region the network is shared by all the public entities, such as Civil Protection Agency, Local Police Cops, First Aid Central, sharing the common objective of territory security and control.

2.2. *The broadband networks*

European Digital Agenda set an objective to reach 100% of European citizens with 2 Mbps connection and with 30 Mbps connection in 2020, used by 50% of the population³.

In Italy some regions, among which Trentino, Emilia-Romagna and Umbria, have started a decade ago strategic plans for the development of PA owned broadband networks, with the primary objective of setting up a new model for PA activities, but also aiming at creating a supporting tool for removing the Digital Divide as well as a facility for public telecom operators and for bringing connectivity, through co-financing and Public Private Partnerships, to citizens and enterprises even in zones where connectivity can only be provided at negative margin.

This approach has allowed the regions adopting it to timely reach first European goal and set the right premises for the achievement of the final one.

3. The Situation in Emilia-Romagna region: Lepida and ERretre networks

Emilia Romagna region is located north of Italy. Starting 2002 Emilia-Romagna Region launched a regional strategic development plan including the realization of two networks owned by Public Administration: ERretre wireless emergency network and Lepida broadband network.

LepidaSpa is the Inhouse company of all the PA entities in Emilia Romagna region and has the objective to expand, manage and maintain the aforementioned regional networks.

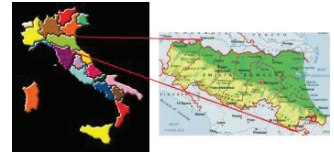


Figure 1: Emilia-Romagna region

3.1. ERretre network

ERretre (or R3, for Rete Radiomobile Regionale), the Regional Radio Network for emergency services in Emilia-Romagna, was created with the objective of setting up an efficient infrastructure shared within all the PA services connected to territory security and control. It is a cellular digital network, based on TETRA standard, similar to GSM/GPRS. Currently, the network is composed of more than 80 sites covering the whole area. The municipalities subscribed to ERretre Radio network are 171, with more than 5900 user terminals connected⁴. ERretre network is currently adopted by all the main public entities in Emilia Romagna dealing with control and security as Civil Protection Agency, Local Police Cops, First Aid Central. Each user group is normally acting in its specific competency area, independently from other user groups. In case of need, it is anyway possible to allow users access to the services on the entire regional area and create temporary mixed groups, in which members can directly connect to each other and to the same operational posts in the Operation Centers.



Figure 2: ERretre sites

3.2. Lepida network

Lepida Network is the NGN (Next Generation Network) broadband network of Emilia Romagna’s PAs and have as main objective to provide connectivity to all municipalities and PA of the region, as well as to create the premises for the development of innovative and standardized services linked to it.

The name of Lepida network comes from the family name of Roman Consul Marco Emilio Lepido who in the second century a.C. built Via Aemilia, the road connecting Piacenza to Rimini and that gave its name to the region. The name is thus recalling an analogy between two infrastructures (road and optic fiber), sharing the same goals (connection) and strategic relevance at regional level.



Figure 3: Via Aemilia

Lepida network currently accounts for 2700km of infrastructures, 60.00 Km of fiber optics and 1086 Access Points (PAL) to the network. Lepida Network is coming from different technologies, sharing the goal to reach all the PA in the regional territory with the best possible performance. Lepida network currently accounts for 2700km of infrastructures, 60.00 Km of fiber optics and 1086 Access Points (PAL) to the network⁵.

Lepida network currently connects all the municipalities in Emilia Romagna region.



Figure 4: Lepida network with its wireless extensions (orange)

4. Case study: Earthquake in Emilia Romagna in May 2012

Emilia Romagna's Earthquake in 2012 was a seismic event made of several quakes located in the Po river plain, mainly in the provinces of Modena, Ferrara, Mantova, Reggio Emilia, Bologna and Rovigo, but noticed in a much wider area including all central and northern Italy, part of Switzerland, Slovenia, Croatia, Austria, southeastern France and southern Germany.

The stronger quake, of magnitudo MI5,9 e Mw5,86 has been recorded on 20 May 2012 at 04:03:52 local time (02:03:52 UTC), with epicenter in the municipality of Finale Emilia (MO). On 29 May 2012, at 09:00:03 local time (07:00:03 UTC), a new strong quake, magnitudo MI5,8 e Mw5,66 has been felt in all northern Italy. Epicenter was located in the area enclosed among Mirandola (MO), Medolla (MO) and San Felice sul Panaro (MO)⁶. The following bulletin from Civil Protection department accounted for 17 casualties, 300 injured, 15.000 displaced.

ERretre was the only network granting uninterrupted communications during stronger quakes on 20 and 29 May, especially during the second one, when fixed and mobile networks were severely affected by infrastructure breakdown or traffic saturation for user connection peaks. ERretre network stayed always on in the hours immediately after the tragic event and in the following days, granting support to the rescue teams during the immediate and hectic intervention. And not only it worked well, proving a rock solid infrastructure with reliable devices and a network able to withstand high traffic peaks, but the very idea of a single network at regional level, overcoming the limits of many not interconnected, even if efficient, municipal networks has been proven as the good one. Ironically, but also as an enforcement of the argumentation, the earthquake had its epicenter in the town of Finale Emilia, which is literally a crossroad among the provinces of Modena, Ferrara and Bologna.

Without ERretre the connection among the provinces would have been more difficult, if not impossible. Immediately following the quake of 20 May, LepidaSpa was involved for supporting the rescue operation from Civil Protection Agency with the task of keeping the telecommunications. Until then, fortunately, Civil Protection Agency had very few opportunities to use ERretre in Emergency operations and it was almost exclusively used for monitoring and prevention activities, while Local Police Corps were intensively using it for day by day activities and for emergencies.

Thanks to the many Tetra terminals available to Police Corps and Civil Protection Agency, it has been possible to set up in very little time a connecting mesh with centers in Bologna, Modena and Ferrara, hosting all the communications from Municipal and Mixed Operational Centers which were routing all the requests to Tetra network and were receiving from the Prefectures real time authorizations for the interventions as they were requested. Procedures were activated to grant radio communications via ERretre also to operators of First Aid Centrals. During the most dramatic days, traffic was more than five times the average. The network resulted advantageous for its regional nature when also operators from others provinces or regions started to join the team. It was sufficient to create and configure three workgroups (SismaMO, SismaFE, SismaBO) to enable the communication with the devices owned by external operators joining the teams, who were already briefed on the action plan to follow on the operation site well before reaching it. All this facilitate the organization of the shifts for the incoming teams and to move people where they were really needed. During the peak, there were almost five thousands terminals operating and communicating at the same time. The fact of having a regional network enabling Local Police Corps from several provinces has therefore been crucial in what it allowed to send additional operators in continuous shift in the affected areas in order to support those already present in the centers, evacuate inhabitants unwilling to leave their unsafe houses, pacify people stressed by forced cohabitation with strangers, watch over security inside camps, manage and grant traffic inside the municipalities, escort experts in the site surveys and the citizens recovering their personal belongings, and all those sorts of secondary activities with high impact on the people and on the territory.



Figure 5: Earthquake of 29th May 2012



Figure 6: Sant'Agostino (FE)



Figure 7: Finale Emilia

In some areas, mainly in the municipalities where ERretre network was not yet active, special measures have been adopted in order to ensure the necessary radio coverage. Cell extender have been installed In Finale Emilia (MO), Bondeno (FE) and S.Agostino (FE) and radio signals from neighboring base stations have been brought in the selected areas. In Camposanto (MO) an even more radical solution has been needed, as a new mobile radio base station has been installed in order to grant service, at first locally through Lepida network since it was already available in the territory, and then integrating it with the rest of ERretre network. For this purpose it has been sufficient to provide a Tetra mobile cart with telescopic post, radio link devices, an energy station with backup diesel generator. The new mobile radio base station has been operational in few hours and it has been kept in service for several weeks, until the emergency situation has stopped and ordinary operations have been restored.

Not only diffusion of Lepida network enabled to rapidly extend coverage of ERretre on areas in need, but also it enabled the quick creation of WiFi access points bringing Ethernet connection to all the population. It has been a solidarity sign, responding to an important, and sometimes essential, need for temporary connectivity of the people involved in a painful and uncertain situation



Figure 8: Temporary base station in Camposanto

5. After the earthquake

From 20 May 2012 and then again from 29 May, the check-up and restore activities for Lepida Network have been restless, and brought to full restore of connectivity in two weeks, by moving Lepida Network Access Points (or PAL Punti di Accesso alla rete Lepida) in accessible and useable areas for restoring PA entities services, and then to increased resilience of the network by finding for the PAL a final position compliant to stricter security, reliability and accessibility criteria. Once the emergency has gone, reconstruction time started⁷. The earthquake left deep scars and the new period started with a thorough consideration about the objectives to achieve in order to avoid situations, often observed in Italy after catastrophic events, of a badly designed and even worse achieved reconstruction. Among the topics of discussion, one was those of IT infrastructures. For this reason, Emilia-Romagna Region, in spite of the dramatic situation, saw in the reconstruction need the strategic opportunity to provide its territory with a cutting edge IT infrastructure, unanimously considered at the same time essential for the economic growth and the competitiveness and necessary rights for the wellbeing of the citizens. Pursuing this goal enabled local enterprises hit by the quake to have an acceleration lever at their disposal for their development after the forced activity stop, and to the citizens to have a value adding factor on their settlements. From an economic perspective, the cost of IT infrastructure involved in this strategy contributed as a very small percentage on the total reconstruction cost, especially as it was simultaneous with civil works. Post-seismic reconstruction phase also represented the opportunity to evaluate once again the strategic areas where an increase of ERretre network coverage has been necessary, not only for individual municipalities, but also for the security and control of the whole regional territory.

6. Synergies and Integration between ERretre and Lepida networks

The use of Private networks at regional level by the Public Administrations brought several advantages:

- Same opportunities for all the municipalities in the region, including the ones in mountain areas.
- Standardization and synergies among different PA services.
- Rationalization in the development of the networks at regional level rather than local.
- Network management cost optimization.
- Granted Service level and reliability.
- PA resources sharing and related synergies.
- Growth factor for the territory beyond PA and agent against Digital Divide

Initially ERretre and Lepida were created as separate networks from a technology and functional point of views. Communications of ERretre network base stations were initially based on E1 technology, both in the case of Radio Links and Cable Networks. A first evolutive step of regional mobile network considered the introduction of E1/IP devices for cabled links, which switched the communication flow from dedicated, and costly, CDN circuits to standard IP circuits in xDSL technology. Lepida network was based on native IP devices for broadband communications. The increasingly capillary presence of Lepida network across the whole regional territory and the recent technology changes were the right premises for a significant impulse to integration and architectural standardization activities on the two regional networks. Starting early 2014, LepidaSpa intensified the actions for migrating all the sites of ERretre network from rented infrastructures and links to Public owned infrastructures, directly linked to Lepida network through the implementation of brand new “IP native” devices. This process not only is bringing significant benefits on the operational cost of ERretre network (the overall investment for the migration is less than the rental cost for one year), but is the right premise for the creation of independent nodes and the migration from the original centralized architecture to a new distributed one. All the sites will therefore become autonomous and perfectly communicating to each other, not controlled any longer by central nodes, and the network resilience will increase accordingly. Besides, the full independency reached by LepidaSpa in ERretre network control and operation, has a significant impact in the increase of the overall network reliability, not depending anymore on third party telecom circuits, but only on directly controlled networks.

Last, but not least, at the end of 2014 LepidaSpa was awarded from the Italian Economic Development Ministry (MISE – Ministero dello Sviluppo Economico) a licence for the usage of 26GHz band, which created the conditions to standardize radio links of ERretre and Lepida Wireless networks over the same transmission frequencies. The fact that licensing cost was not anymore calculated by link, but as a lump sum for each frequency, made even more convenient to share the same frequency for the two networks. This additional standardization factor allowed the use of the same devices for all the wireless networks, brought an optimization in their monitoring and operation processes and created a step forward in their integration process.

7. Conclusions

The earthquake of May 2012, but also other critical events happened in Emilia Romagna, have demonstrated the efficacy of ERretre network and the correctness of the idea underneath it, that is the availability of a single regional network, able to overcome the limit of many small networks at municipality or province level, not connected and not communicating to each other.

The exceptional snowfall in February 2012, the flood of river Po in April 2012 and the flood of river Barganza near Parma in October 2014 are just some more examples of how ERretre features, such as the radio coverage of the whole region, the reliability and security of the devices, the flexibility in managing communication among independent and not related teams gathering from several places, are providing during emergencies added values that cannot be found in public radio network or legacy analog systems. With respect to all other cases, the earthquake of May 2012 made evident in Lepida network an additional added value which goes beyond its essential and institutional objectives. Its capillary distribution in the entire region has been an enabling factor for the extension and the strengthening of other networks, as in the case of ERretre network, or the opportunity to create new services for population, as in the case of WiFi network, on top of the premise for innovative services that only the full geographical and technological integration of the two networks can offer.

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