PostgreSQL @ NIC

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About Me

- 26+ years in National Informatics Centre (NIC).
- Mostly worked in Linux Platforms.
- Recent Past Key Assignments include;
  - Immigration
  - Central Pension Accounting
  - Multipurpose National Identity Projects
- Currently working with Open Technology Group (OTG) of NIC-Chennai for the promotion of Open Source Software Solutions and helping project teams across the nation in troble-shooting & consulting on
  - PostgreSQL Database Design/ Tuning / Disaster Recovery
  - Apache HTTPD Server
  - Tomcat
- Recent new assignment includes
  - Apache Cassandra (NOSQL) DBMS.

PostgreSQL Past & Present

- Earlier, PostgreSQL usage at NIC was purely on the choice of Individual Team members.
- NIC-OTG has been promoting (including hands-on-supporting, capacity building, trouble-shooting, tuning) PostgreSQL across the nation.
- Accordingly OTG conducted trainings at Delhi, Calcutta, Pune and at Chennai.
- Institutionalized support for PostgreSQL is being ensured through
    - Issue Track Site / Portal
    - Online Help (Ammyy/Team Viewer)
    - Advisories through Intranet Portal
- A very significant number of projects use PostgreSQL be it National Data Centres / State Data Centres across the Country.
- Last year, Govt of India declared the Policy on Open Source Software which shall not be ignored if it is viable for projects in the e-Governance domain.

Why Community Version?

- PostgreSQL is the major Open Source Community (besides communities on Apache HTTPD Server & Tomcat) continuing for the past 2 decades as a strong & active community with added features regularly.
- PostgreSQL from source for NIC is good due to the following factors
    - Simple to Install
    - Manage
    - Ownership
    - Handle Emergency
- Ultimate responsibility of data and delivery fall on NICians who are technical hands, hence it is essential to use Community version.
- In National Data Centres & State Data Centres, major projects are running on Community PostgreSQL.

Streaming Replication

- Standby/Disaster DB is very essential since most of the e-Governance Services are paper-less and 24x7; the Officials at Centre / State do not maintain manual-records at their Office.
- PITR and Slony were used, earlier to PostgreSQL Version 9.0, for creating a Standby Server which is difficult to establish and manage; even if a single file is misplaced or corrupted, every thing has to be redone.
- From version PostgreSQL 9.0 onwards, the Streaming Replication (Master-Slave) has eliminated the above issue. The replication at both Master and Slave ends can be monitored through SMS/Mail alert. Replicated Server(s) can also be used for report generation & thus the load on the production server is minimised. It is also suggested to have a third server at a remote location for DR.

Important Steps for Performance

- Proper Design, appropriate hardware resources (sufficient number of CPUs and RAM taking into consideration of concurrent users during Peak time) and Aging Policy are required as a pre-requiste. This will help to manage the application even with single-box database engine.
- Essential features include
  - proper connection pooling setup,
  - required indexes and
  - proper Vacuum settings(no of vacuum threads,snaptime)

Why Aging of Data ?

- The policy / guidelines on Aging of Data and rendering the aged data should be finalized as a first step; then, the database size does not grow arbitrarily.
- No RDBMS can perform when the database growing/bloating, due the inherent restriction of RDBMS.
- Users often expect the query spanning across years with drilldown feature in real-time; this is technically in-correct. Such reports can be worked out using batch mode preferably during off-time.
- Views cannot match the needs of the ever-growing demand by decision-makers since needs often change on day to day basis.

Why not Clustering?

- Clustering requires lot of hardware-resources, tools (like pg_xc,bdr, Bucardo) and skilled-manpower. Hence, this can be considered mainly for crtical applications.
- Due to financial constraints, master-slave setup is sufficient for the majority of non-critical applications. Hence, Clustering is not essential in these cases.

TN e-Districts (1)

- During peak period of Admissions, the TN-eDistrict-Project receives request from Students for issuance of Certificates for Community, Income & Nativity; the number of hits [via Community Service Centres (CSC)] per day are in lakhs.
- CAS Single-Sign-On is used for accessing applications like Revenue Dept, Social-welfare Dept, etc from single window.
- The project has 4 DB Servers and 2 Application Servers with 132 GB RAM and 64 Processors. Two active Servers and two standby Servers using Streaming Replication, used for mainly reports. Thus reducing the report load on the production server.
- Only DB servers are used optimally. The application server resources particularly CPU are hardly used.
- JDK 8 has auto-tuning feature manages limited resource and provide high throughput using BIO/NIO connector for high concurrency.

TN e-Districts (2)

- In a year, about 40+ lakhs certificates are issued after due verification of attached documents with the application; they are digitally signed under eDistricts Project of Tamil Nadu.
- Now the Database size is around 3.5 TB.
- Aging Policy is getting finalised. Once approved, the processed data of previous years (certificates) will be moved to separate-schema from production-schema (public-schema).
- This year, more than one crore applications are expected since more services (like Transport, Police, PDS, General Peition, Land Extracts etc) are integrated . The Services are provided to citizen on payment-basis and hence prompt delivery has to be ensured.
- Around 6000 CSC's are operating around the State on 24 X 7 basis.

CCTNS Project (1)

- CCTNS application deals with computerization of Police Station activities. About 3000 Police Stations are connected via TNSWAN and the application is locally run on a desktop with PostgreSQL 8.2 bundled with NIC-Linux. Data is entered at local police station, gets replicated (using SymmetricDS - a asynchronous replication tool) to TN-SDC (PostgreSQL 9.1 DB). The current data size is about 700 GB.
- After appropriate study, it is decided that Schema based approach is suitable; here, each schema corresponds to a Police-District.
- Thus, tables like FIR and Registration per district have records in lakhs only (instead of crores).
- The relevant records are read by the concerned official at the Police-District level .

CCTNS Project (2)

- The other approach for handling the large-data, like Partition-approach, cannot match the requirement.
- General Complaints like loss of Mobile, Valuables can be applied on line.
- At the State Level and District-level, monitoring of Cases are done.
- The Application runs on two Tomcat-based Servers facing Apache HTTPD Server (mod_proxy_balancer). 3 database servers (production, local & remote) are used with remote DR at NDC-Pune.
- Application is developed using Apache Wicket framework.
- Data from Police Stations are received when ever the network is up.
- In some cases, if the data is lost at Police Station, it can be extracted from Central Server and sent back to respective Police Station.
- URL http://eservices.tnpolice.gov.in.

TN Local Body Election 2011

- NIC was asked to take up the project of Conducting Local Bodies Election in TN.
- The data was given from the Office of Central Election Commissioner,, TN; the data was in MS-SQL Server in mdb format.
- The complete work of conversion of Data to PostgreSQL, developing PHP application for publishing the voter-rolls / booth-details / voter-slips / results was completed within 4 months but only with 5 manpower.
- There were about 5 crore voters with Photograph. Considering the complexity of processing of Data by District Officials for allotting booths to Citizens, the schema per District approach was adopted.
- The work was completed within the stipulated period to the satisfaction of concerned stakeholders.

Other Major Projects

- Applications running at Supreme Court / High Courts / District Courts
- State PDS applications.
- e-Procurement developed by NIC for many Centre Govt / State Govt / PSU's.
- Online Reservation System (http://ors.gov.in) for Hospitals and e-Hospital System (from NIC).
- Online Consent Management System for Pollution Control Boards to register & monitor Industries in 14 States and Union Territories.
- Many such applications are using PostgreSQL across the country like Vahan, Sarathi (Driving License), RTI-Online etc.

References

- http://postgresql.org
- Proceedings and slides of PostgreSQL Conferences across the world, Which gives a view what is the upcoming features and the latest developments.
- Mr Bruce Momjian's Blog spot (http://momjian.us/)
- Planet PostgreSQL (http://planet.postgresql.org/)
- PostgreSQL Online Journal (http://www.postgresonline.com/).
- PostgreSQL-Wiki (https://wiki.postgresql.org/wiki/Main_Page)