D3: A Collaborative Infrastructure for Aerospace Design

Joan Walton, National Aeronautics and Space Admn.

Robert E. Filman, Research Institute for Advanced Computer Science

Chris Knight, National Aeronautics and Space Admn.

David J. Korsmeyer, National Aeronautics and Space Admn.

Diana D. Lee, Science Applications International Corporation

at NASA Ames Research Center; Moffett Field, CA

August 9, 2001

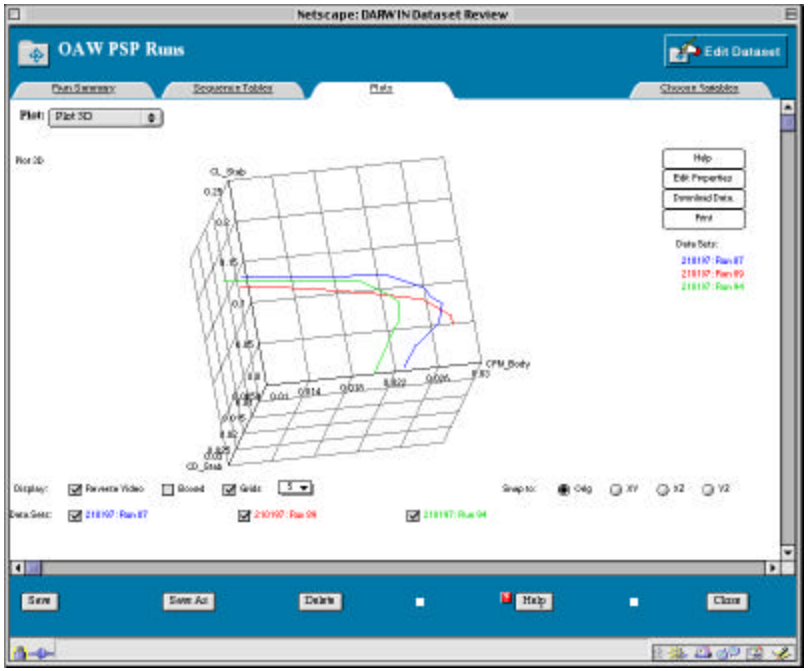
What is D3?

D3 (the third generation of the DARWIN system):

- NASA developed, Internet-based system
- enables aerospace researchers to access aerospace vehicle data (originally from wind tunnels)
  - secure
  - remote
  - collaboration

Collaboration with D3

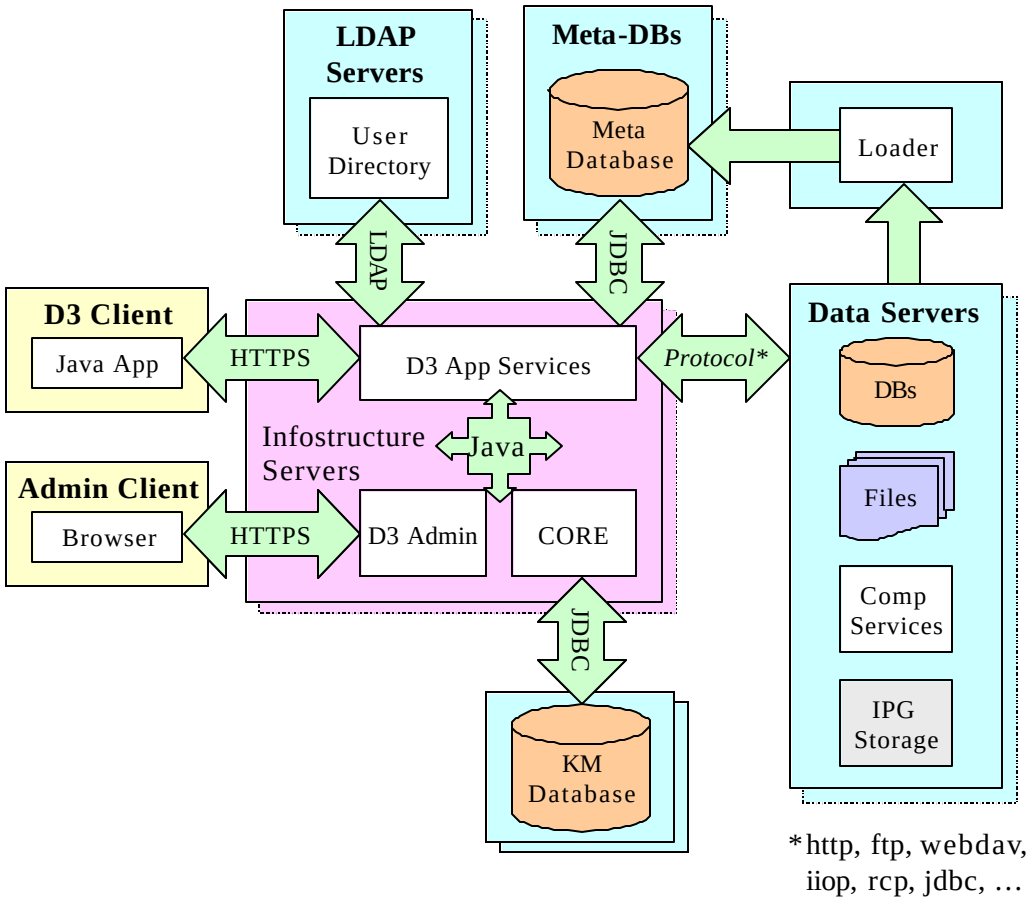
- Shared visualization of data
- Collaborative tools for working with data: message board, shared files “shelf”, annotated “reviews and “studies”
- CORE (Complex Relationship Engine):
  - handles continuous and incremental enhancement of knowledge data such as:
    - metadata about stored documents,
    - user extension of the data model, and
    - for workflow applications, user contributed application logic
  - Security: fine-grain security control
- Real-time mechanisms for interacting with ongoing activities



Characterization of the D3 Application

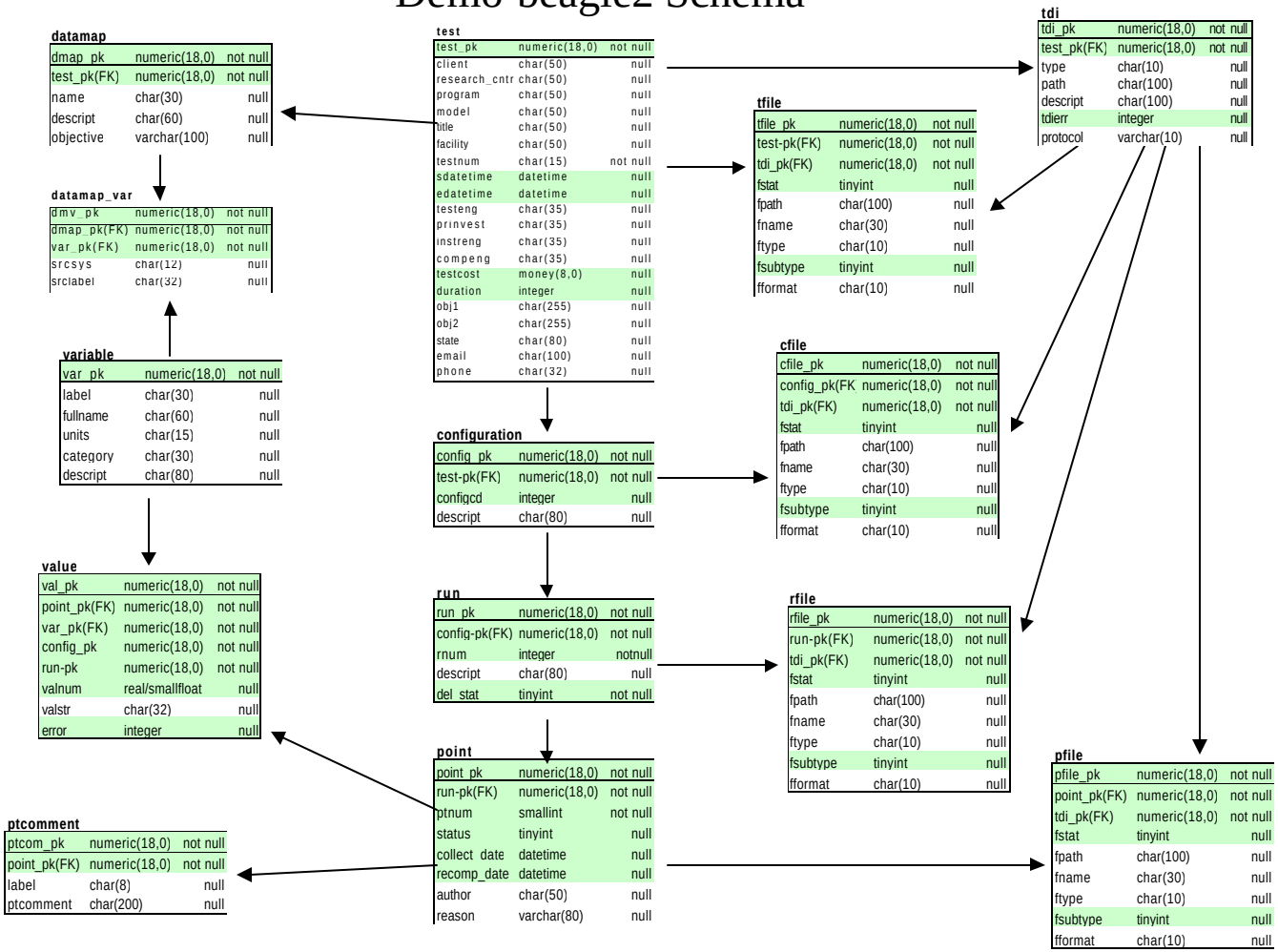
- Large volumes of data: performance needs to be optimized (pre-fetching)
- Heterogeneous data (text and binary) from multiple data servers
- Distributed data: queries that can refer to more than one database at more than one location
- Security:
  - row-level access-control of our relational database
  - multiple authority-realms for access control
- Server has limited knowledge of how data will be processed by client (the D3 client is a “Fat Client”)

Architecture



Example Data Model: Wind tunnels

Demo-beagle2 Schema



D3 Requirements

- give the client the appearance of having data resident
  - Issues:
    - There is too much data to ship in its entirety
    - Security: need for row-level access control
- Single Login

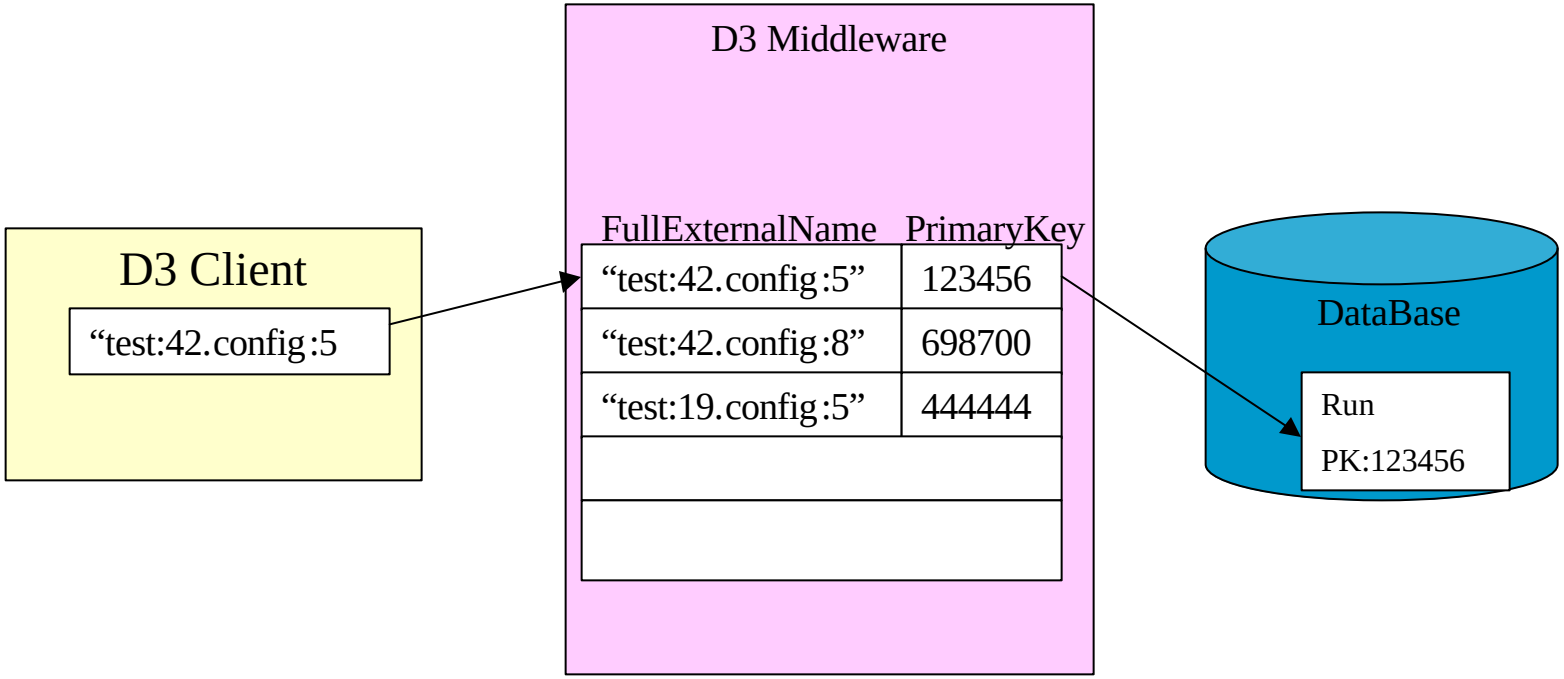
Security:

Need for Row-Level access control

- Access control for the data is centered on tests
- However, data for all tests are mixed in the same tables
- **Security Problem**: clients cannot run random queries
- **Solution**: The client and server communicate in terms of a "full external name"; the server maps this name to a primary key
- Caches the map of "full external name" to primary key so that future requests will not have to run the security check

Security:

Cache of Full External Name -> Primary Key



Security:
Use of LDAP

Pre-fetching

- Optimize the calls/accesses to the database with Pre-fetching
- Client explicitly asks for the data needed as well as providing a context
- Have the server “learn” the usage patterns
- Client/Server conversations are not just in terms of answers to queries, but also as additional information the client may want to know

Closing Remarks

- Related work within NASA:
  - Remote Access Wind Tunnel, Remote Access Control Room
  - PrISM, ADAPT, PostDoc
- Darwin 2.5 is a functioning system
- D3 Prototype is in progress and scheduled for first demo this fall