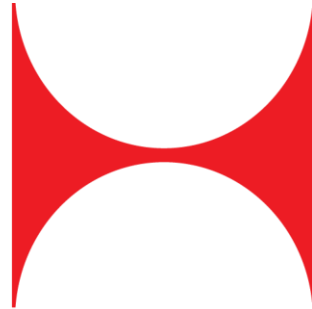


# Migrating to Multi-tenancy



The step-by-step conversion of two stand-alone sports databases into a single Multi-tenant database

By Tim Kuehn



**TDK**  
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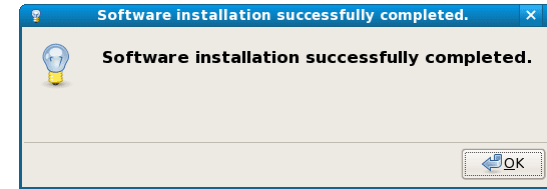
# About TDK Consulting

## TDK Consulting Services

..delivers full life cycle development from a clean sheet of paper



to a finished product



...specializes in the development of software engines



that wrap complex business logic in easy to use APIs



..can refactor code like this:



into code like this:



...develops and delivers training solutions to turn questions



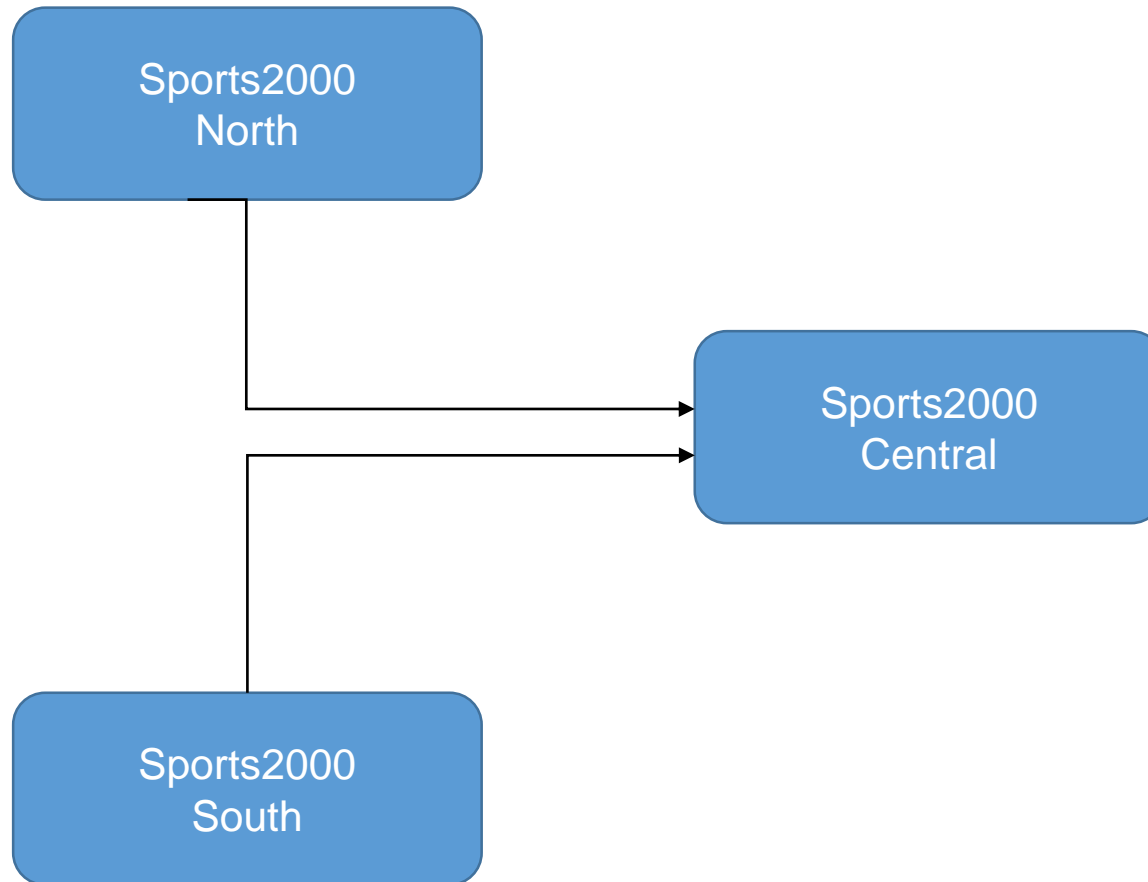
into knowledge and understanding



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# Merge “North” and “South” into one DB



Two Options:

Create a new MT DB

Convert an existing DB to MT

## Convert an existing DB to MT

- Requires all MT DB objects be in a Type II area
- (default indexes too!)
- Enable tables for MT
- Delete and create sequences for MT
- Create Tenants, Domains, and Users
- Copy tenant's data from default partition to their MT Tenant partition
- Delete default tenant partition data
- Load other tenant's data and sequences
- Configure user login sequence

## Start from Scratch

- Create new db with Type II Areas
- Edit .df to set tables and sequences to be MT
- Load .df
- Create Tenants, Domains, and Users
- Load data and sequences for each MT Tenant
- Configure user login process

.st file with all Type II Storage Areas

.df file converted to MT

## Original .st

```
b .  
d "Schema Area":6,32;1 .  
  
d "Employee":7,32;1 .  
d "Inventory":8,32;1 .  
d "Cust_Data":9,32;1 .  
d "Cust_Index":10,32;1 .  
d "Order":11,32;1 .  
d "Misc":12,32;1 .
```



1 block / cluster = Type I area

## .st Converted to Type II Areas

```
b .  
d "Schema Area":6,32;1 .  
  
d "Employee":7,32;8 .  
d "Inventory":8,32;8 .  
d "Cust_Data":9,32;8 .  
d "Cust_Index":10,32;8 .  
d "Order":11,32;8 .  
d "Misc":12,32;8 .
```



> 1 block / cluster = Type II Area

## Before MT

```
ADD TABLE "Family"  
  AREA "Employee"  
  DUMP-NAME "family"
```

## With MT

```
ADD TABLE "Family"  
  MULTITENANT yes  
  AREA "Employee"  
  DUMP-NAME "family"
```

## Before MT

```
ADD SEQUENCE "NextCustNum"  
  INITIAL 1000  
  INCREMENT 5  
  CYCLE-ON-LIMIT no  
  MIN-VAL 1000
```

## With MT

```
ADD SEQUENCE "NextCustNum"  
  MULTITENANT yes  
  INITIAL 1000  
  INCREMENT 5  
  CYCLE-ON-LIMIT no  
  MIN-VAL 1000
```

D:\MT\central\db\prodb sports2000

Please enter

demo to get the system demonstration database, or

sports to get the sports demonstration database, or

isports to get the international sports database, or

sports2000 to get the sports2000 sample database, or

empty to get the system empty database, or

anyname to get a copy of that database. : **empty**

Procopy session begin for tdk on CON:.. (451)

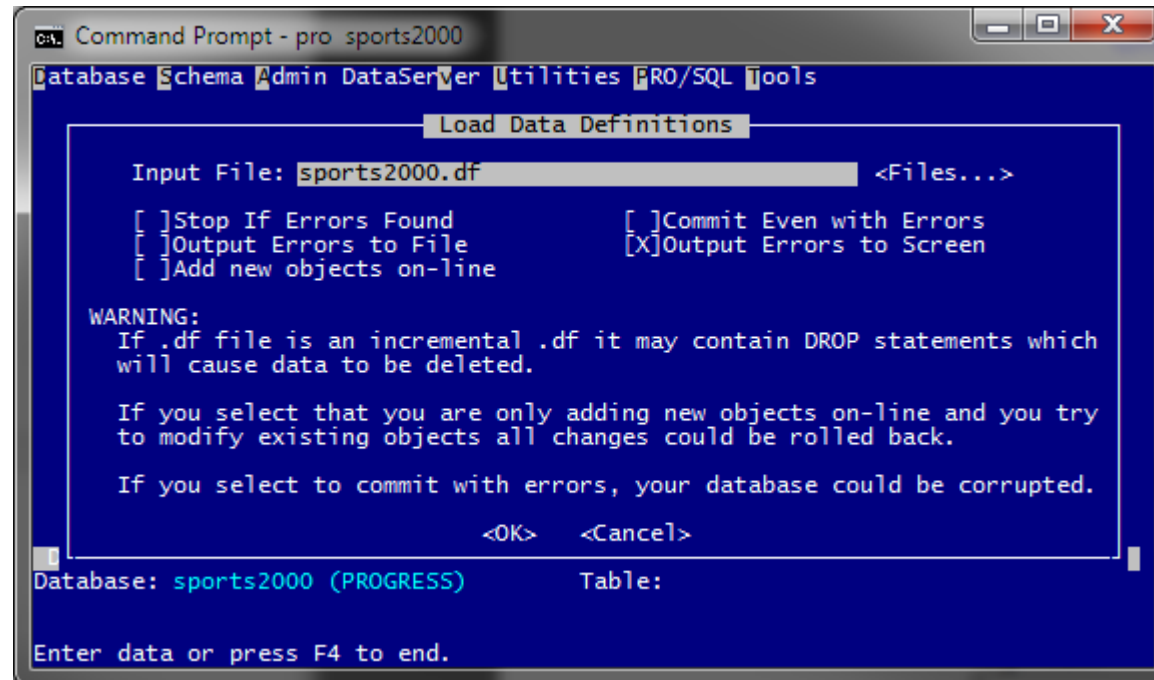
Database copied from c:\progress\openedge\11.1\empty. (1365)

Procopy session end. (334)

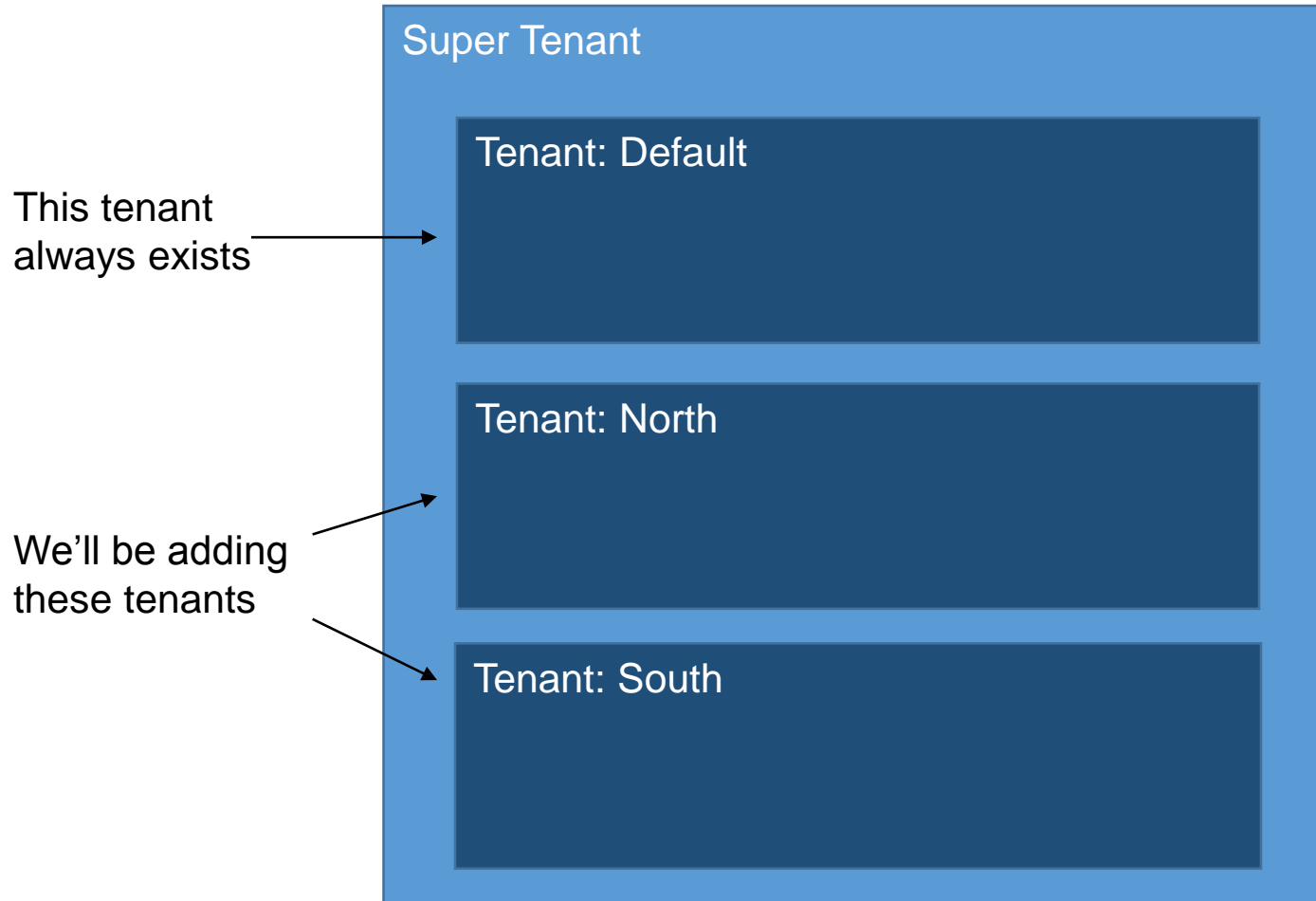
D:\MT\central\db\proutil sports2000 -C enableMultitenancy

OpenEdge Release 11.1 as of Fri Jun 15 19:01:20 EDT 2012

Multi-tenant Tables has been successfully enabled. (15900)



## Segregation and Visibility of Tenant Data



## Tenant: North

Domain: Personnel.north.s2k.com

User: cashier  
User: shipping

Domain: Manager.north.s2k.com

User: day  
User: night

Domain: audit.north.s2k.com

User: auditor

Who and what goes where

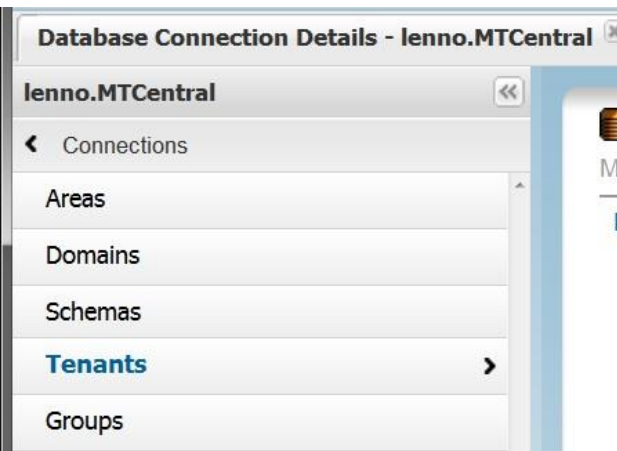
cashier@personnel.north.s2k.com  
shipping@personnel.north.s2k.com

day@manager.north.s2k.com  
night@manager.north.s2k.com

auditor@audit.north.s2k.com

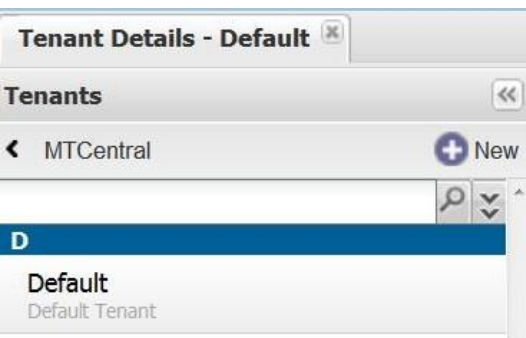
Options for setting up and configuring a (new) tenant:

- Data Admin Tool – Can create / maintain almost everything but tenants
- API – use to automate MT administration (outside scope of this presentation)
- OE Explorer



← OE Explorer main screen

← Maintain Tenants



← Make a new tenant

Database Connection Details - lenno.MTCentral

Create Tenant

Tenant name:

Description:

External ID:

Tenant type:

Regular

Super

Enable data access:

Database connection: lenno.MTCentral

Default data area: --None--

Default index area: --None--

Default LOB area: --None--

Object allocation rule:

Set new objects not to allocate space

Set new objects to allocate space on tenant creation

Set new objects to delay space allocation

Copy default from:

Do not use template

Tenant

Template --None--

Create tenant

Generate tenant progra

Tenant Name

Regular or Super Tenant

Is the tenant allowed access

Where to store new db objects

New db object allocation policy

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Database Connection Details - lenno.MTCentral

Create Tenant

Tenant name:

North

Description:

Northern Sports2000 store

External ID:

Tenant type:

☒ Regular☐ Super

Enable data access:

☒

Database connection:

lenno.MTCentral

Default data area:

Misc

Default index area:

Misc

Default LOB area:

Misc

Object allocation rule:

☐ Set new objects not to allocate space☒ Set new objects to allocate space on tenant creation☐ Set new objects to delay space allocation

Copy default from:

☒ Do not use template☐ Tenant☐ Template --None--

?

Create tenant

Generate tenant program

Tenant Name

Regular or Super Tenant

Is the tenant allowed access

Where to store new db objects

New db object allocation policy

How to create the tenant

Database Connection Details - lenno.MTCentral

Create Tenant

Tenant name: SuperTenant

Description: Super Tenant

External ID:

Tenant type: ☐ Regular ☒ Super

Enable data access: ☒

Database connection: lenno.MTCentral

Default data area: --None--

Default index area: --None--

Default LOB area: --None--

Object allocation rule: ☐ Set new objects not to allocate space ☒ Set new objects to allocate space on tenant creation ☐ Set new objects to delay space allocation

Copy default from: ☒ Do not use template ☐ Tenant ☐ Template --None--

?

☒ Create tenant

Generate tenant program

Tenant Name

Regular or Super Tenant

Is the tenant allowed access

How to create the tenant

Tenant Details - North

Tenants

MTCentral

<Search tenants>

D

Default  
Default Tenant

N

North  
Northern Sports2000 store

S

South  
Southern Tenant

SuperTenant  
Super Tenant

Manage Tenant

Review and edit tenant configuration information

Edit tenant

Delete tenant

Tenant data access: **enabled**

Generate tenant program

Have to Edit a  
Tenant in order to  
add (a) Domain(s)

Tenant Details - North

Tenants

< MTCentral

+ New

<Search tenants>

D

Default

Default Tenant

N

North

Northern Sports2000 store

S

South

Southern Tenant

SuperTenant

Super Tenant

General

Partitions

Groups

Users

Domains

Commit Tools Configure working areas

Tenant name: North

Tenant type: Regular

Description: Northern Sports2000 store

External ID:

Tenant data access: ☒

Database connection: lenno.MTCentral

Default data area: Misc

Default index area: Misc

Default LOB area: Misc

Object allocation rule: 

☐ Set new objects not to allocate space

☒ Set new objects to allocate space immediately

☐ Set new objects to delay space allocation

☒ Is allocated

Click To Edit Domain

Tenant Details - North

Tenants

< MTCentral

+ New

<Search tenants>

D

Default

Default Tenant

N

North

Northern Sports2000 store

S

South

Southern Tenant

SuperTenant

Super Tenant

General

Partitions

Groups

Users

Domains

Make a New Domain

Commit Cancel New Delete

Domain name: <Search>

Name	Authentication System	Enabled
------	-----------------------	---------

Page 1 of 1

No domains to display

Domain name:

Authentication system:

Access code:

Confirm access code:

Description:

Comments:

☐ Enabled

Auditing context:

Runtime options:

System options:

Domain.tenant

How a user is authenticated

Access code – used when creating CP objects

Is this domain active?

Tenant Details - North

Tenants

MTCentral

<Search tenants>

Default

North

South

SuperTenant

General

Partitions

Groups

Users

Domains

Commit

Cancel

New

Delete

Domain name: <Search>

Name	Authentication System	Enabled
personnel.north.s2k.com	_oeusertable	true

Page 1 of 1

Displaying domain 1 - 1 of 1

Domain name:

personnel.north.s2k.com

Authentication system:

\_oeusertable

Access code:

\_extsso

Confirm access code:

\_oeusertable

Description:

\_oslocal

Comments:

Auditing context:

☒ Enabled

Runtime options:

System options:

“Commit”  
when done

How to  
authenticate  
a user

Tenant Details - North

Tenants

< MTCentral

<Search tenants>

D

Default

Default Tenant

N

North

Northern Sports2000 store

S

South

Southern Tenant

SuperTenant

Super Tenant

General

Partitions

Groups

Users

Domains

Commit

Cancel

New

Delete

Domain name: <Search>

Name	Authentication System	Enabled
personnel.north.s2k.com	_oeusertable	true

Page 1 of 1

Displaying domain 1 - 1 of 1

Domain name: personnel.north.s2k.com

Authentication system: \_oeusertable

Access code: .....

Confirm access code: .....

Description:

Comments:

☒ Enabled

Auditing context:

Runtime options:

System options:

How things look after the “personnel” domain’s been added

Tenant Details - North

Tenants

< MTCentral

<Search tenants>

D

Default

Default Tenant

N

North

Northern Sports2000 store

S

South

Southern Tenant

SuperTenant

Super Tenant

General

Partitions

Groups

Users

Domains

Commit

Cancel

New

Delete

Domain name: <Search>

Name	Authentication System	Enabled
audit.north.s2k.com	_ousercontent	true
manager.north.s2k.com	_ousercontent	true
personnel.north.s2k.com	_ousercontent	true

Page 1 of 1

Displaying domain 1 - 3 of 3

Domain name:

audit.north.s2k.com

Authentication system:

\_ousercontent

Access code:

.....

Confirm access code:

.....

Description:

Comments:

Enabled

Auditing context:

Runtime options:

System options:

And how they look after all the “north” domains have been added

Tenant Details - North

Tenants

< MTCentral

<Search tenants>

D

Default

N

North

S

South

SuperTenant

General

Partitions

Groups

Users

Domains

Commit Cancel New Delete

Domain name: <Search>

Name	Authentication System	Enabled
audit.north.s2k.com	_ousercontent	true
manager.north.s2k.com	_ousercontent	true
personnel.north.s2k.com	_ousercontent	true

Page 1 of 1

Displaying domain 1 - 3 of 3

Domain name: audit.north.s2k.com

Authentication system: \_ousercontent

Access code: .....

Confirm access code: .....

Description:

Comments:

☒ Enabled

Auditing context:

Runtime options:

System options:

Click to  
add users

Tenant Details - North

Tenants

< MTCentral

<Search tenants>

D

Default

Default Tenant

N

North

Northern Sports2000 store

S

South

Southern Tenant

SuperTenant

Super Tenant

General

Partitions

Groups

Users

Domains

Commit

Cancel

New

Delete

User name:

<Search>

User ID	User Name	Domain Name	SQL Only	Description
No users to display				

Page

1

of 1

User ID:

User name:

Domain name:

Password:

Confirm password:

☐ SQL Only

Description:

Given name:

Middle initial:

Surname:

Telephone:

E-mail:

Create a blank new user

ID for user

Name

Domain

Password

Tenant Details - North

Tenants

< MTCentral

<Search tenants>

D

Default

Default Tenant

N

North

Northern Sports2000 store

S

South

Southern Tenant

SuperTenant

Super Tenant

General

Partitions

Groups

Users

Domains

Commit

Cancel

New

Delete

User name: <Search>

User ID	User Name	Domain Name	SQL Only	Description
cashier@personnel.north.s2k...	cashier	personnel.north.s2k.com		

Page 1 of 1

No users to display

User ID:

cashier@personnel.north.s2k.com

User name:

cashier

Domain name:

personnel.north.s2k.com

Password:

.....

Confirm password:

.....

☐ SQL Only

Description:

Given name:

Front Desk

Middle initial:

Surname:

Telephone:

E-mail:

cashier@north.s2k.com

Commit  
new user

ID for user

Name

Domain

Password

Tenant Details - North

Tenants

< MTCentral

<Search tenants>

D

Default

Default Tenant

N

North

Northern Sports2000 store

S

South

Southern Tenant

SuperTenant

Super Tenant

General

Partitions

Groups

Users

Domains

Commit Cancel New Delete

User name: <Search>

User ID	User Name	Domain Name	SQL Only	Description
auditor@audit.north.s2k.com	auditor	audit.north.s2k.com	false	
cashier@personnel.north.s2k.com	cashier	personnel.north.s2k.com	false	
day@manager.north.s2k.com	day	manager.north.s2k.com	false	
night@manager.north.s2k.com	night	manager.north.s2k.com	false	
shipping@personnel.north.s2k.com	shipping	personnel.north.s2k.com	false	

Page 1 of 1

Displaying users 1 - 5 of 5

User ID: auditor@audit.north.s2k.com

User name: auditor

Domain name: audit.north.s2k.com

Password: .....

Confirm password: .....

☐ SQL Only

Description:

Given name:

Middle initial:

Surname:

Telephone:

E-mail:

How things look after all the “north” users have been added

## Tenant: North

Domain: Personnel.north.s2k.com

cashier  
shipping

Domain: Manager.north.s2k.com

night  
day

Domain: audit.north.s2k.com

auditor

## Tenant: South

Domain: Personnel.south.s2k.com

cashier  
shipping

Domain: Manager.south.s2k.com

night  
day

Domain: audit.south.s2k.com

auditor

Default Tenant

Tenants need their data....

```
D:\test\MT\central\db>mpro sports2000 -U superuser@superdomain.s2k.com -P password
```

- Go to the Data Admin Tool
- Admin->Load->Table Contents
- Select all tables to load

```
Command Prompt - mpro sports2000 -U superuser@superdomain.s2k.com -P pa...
Database Schema Admin DataServer Utilities PRO/SQL Tools

Load Data Contents for All Tables

Effective Tenant: Default <Select Tenant...>
Use Default Location: [X] (Tenant data and lobs in subdirectories)
Shared Directory:
Tenant Directory: Default
Include LOB: [X]
Tenant LOB Directory: Default/lobs

Specify an acceptable error percentage. When this limit is reached,
loading will stop. Enter 0 if any error should stop the load; enter
100 if the load should not stop for any error.

Acceptable Error Percentage:

[ ] Output Errors to Screen

<OK> <Cancel>

Enter data or press F4 to end.
```

```
Command Prompt - mpro sports2000 -U superuser@superdomain.s2k.com -P pa...
Database Schema Admin DataServer Utilities PRO/SQL Tools

Load Data Contents for All Tables

Effective Tenant: Default <Select Tenant...>
Select Tenant:
Name      Id ExternalId      Type
-----
Default   0
North     1 ?
South     2 ?

< OK > < Cancel >

Enter data or press F4 to end.
```

```
Command Prompt - mpro sports2000 -U superuser@superdomain.s2k.com -P pa...
Database Schema Admin DataServer Utilities PRO/SQL Tools

Load Data Contents for All Tables

Effective Tenant: North <Select Tenant...>
Use Default Location: [X] (Tenant data and lobs in subdirectories)
Shared Directory: d:\test\mt
Tenant Directory: d:\test\mt\North
Include LOB: [X]
Tenant LOB Directory: d:\test\mt\North\lobs

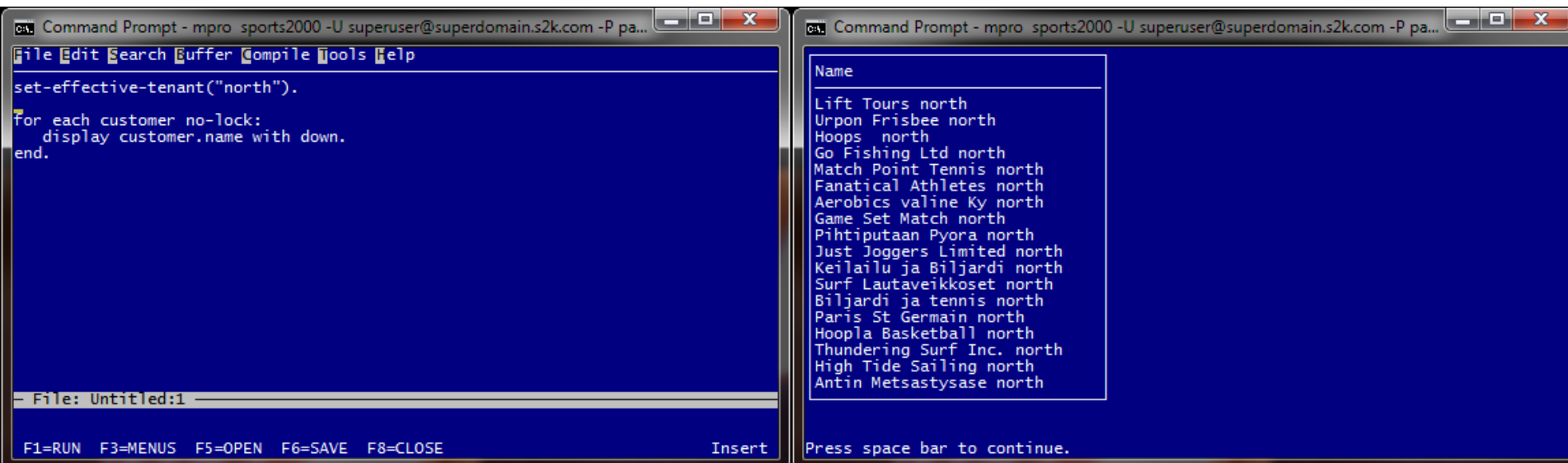
Specify an acceptable error percentage. When this limit is reached,
loading will stop. Enter 0 if any error should stop the load; enter
100 if the load should not stop for any error.

Acceptable Error Percentage:

[ ] Output Errors to Screen

<OK> <Cancel>

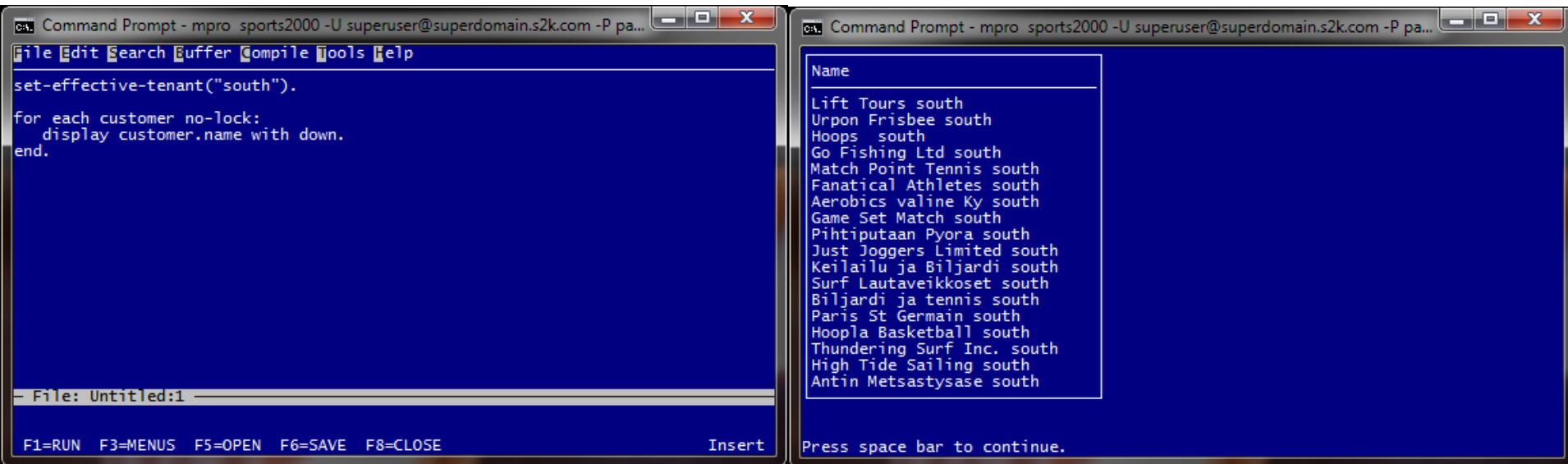
Leave blank for current directory
```



The image shows two side-by-side screenshots of a Command Prompt window. The left window displays a script being executed, and the right window displays the output of that script.

**Left Window:** Command Prompt - mpro\_sports2000 -U superuser@superdomain.s2k.com -P pa...  
File Edit Search Buffer Compile Tools Help  
set-effective-tenant("north").  
for each customer no-lock:  
  display customer.name with down.  
end.  
File: Untitled:1  
F1=RUN F3=MENUS F5=OPEN F6=SAVE F8=CLOSE Insert

**Right Window:** Command Prompt - mpro\_sports2000 -U superuser@superdomain.s2k.com -P pa...  
Name  
Lift Tours north  
Urpon Frisbee north  
Hoops north  
Go Fishing Ltd north  
Match Point Tennis north  
Fanatical Athletes north  
Aerobics valine Ky north  
Game Set Match north  
Pihtiputaan Pyora north  
Just Joggers Limited north  
Keilailu ja Biljardi north  
Surf Lautaveikkoset north  
Biljardi ja tennis north  
Paris St Germain north  
Hoopla Basketball north  
Thundering Surf Inc. north  
High Tide Sailing north  
Antin Metsastysase north  
Press space bar to continue.



```
Command Prompt - mpro_sports2000 -U superuser@superdomain.s2k.com -P pa...
File Edit Search Buffer Compile Tools Help
set-effective-tenant("south").
for each customer no-lock:
  display customer.name with down.
end.
File: Untitled:1
F1=RUN F3=MENUS F5=OPEN F6=SAVE F8=CLOSE Insert
```

```
Command Prompt - mpro_sports2000 -U superuser@superdomain.s2k.com -P pa...
Name
Lift Tours south
Urpon Frisbee south
Hoops south
Go Fishing Ltd south
Match Point Tennis south
Fanatical Athletes south
Aerobics valine Ky south
Game Set Match south
Pihtiputaan Pyora south
Just Joggers Limited south
Keilailu ja Biljardi south
Surf Lautaveikkoset south
Biljardi ja tennis south
Paris St Germain south
Hoopla Basketball south
Thundering Surf Inc. south
High Tide Sailing south
Antin Metsastysase south
Press space bar to continue.
```

# Are we there yet?

And there was great celebration!



# What about...the elephant in the room?

What about  
appservers?



What about  
webservices?



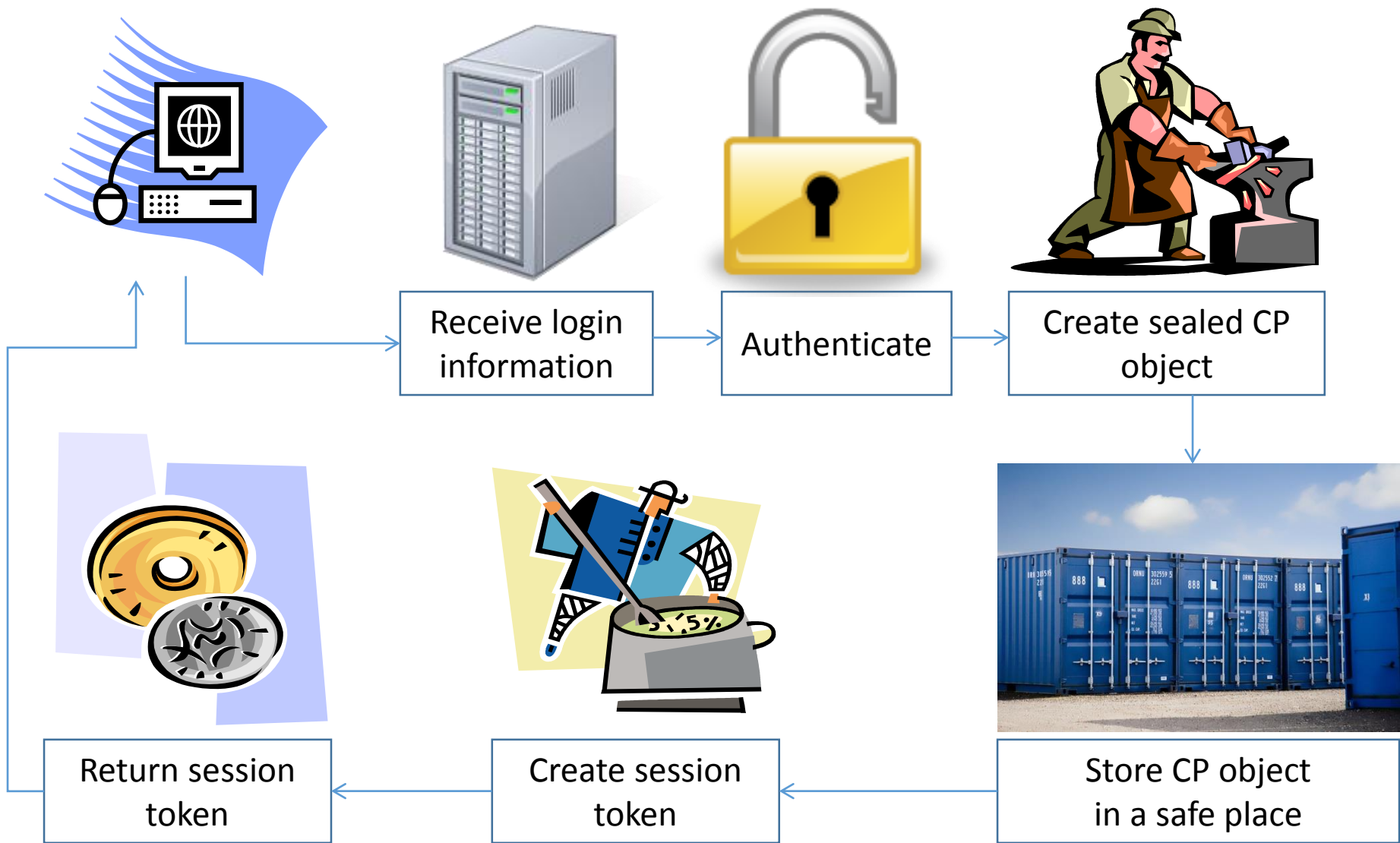
# Client Principal to the Rescue!

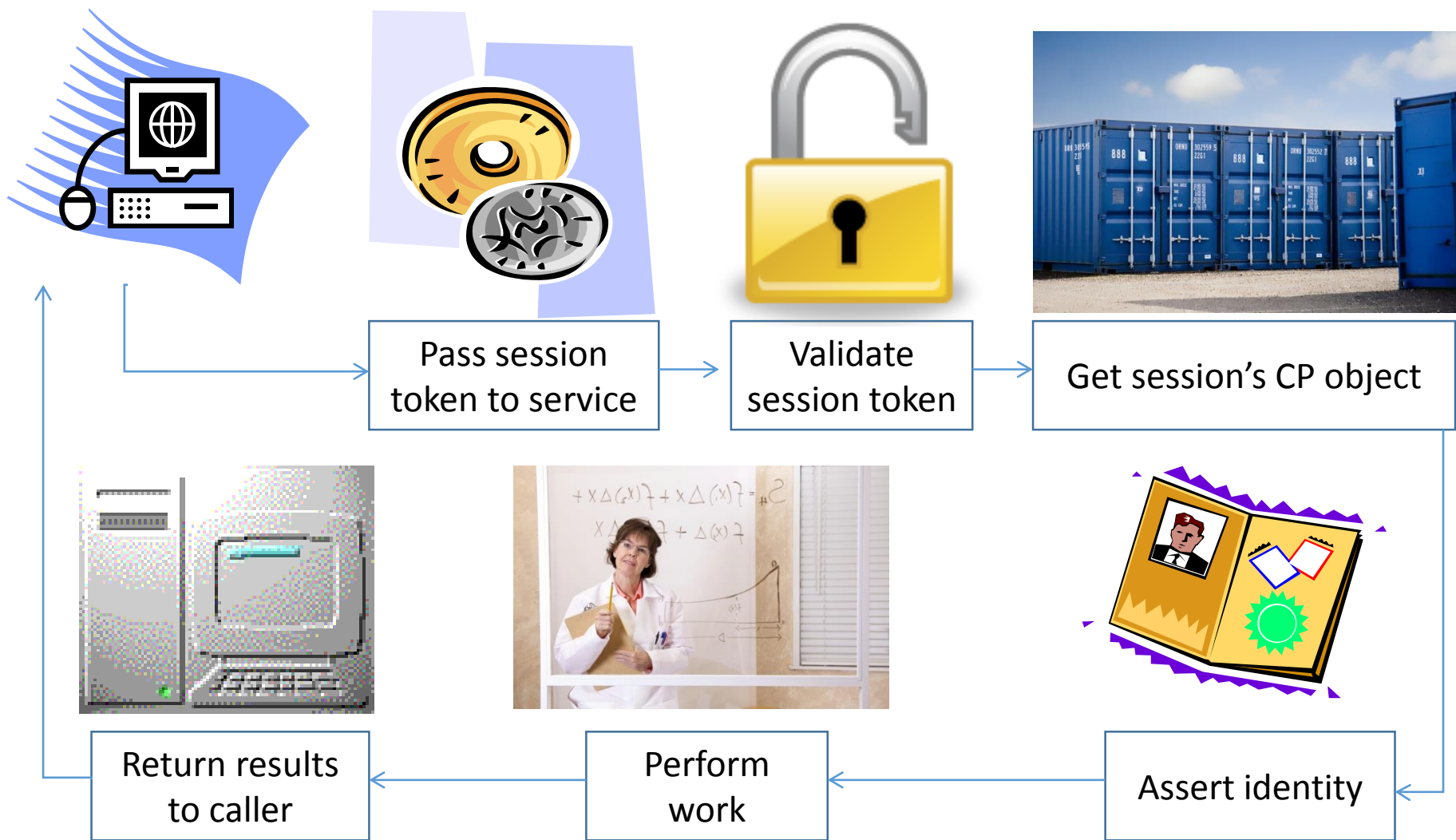
Client-Principal: A security token containing trusted user credentials that establish and track user identity for an ABL session and database connection(s).

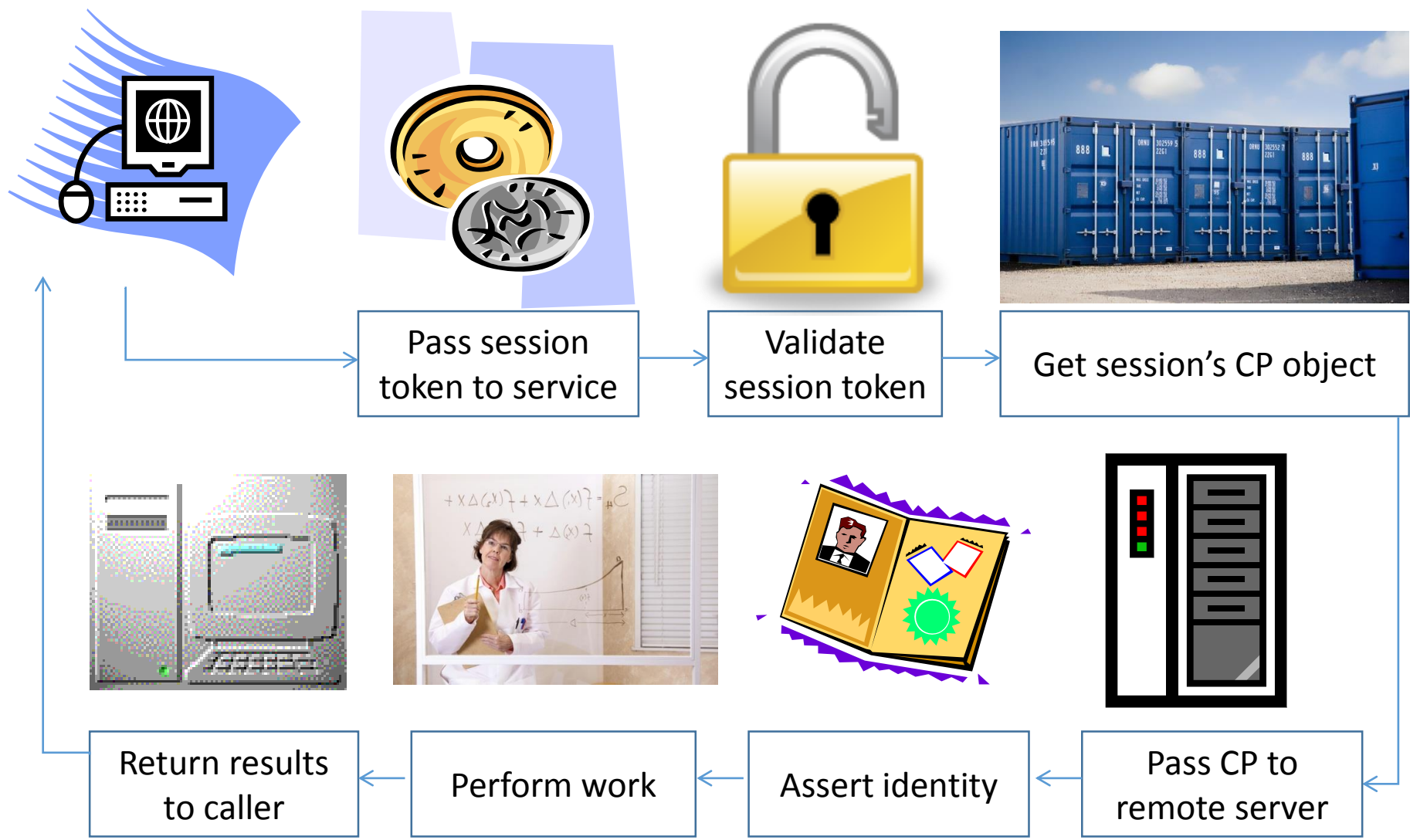
Types of CP objects:

Type	Description
Unsealed	The CP object information has not been authenticated and can be changed. (See the "LOGIN-STATE" attribute for more details)
Sealed	CP object values have been set to authenticate access to the user@domain's tenant, then converted to a tamper-proof token that can't be changed.











Session	Title	Description
198	OO ABL Events	A talk on OO "Events" w/bonus material
206	Migrating to Multi-tenancy	A step-by-step walk-through of merging two Sports2000 databases into a single MultiTenant database.
207	ABL Buffers and Queries in OO Wrappers	A research report on the development of an OO based Data Access layer

# Thank you for your time!

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