

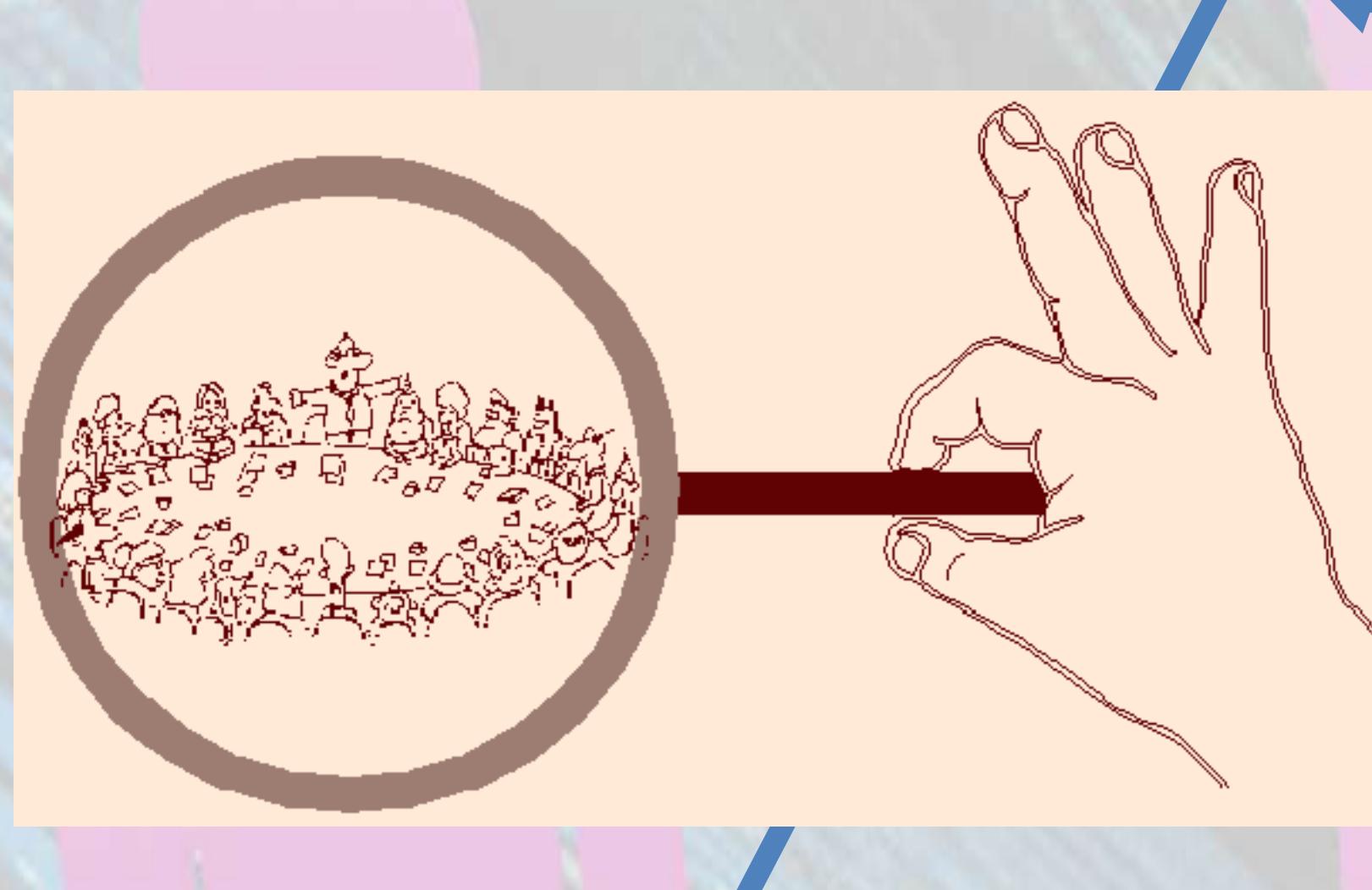
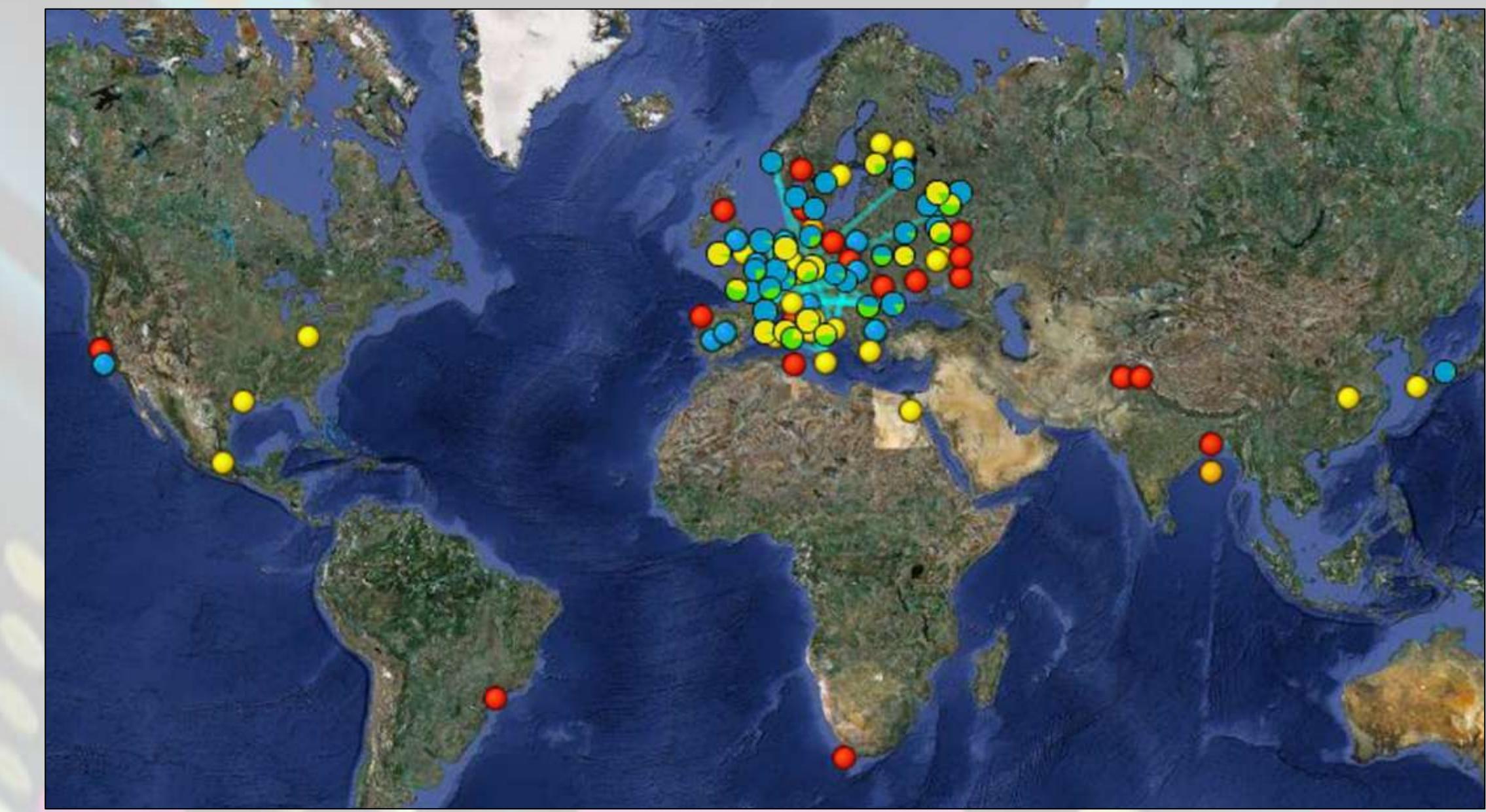
How computing centres of ALICE connect? A social network analysis of cooperative ties

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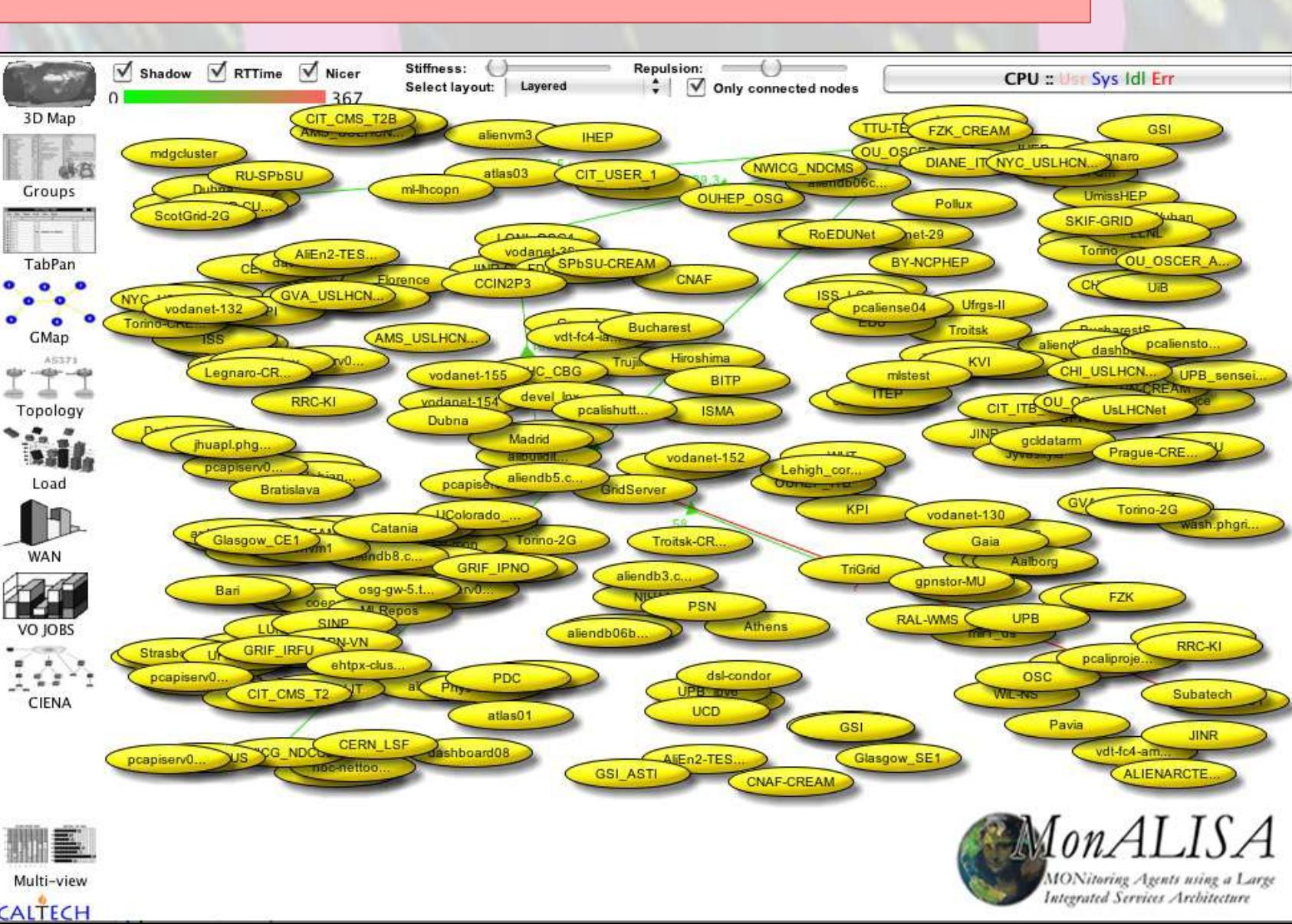
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The computing needs of the ALICE experiment range in the 200 KHEP06/year and 10PB of disk storage. This is provided by 80 computer centres worldwide arranged in Tiers (1 T0, 6 T1s, 73 T2s). These centres form a large computational network where data and workload are exchanged, but also a large and complex social network with ~3,000 possible links.

The operation experience of this Grid since 10 years has shown that the social relations between the different centres is as important as the *material* conditions to ensure the proper functioning of this complex system extended over different timezones and continents.



This study aims at characterizing the collaboration ties between the centres of the ALICE Distributed Computing infrastructure based on social networks methods (Wasserman, S., and K. Faust (1994), Social Network Analysis: Methods and Applications, Cambridge University Press, <http://www.insna.org>)



Social network analysis aims at recognizing and studying the patterns of people's interaction.

The intuitive realization that these patterns are important elements in the life of the individuals that enact them lead to a systematic approach to theory and research on Social Networks (J.Moreno). After WW2 A.Bavelas establishes the Group Networks Laboratory at M.I.T. to conduct a research guided by formal theory in mathematical terms and based on empirical data.

Centre relations are characterised via different metrics:

- The theoretical capacity of the network linking them;
- The actual quantity of data exchanged;
- Their physical distance;
- Their geo-political affiliation;
- The Internet Round Trip Time (RTT);
- Their *social networking*

Our study was based on a questionnaire containing five questions:

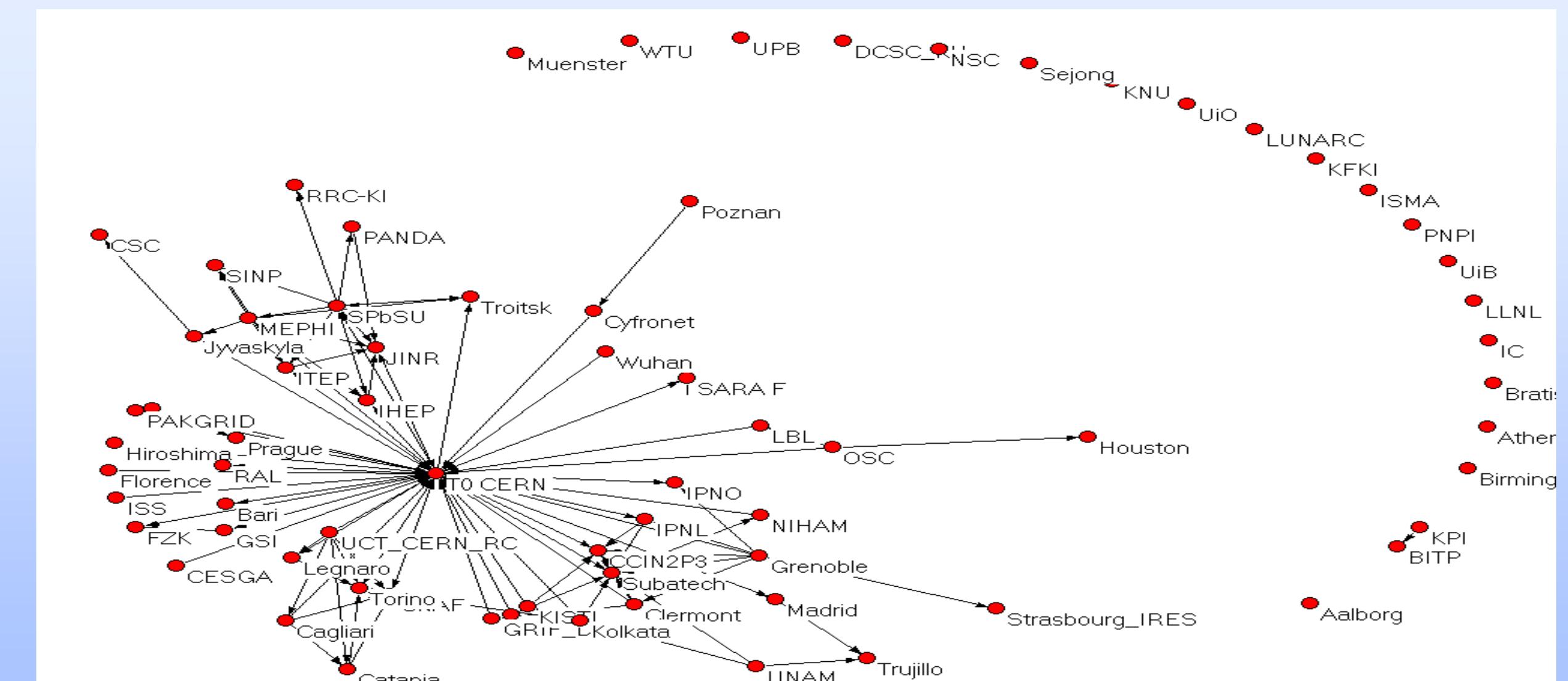
- 1 Which centers provide your center with significant help in its work at least once a week;
- 2 Which centers make it difficult for your center to carry out its job responsibilities
- 3 Which centres are in regular e-mail contact with you, at least once a week
- 4 With which centers your center would like to have more interaction in its work?
- 5 Overall, how do you rate the functioning of your centre?

The form was sent to 73 centres and 50 (68%) answered.

- 2 Which centers make it difficult for your center to carry out your job responsibilities?

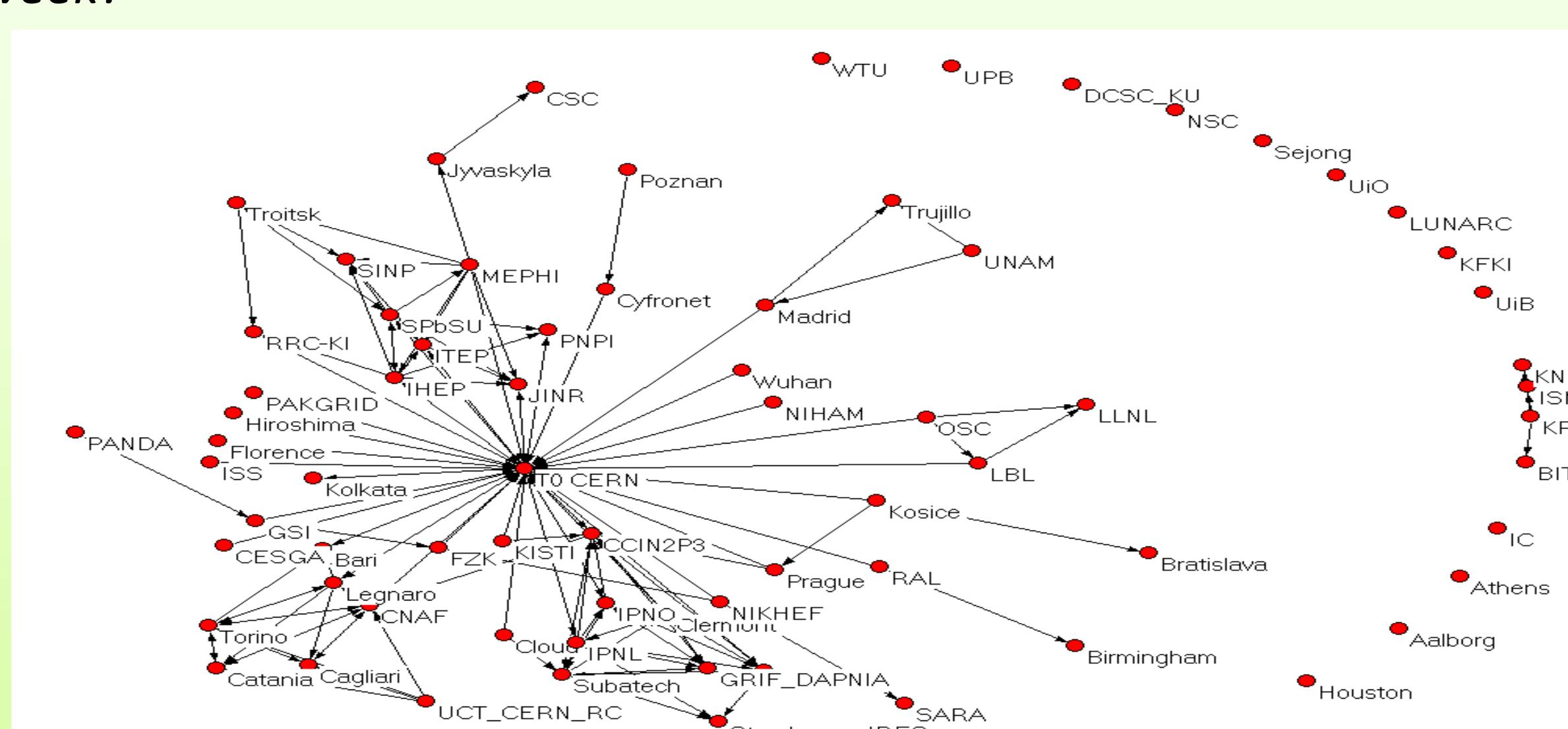
Not enough answers were provided to this question. Centers do not feel hindered by colleagues in their work.

- 1 Which centers provide your center with significant help in its work at least once a week?



Support is perceived as coming essentially from CERN with some signs of presence of local support structures in Italy, France and Russia.

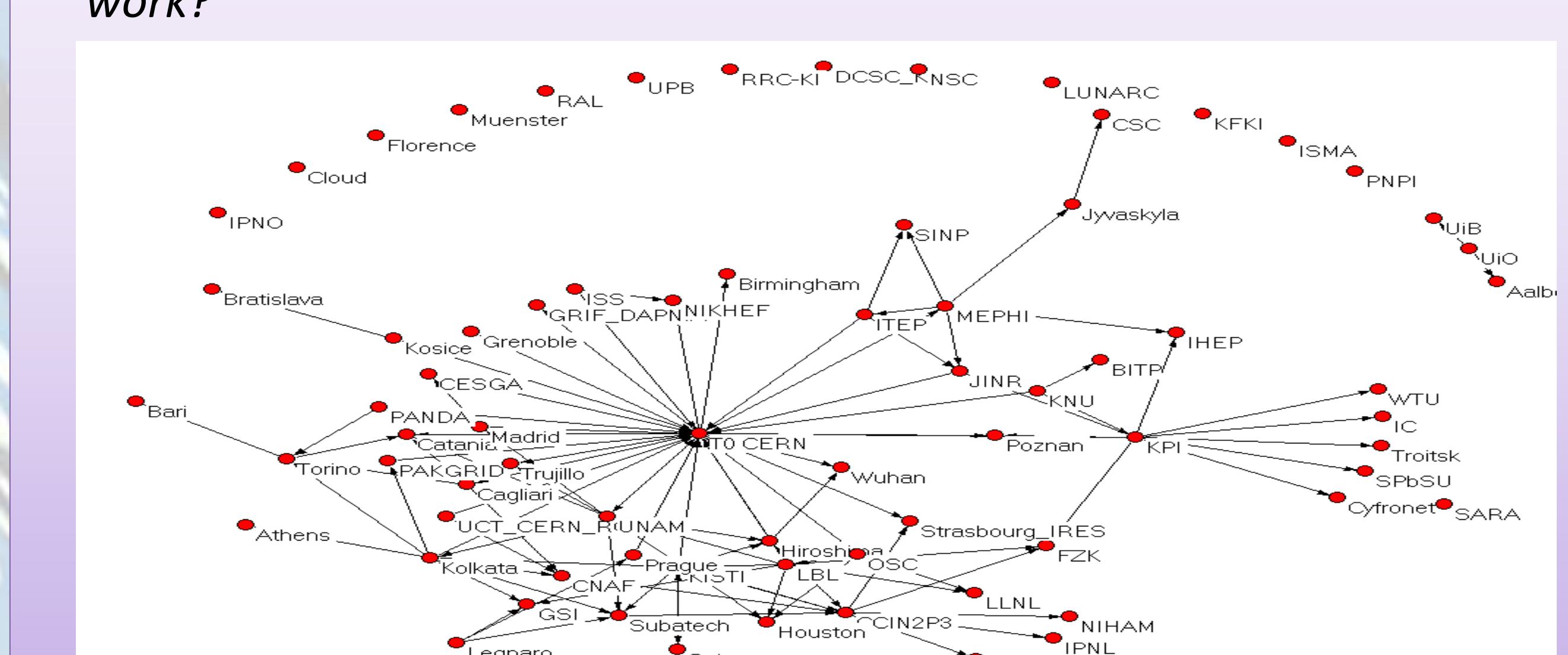
- 3 Which centers are in regular e-mail contact with you, at least once a week?



Similar pattern than in Q1, however with a stronger centralization on CERN.

There is a difference between support and e-mail exchanges.

- 4 With which centers your center would like to have more interaction in its work?



Similar pattern as in Q1, however with a stronger localization. This clearly expresses a request for an increased local support.

Preliminary observation in place of Conclusions

The centers of the ALICE Distributed Computing Infrastructure derive most of their support from CERN. Communication is clustered mostly according to geographic locality as foreseen by the WLCG computing model and T1s seem to fulfill to some extent their role of support of smaller centers. There is no sign of hindrance in the work of the different centers. There is a clear request for increased communication at the local level and with CERN. Centers of areas with a small concentration of sites (Asia, South America), tend to privilege existing relations due to personal contacts or collaboration agreements rather than regional communication.