MyCoG.NET: 
Towards a Multi-Language CoG Toolkit

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Introduction

CoG Kits

- Java Platform
- Others – Python, Matlab
- .NET Platform – MyCoG.NET
- Globus Grid Services
  - GridFTP, GRAM, MDS

Advantages:
1. Multi-language support (C#, C++, Java, FORTRAN etc.)
2. Not just .NET API to access Grid services, but enables developers to access the .NET Framework for Grid application development

MyCoG - Architecture

- MyCoG.NET
  - GridFTPClient
  - GramClient
  - GridSecurity - GSI-GSSAPI Authentication, Delegation
  - MyProxyInit Tool to generate proxy certificate from PKCS12 input
  - Proxy class

- .NET Framework Class Library (FCL)

- .NET Common Language Runtime (CLR):
  - Multi-language support

- SSPI
  - SSLv3, Kerberos, NTLM Authentication

- CryptoAPI
  - ASN.1 Encoding, PKCS, Certificate Management, Encryption/Decryption

SSPI and CryptoAPI are part of Platform SDK

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Security

- GridSecurity class provides client side functionality of Globus Grid Security Infrastructure (GSI)
- X.509 Certificate based Mutual Authentication
- Authorization based on Certificate Subject
- Delegation of credentials
- Proxy Certificate can be created using MyProxyInit tool
- MyCoG uses Windows native security library
  - SSPI (Security Service Provider Interface)

MyCoG Clients (Windows) → SSPI → GSI Messages → GSSAPI based on OpenSSL → Globus Services (Unix)

GSI Handshake

- Three phases as per GSI message specification
  - Context Establishment phase
    - Mutual authentication using EEC or proxy certificate
    - Standard SSLv3 handshake messages exchanged
  - Delegation phase
    - Client can delegate its credential to server (Optional)
    - Client sends a flag (D), server replies with PKCS10 CertRequest and client sends back Proxy Certificate Chain
  - Application Specific Messages
    - Messages are protected using ciphers derived during Context Establishment
    - For example, GridFTP control channel commands are encrypted
## GridFTPClient class

- **Control Channel** – for GridFTP Commands, GSSAPI authenticated and encrypted
- **Data Channel** for actual data transfer
- **Extended block mode** (MODE E) apart from basic FTP Stream (S) and Block (B) modes
- **Parallelism** – Allows multiple TCP streams (Data channels) between client and server
- **Third Party Data transfer** – Client initiated, server-to-server

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### MyCoG - Multilanguage Programmability

Usage in FORTRAN - Lahey/Fujitsu .NET FORTRAN Compiler

```fortran
use MyCoG%GridFTP
use MyCoG%GridSecurity
use MyCoG%Proxy
! Read X.509 Certificate ...
type(GridFTPClient), pointer :: gftp
allocate(gftp, source=GridFTPClient(serverName, port))
gftp%DELEGATION = DelegationType%LimitedDelegation
call gftp%Authenticate(GetDefaultProxyLocation)
call gftp%Mode(GridFTPClient%ExtendedMode)
call gftp%ParallelUpload(localFile, remoteFile, numberOfStreams)
```
Usage in C++ (Visual Studio .NET Compiler)

```cpp
using namespace MyCoG::GridFTP;
using namespace MyCoG::GridSecurity;
using namespace MyCoG::Proxy;
// Read X.509 Certificate ...
GridFTPClient *gftp;
  gftp = new GridFTPClient(serverName, port);
  gftp->DELEGATION = DelegationType.LimitedDelegation;
  gftp->Authenticate(GetDefaultProxyLocation);
  gftp->Mode(GridFTPClient::ExtendedMode);
  gftp->ParallelUpload(localFile, remoteFile, numberOfStreams)
```

Usage in Java (Visual Studio .NET Compiler)

```java
import MyCoG.GridFTP.*;
import MyCoG.GridSecurity.*;
import MyCoG.Proxy.*;
// Read X.509 Certificate ...
GridFTPClient gftp = null;
  gftp = new GridFTPClient(serverName, port);
  gftp.DELEGATION = DelegationType.LimitedDelegation;
  gftp.Authenticate(GetDefaultProxyLocation);
  gftp.Mode(GridFTPClient.ExtendedMode);
  gftp.ParallelUpload(localFile, remoteFile, numberOfStreams)
```

- Similarly usage in C# is possible
- Mixed language support in .NET CLR
- One could develop GUI in Visual Basic and computations in FORTRAN
GramClient class

- GSSAPI Mutual authentication and job submission to the Globus Gatekeeper service
- Job requests specified as Resource Specification Language (RSL)
- User can 'ping' prior to actual submission to check for privileges

```c
using MyCoG.Gram;
using MyCoG.GridSecurity;
using MyCoG.Proxy;

gram = new GramClient(serverName, port);
gram.DELEGATION = DelegationType.LimitedDelegation;
gram.Authenticate(GetDefaultProxyLocation);
// Construct rsl string here
gram.Request(rslString)
```

GridFTP LAN Performance (Download)

**Client:**
- Pentium-4
- 2.2 GHz
- Windows XP

**Server:**
- Dual Pentium III
- 450 MHz
- Linux

**Network:**
- 100 Mbps Ethernet LAN
LAN Performance (Upload)

Client:
Pentium III
733 MHz
Windows 2003
@ Southampton

Server:
Dual Xeon 3.06 GHz
Linux
UK Grid Node
@ Manchester

Network:
Backbone network 2.5 Gbps
Access network 1 Gbps

WAN Performance (Download)

Client:
Pentium III
733 MHz
Windows 2003
@ Southampton

Server:
Dual Xeon 3.06 GHz
Linux
UK Grid Node
@ Manchester

Network:
Backbone network 2.5 Gbps
Access network 1 Gbps
WAN Performance (Upload)

![Graph showing WAN performance](image)

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**Case Study – Wind Tunnel Grid**

- Experimental facilities cater to Aerodynamicists
- Effective experimental data management & processing are major requirement
- Portal as well as programmatic access to data and processing are required
Solution – based on MyCoG & Globus

- Wind Tunnel Grid Portal hosts MyGridFTP
- MyGridFTP – ClickOnce (No Touch Deployment) GridFTP client for experimental data upload
- Processing is invoked by triggering the GRAM client
- Visualization using PlotWS web service ([http://www.soton.ac.uk/~ghydflex/](http://www.soton.ac.uk/~ghydflex/))
- Experimental metadata and results are stored in RDBMS

Conclusions & Future work

- CoG Kits based on Commodity technologies like Java & .NET can improve the Grid application development time
- MyCoG leverages .NET multi-language support
- Extends Grid to Windows application developers, even Visual Basic and FORTRAN ones!
- Performance is comparable to Java CoG
- Globus MDS support, GT4 security are to be incorporated to make it a full-fledged CoG toolkit
- Mono project provides the possibility of porting onto other platforms

Thank You!