

# CYBERINFRASTRUCTURE FOR INTERNATIONAL COMPETITIVENESS

By Dr Happy Sithole



Figure 1: SANReN network roll-out.



Figure 2: A sample of data for ALICE projects showing the number of jobs processed at the CHPC from April to June 2015.

Cyberinfrastructure refers to information technology systems that provide particularly powerful and advanced capabilities. It encompasses a combination of massive processing capability, high-speed connectivity, massive storage facilities and highly skilled personnel. Leading nations have invested significantly in these facilities and closely aligned them with their economic activities.

South Africa has in the past decade invested in national cyberinfrastructure to enable cutting-edge research and development within its academic and research institutions as well as industry. The CSIR, through the relevant centres and initiatives it hosts, plays a key role in developing South Africa's cyberinfrastructure landscape to ensure maximum impact from its various services.

#### THE CENTRE FOR HIGH PERFORMANCE COMPUTING

(CHPC), hosted by the CSIR, is one of three primary pillars of the national cyberinfrastructure intervention supported by the Department of Science and Technology.

The CHPC provides massive parallel processing capabilities and services to researchers in industry and academia. The South African National Research Network (SANReN) provides high-speed connectivity to academic institutions and research councils around the country, while the Data Intensive Research Initiative of South Africa implements tools and facilities to enable efficient data-driven scientific and engineering discoveries.

To facilitate cutting-edge research, a wide range of skills development initiatives and support services ensure efficient utilisation of these facilities.

The performance of research activities in South Africa when compared to the rest of the world is used as a measurement of the outputs from these interventions. In addition, adoption of cyberinfrastructure in industry and other science and engineering domains is accelerating discoveries and development.

#### Cyberinfrastructure achievements in South Africa

The Department of Science and Technology has invested in cyberinfrastructure entities since 2006 and much has been achieved to date.

- The list of initiatives and organisations benefitting from connectivity from SANReN continues to grow and includes 25 universities; most statutory science and research councils; selected Technical Vocational Training and Education and Training colleges; and some

schools. The 204 connected sites (with over 1 million users connected) receive between 1 Gigabit per second (Gb/s) and 10 Gb/s, with an average bandwidth availability of 2.82 Gb/s per site. The connectivity status is depicted in Figure 1.

- High performance computing (HPC) infrastructure has grown from 2.5 TFLOPS in 2007 to 61.4 TFLOPS, and is being upgraded to 1 PFLOPS (that is a thousand trillion operations per second) in the current year.
- A 4 PBytes-storage system split between the Pretoria and Cape Town campuses of the CSIR has been designed for data-driven applications and near-real time synchronisation to provide for full disaster recovery of all research data. This facility provides storage for big data resources in support of data intensive research activities.

Furthermore, these cyberinfrastructure entities also provide value-add services:

- The eduroam wireless roaming service allows researchers, students and educators to seamlessly connect to eduroam-enabled sites globally using their home organisation credentials.
- A combination of HPC-related training initiatives, which includes winter schools and a student cluster challenge, to develop high-end skills in the country.
- An annual meeting that attracts over 400 participants from all over the world with renowned cyberinfrastructure personalities giving keynote lectures.



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The successful implementation of cyberinfrastructure in South Africa has enabled competitiveness of the country in many aspects, notably:

- The reduction of bandwidth costs for the South African higher education and research communities from R43 000 for 1 Mbps per month to R6 100 for 1 Gbps per month for local connectivity, and from R52 425 to R880 per month for 1 Mbps for international connectivity.
- The critical contribution made to the Square Kilometre Array bid by demonstrating efficient connectivity and processing capability that led to the successful award of the hosting rights for South Africa.
- South Africa is rated among the leading countries to provide support for the Large Hadron Collider experiments of the European Organization for Nuclear Research (CERN) with recognition for a Tier-2 facility producing 2 400 jobs per day for project ALICE (A Large Ion Collider Experiment). See Figure 2.
- The human capital development programme, through the Student Cluster Challenge, has proven to be world-class with South African students crowned champions two years in a row at the

international competition hosted by the International Supercomputing Conference.

- The HPC system in South Africa has been rated among the TOP500 supercomputers in the world – number 311 in 2012.
- South African industries are adopting HPC for their research and development competitiveness.
- A multinational corporation, Johnson Matthey, established its research centre in South Africa in 2013, mainly attracted by the expertise in modelling and simulation in this country, and the existence of high-speed connectivity and HPC resources. The company is currently one of the leading industrial users of the CHPC.
- There has been an increase in publications from South African researchers in high impact journals, coupled with an increase in postgraduate qualifications in HPC-related fields.

It is evident that South Africa's ability to compete globally is receiving a substantial boost through significant bandwidth; massive processing facilities and data storage systems, driven by high-end skills.