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VegaFS: A Prototype for File-sharing crossing Multiple Administrative Domains

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Content

- ✓Research motivation about VegaFS
- ✓Architecture of VegaFS
- ✓Implementations
- ✓Evaluations
- ✓Conclusions and future work

Research motivation about VegaFS

- ✓ The requirements of the Grid problem:
  - coordinated resource sharing;
  - problem solving in dynamic, multi-institutional virtual organizations.
- ✓ The feature of a grid file system:
  - the ability to cross multiple institutions or administrative domains.

Research motivation about VegaFS (Continue)

- ✓ To solve the cross-domain problem, we should consider following issues:
  - How to represent file users uniquely in grid environments?
  - What is the relation between a grid file system and existing administrative domains?
  - What is the file access scheme in a grid file system?

Research motivation about VegaFS (Continue)

- ✓ To answer the above three questions, we adopt following strategies:
  - Adopting the public key as the global user identity.
  - Detaching native file systems from administrative domains.
  - Using peer-to-peer authorizations for access control.

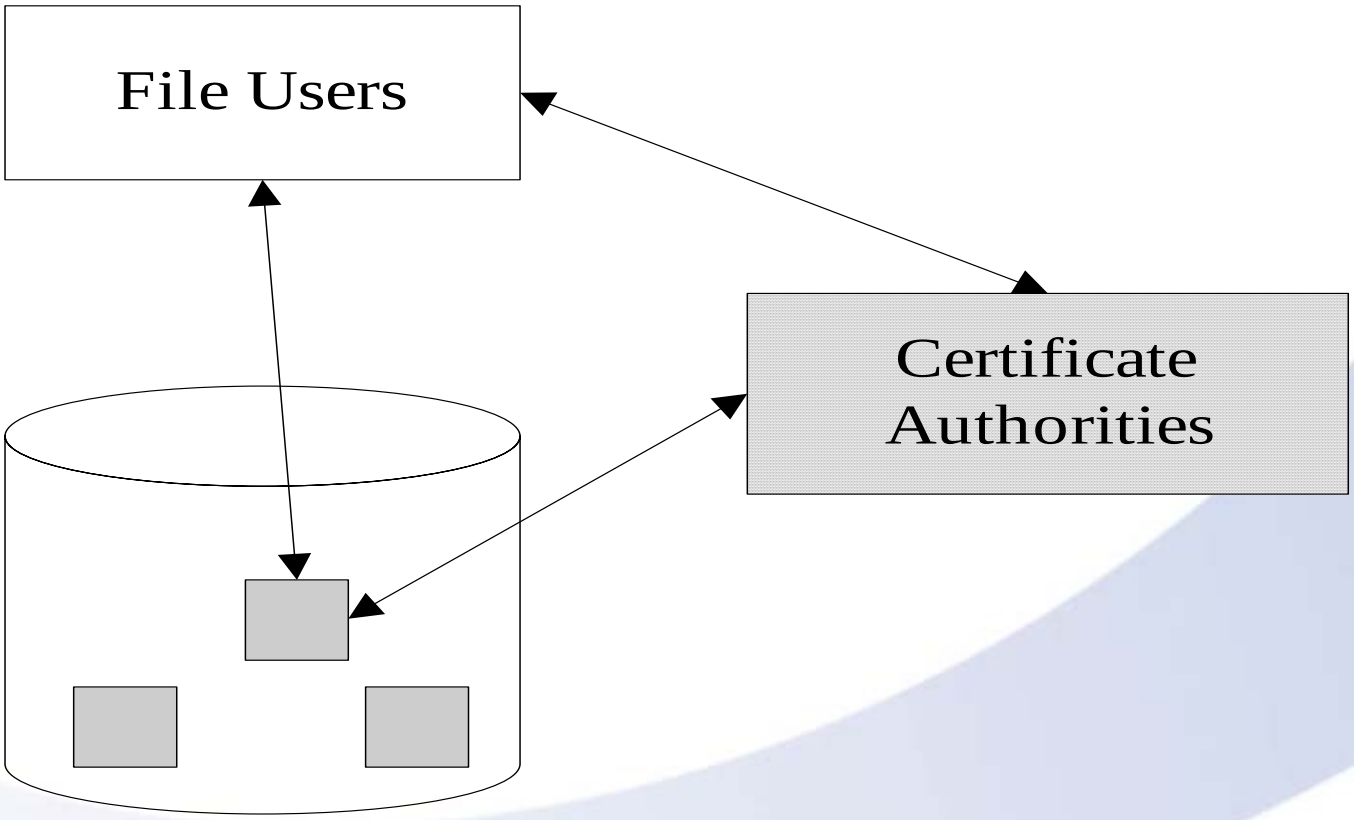
Research motivation about VegaFS (Continue)

- ✓ Several related research projects:
  - SFS: self-certifying pathnames
  - AFS: uses multiple authentication servers.
  - CFS: encrypting file systems.
  - OceanStore and LegionFS: identifies resource owner by public keys, based on objects but not files.

Research motivation about VegaFS (Continue)

- ✓ Some ideas about VegaFS:
  - using a user's public key as his global identity;
  - implanting the public key into the file itself ;
  - the work of file access control is transferred from local domains to certificate authorities;
  - native file systems will not be managed by local domains;
- ✓ So all file systems in VegaFS can be abstracted as grid services detached to computational nodes.

VegaFS Architecture Overview



VegaFS Architecture Overview (Continue)

- ✓ File users: access his files or authorize access right to other file users;
- ✓ Native file systems: mainly response for file access control;
- ✓ Certificate authorities: we adopt PKI as a global user administrative system; have the operations such as registration, certificate issuing, authentication, etc.

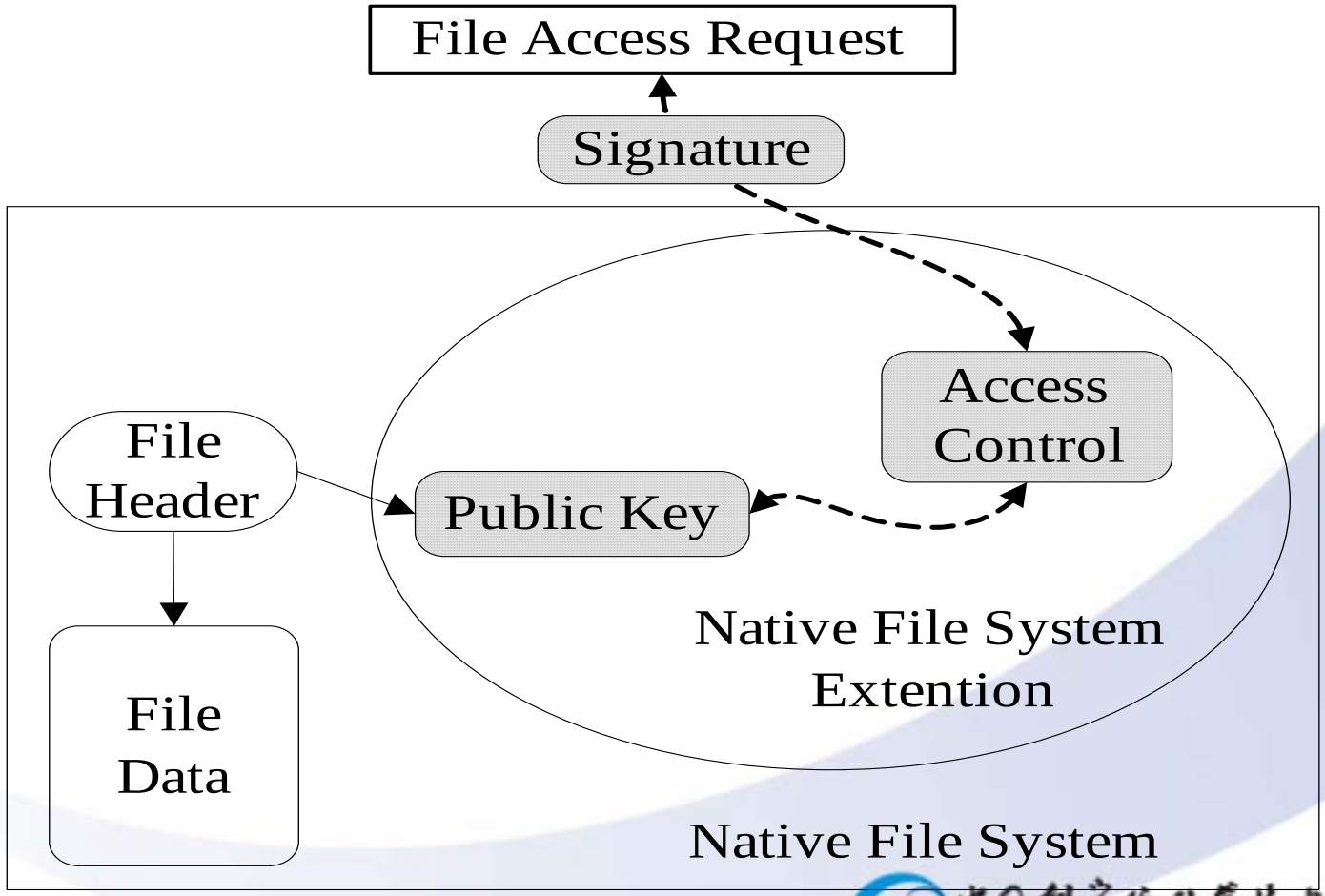
VegaFS Architecture - Global User Identity

- ✓ To implement the cross-domain ability, the representation of users should be global meaningful. That is, the identity should:
  - be global unique;
  - be hard to forge;
  - not be centralized maintained.
- ✓ In VegaFS, we adopt the user's public key as his global identity.

VegaFS Architecture - Native File System Extensions

- ✓ extending the existing native file systems:
  - implanting the global user identity into the file;
  - implementing the file access control in the native file system itself;
- ✓ two merits:
  - enable file users interact with files servers directly, and avoids the overhead brought by a middle layer;
  - better support the fine-grained dynamic access control requirements.

VegaFS Architecture - Native File System Extensions (Continue)



VegaFS Architecture Peer-to-peer Authorizations(1)

- ✓ access control information is not pre-stored in a central location:
  - When a file user wants to share other users' file, he needs to contact to file owners to obtain the file access right.
  - For file owners, they can issue the file access right on demand and dynamically.

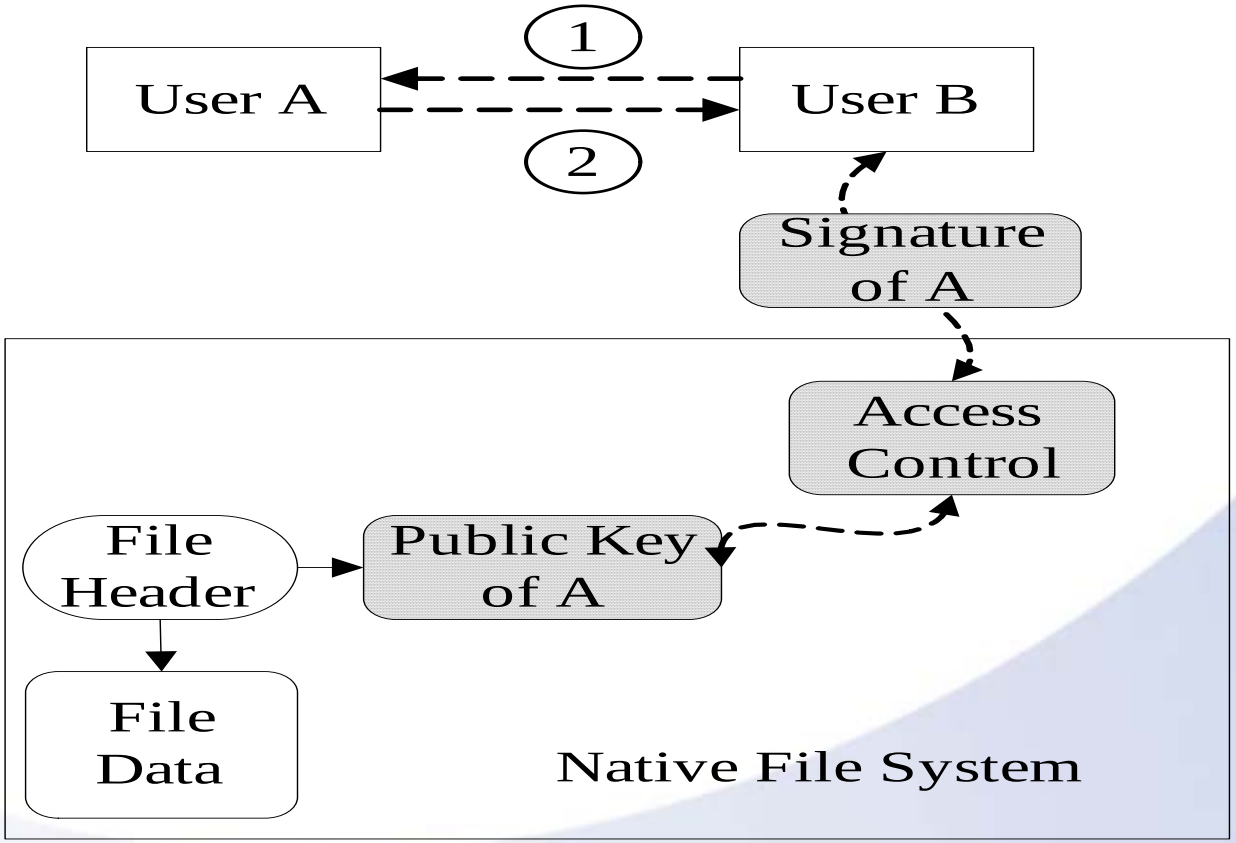
VegaFS Architecture Peer-to-peer Authorizations(2)

- ✓ the peer-to-peer authorization includes following meanings:
  - On demand access control: The file users should interact with each other in an on demand manner when sharing files.
  - Fine-grained file sharing: each file owner can maintain the access control information of his own files.

VegaFS Architecture Key Operations in VegaFS(1)

- ✓ The Owner's Operations:
  - File create process:
    - authenticating a file user;
    - implanting a public key into a file header.
  - File access process:
    - User sends a request containing his digital signature;
    - File server uses the public key stored in that file to verify the validity of the request.

VegaFS Architecture Key Operations in VegaFS(2)



Implementations

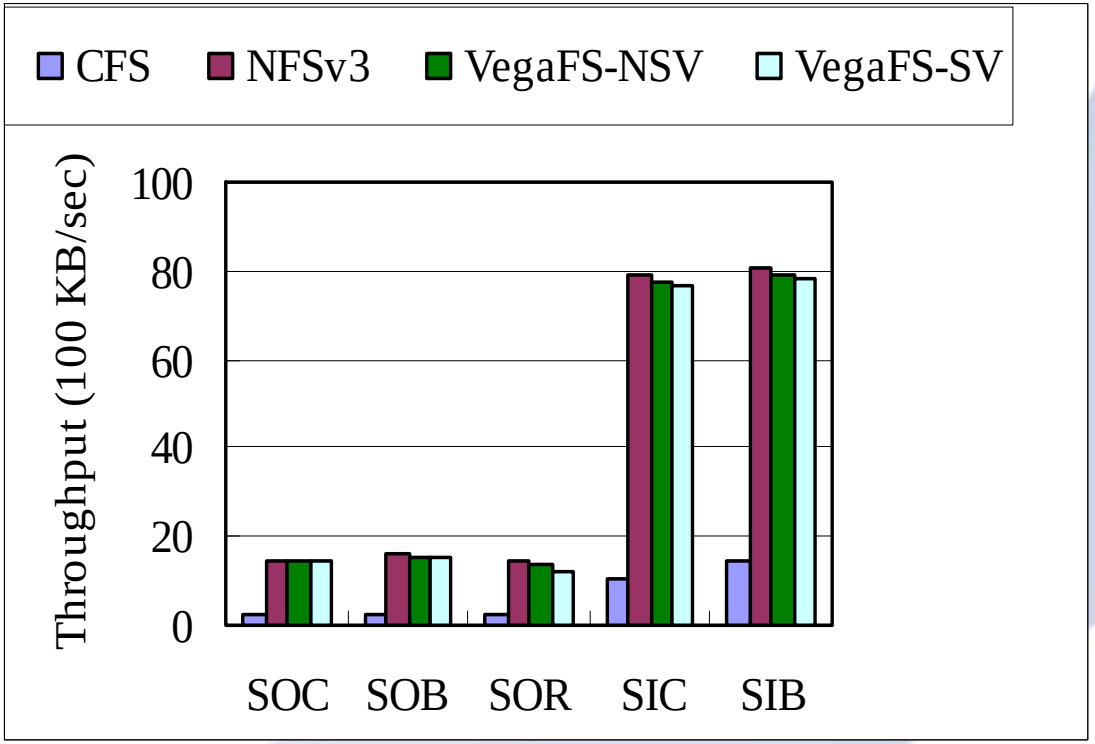
- ✓ We modified *Network File System* to implement VegaFS.
- ✓ Two major components in VegaFS: the VegaFS Client (VC) and VegaFS Server (VS).
- ✓ The implementation of peer-to-peer authorizations in VegaFS.

Evaluations

- ✓ The test environment:
  - two Intel Pentium III machines at 667MHz, 128MB of RAM and 7.5 GB Seagate IDE disk;
  - two machines were connected to a stand-alone dedicated switched 100 Mbps network.;
  - On both machines, we installed Redhat 7 and Linux-2.4.19 kernel.

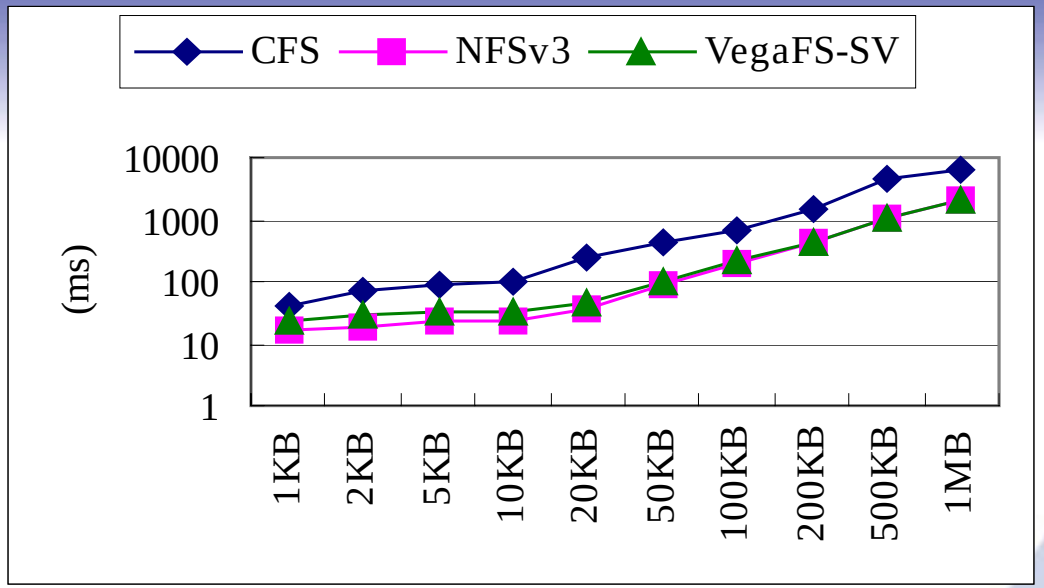
Evaluations (Continue)

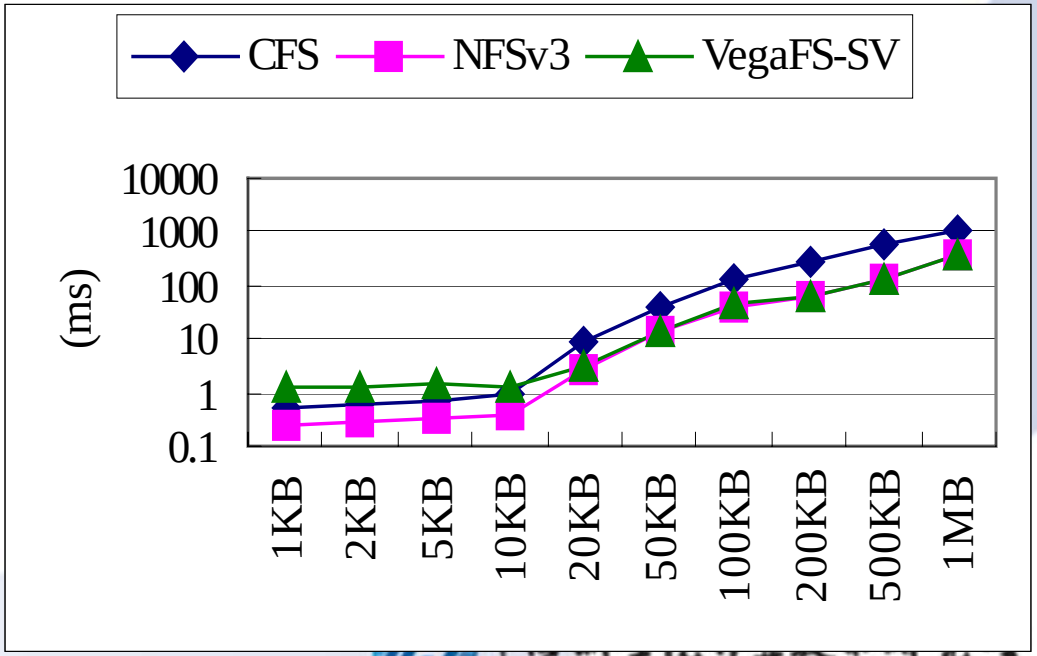
- ✓ Read/write large files: a file 512MB
  - the performance of VegaFS is superior to that of CFS;
  - VegaFS-NSV has the similar performance with NFSv3;
  - The overhead introduced by VegaFS-SV is not very remarkable.
- ✓ Compared with the cost of read/write operations, signing and verifying impacts the performance slightly.



Evaluations (Continue)

- ✓ Write/Read Files in Different Size: the file size changes from 1KB to 1MB.
  - The first figure is about “write files”.
  - The second figure is about “read files”.





Evaluations (Continue)

- ✓ Write/Read Files in Different Size:
  - In VegaFS, for read operation, when file size is less than 50KB, the performance is impacted remarkably;
  - In VegaFS, for write operation, when file size less than 20KB, the performance is impacted remarkably.
  - When the file size increases, the performance of VegaFS-SV will approach the performance of NFSv3.

Evaluations (Continue)

- ✓ Compared with the NFS implementation :
  - VegaFS introduces a fixed amount of overhead for each file system RPC call;
  - In a wide area, the performance lost can be omitted compared with the actual time cost of data transferring.

Conclusions and Future Work

- ✓ Conclusions:
  - Main contribution of VegaFS: Cross-domain ability, Flexible and fine-grained access control ability, Scalability, Security and Acceptable performance.
  - Our test shows that the performance of VegaFS is acceptable.
  - When transferring large size files, the impact on performance can be omitted.

Conclusions and Future Work

- ✓ Future Work:
  - fulfill the unfinished work: multiple namespaces, performance tuning, bug fix, etc.
  - use GSI standard to replace the current SPKI standard, so VegaFS can be a part of the OGSA framework.