BEA TSAM

Plug-in Programming Guide

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Contents

CHAPTER 1

BEA TSAM Agent Plug-in Programming Introduction

This topic contains the following sections:

Overview

The BEA TSAM Agent includes three major layered modules:

- BEA TSAM framework

  The BEA TSAM framework is responsible for Tuxedo system data collection. The collection behavior is controlled by the monitoring types and policies. The gathered metrics are passed to the plug-in using an open interface.

- Plug-in data receiver

  The BEA TSAM Agent ships with a default plug-in. The default plug-in performs event trigger evaluation and sends metrics to LMS

- LMS (local monitor server)

  The LMS synchronizes data with the BEA TSAM Manager.

The BEA TSAM Agent and BEA TSAM Manager provide a complete solution for data collection, aggregation, storage and presentation. To support various requirements for monitoring data usage, the BEA TSAM Agent plug-interface is based on an open architecture so that you can write customized plug-ins to interpret the performance metrics data. The custom plug-ins can

work with the BEA TSAM Agent default plug-in or independently. The custom plug-ins are typically used for:

- Integration with third party management software
- Developing in-house application monitoring suites
- Audit-based application data

CHAPTER 2

BEA TSAM Agent Data Collection Framework

This topic contains the following sections:

Overview

The BEA TSAM Agent enhances Tuxedo infrastructure to collect the performance metrics when TSAM is enabled. The instrument covers the major performance sensitive areas in Tuxedo applications, that is call path stages, services, transactions and system servers. TSAM Agent uses Tuxedo FML32 typed buffer to contain the metrics collected so that each metric is defined as a built-in FML32 field. The monitoring points depend on the monitoring types and only apply to Tuxedo ATMI applications. Listing 2-1 lists the monitoring points.

Table 2-1 Call Path Monitoring Points

Stage	Supported Tuxedo Process Types
Before request message sent to IPC queue	Native Client, Application Server, GWTDOMAN, BRIDGE
Request sent to IPC queue failure	Native Client, Application Server, WSH and JSH

Table 2-1 Call Path Monitoring Points

After request message got from IPC queue	Application Server, GWTDOMAIN
Before reply message sent to IPC queue	Application Server, GWTDOMAIN, BRIDGE
After reply message got from IPC queue	Native Client,Application Server, GWTDOMAIN
Before request message sent to network	GWTDOMAIN
After request message got from network	GWTDOMAIN
Before reply message sent to network	GWTDOMAIN, WSH,JSH
After reply message got from network	GWTDOMAIN

Table 2-2 Service Monitoring Points

Stage	Supported Tuxedo Process Types
After request[1] message got from IPC queue	Application Server, GWTDOMAIN
Before reply message sent to IPC queue	Application Server,GWTDOMAIN

1. Only data collection point, no plug-in invocation

Table 2-3 System Server Monitoring Points

Stage	Supported Tuxedo Process Types
Main Loop[1]	GWTDOMAIN, BRIDGE

1. The metrics are collected internally and this point is to pass the data to plug-in

Table 2-4 Transaction Monitoring Points

Stage	Supported Tuxedo Process Types
Before the[1] transaction routine executed	Native Client, Application Server, TMS, GWTDOMAIN,WSH, JSH, TMQFORWARD
After the transaction routine executed	Native Client, Application Server, TMS, GWTDOMAIN,WSH, JSH, TMQFORWARD

1. Only data collection point, no plug-in invocation

Note: The monitoring point is not necessarily added for all the message processing stages. It depends on the process internal running model. For example, when BRIDGE or WSH receives a message from the IPC queue, the message is forwarded to the network immediately. In this case, there is only one monitoring point (point l).

CHAPTER 3

Creating a BEA TSAM Agent Custom Plug-in

This topic contains the following sections:

Overview

Tuxedo has a built-in plug-in framework that facilitates additional functionality. For example, the Tuxedo security mechanism is constructed on the plug-in framework. Tuxedo defines an i*nterface set* as a contract between a service provider and end user. The term “service” here is used as a general term; not a Tuxedo ATMI service. BEA TSAM Agent also use the Tuxedo plug-in framework to attach different data receivers.

Tuxedo Plug-in Framework Concepts

The following section highlights Tuxedo plug-in framework key concepts.

Interface

An Interface is the contract format between the plug-in implementation and the plug-in caller. An interface requires the following attributes:

- **Interface ID**

  The interface ID is the name of the interface that is uniquely identified in the Tuxedo plug-in framework and uses the following format:

  ```
  <interface id> ::= <component name>[/<sub-component/name>]/<interface name>
  ```

  The BEA TSAM Agent plug-in uses the following format:

  ```
  engine/performance/monitoring
  ```

- **Version**

  An interface has two versions, the major version number and minor version number.

- **Data Structure and Function Declaration**

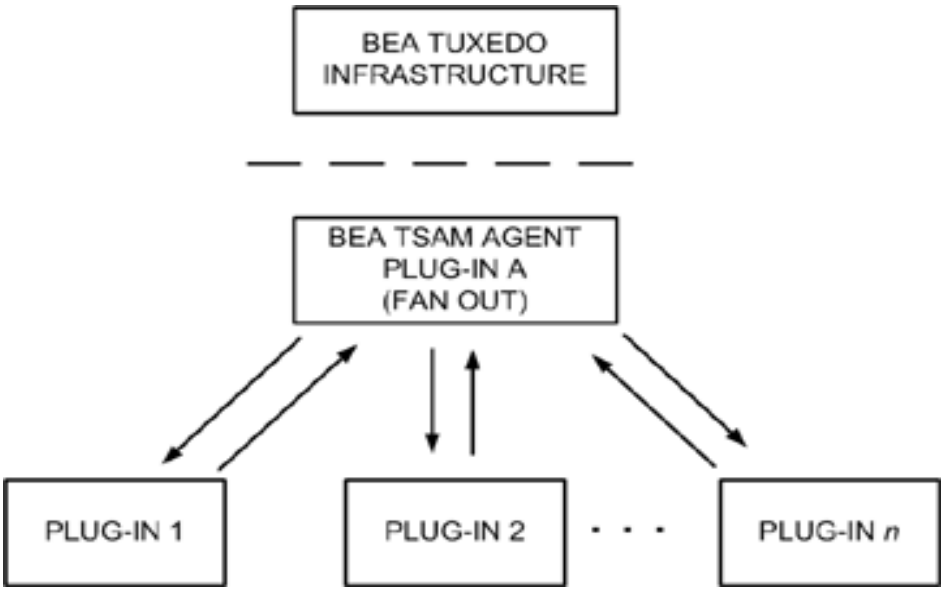
  The data structure defines the concrete information conveyed between plug-in caller and implementation.The function declaration defines the routines must be implemented by plug-in.

Implementation

A plug-in is a dynamic library written in C code. The library implements the methods specified by the interface. The Tuxedo plug-in framework supports multiple implementations (interceptors) for one interface.

Tuxedo supports two types of interceptors: Fan-out interceptors and Stack interceptors. The BEA TSAM Agent uses the Fan-out interceptors. Figure 3-1 displays the BEA TSAM Agent plug-in architecture.

Figure 3-1 BEA TSAM Agent Plug-in Architecture



When the Tuxedo infrastructure invokes plug-in A method X, plug-in A invokes method X of the intercepting plug-ins in the order specified by the `InterceptionSeq` attribute as follows:

- Plug-in method X is invoked
- Plug-in 1 method X is returned
- Plug-in 2 method X is invoked
- Plug-in 2 method X is returned
- Plug-in *n* method X is invoked
- Plug-in *n* method X of is returned

All plug-ins involved in the interceptor implement the same interface. Multiple occurrences of the same plug-in are not allowed in an interception sequence.

BEA TSAM Agent provides the Fan-out plug-in which allows you to write/create an interceptor plug-in.

Plug-in Register/Un-register/Modifications

Once the plug-in written it must be registered in the Tuxedo registry so that the functional components will locate the plug-in and invoke the appropriate methods. Tuxedo provides three commands specifically for plug-in use:

- `epifreg`: registers a plug-in
- `epifunreg`: un-registers a plug-in
- `epifregedt`: edits a plug-in

Developing a BEA TSAM Agent Plug-in

BEA TSAM Agent plug-in invocation begins at the monitoring points. The BEA TSAM Agent collects and computes the metrics, and composes the arguments passed to the plug-in. The BEA TSAM Agent Fan-out plug-in invokes the interceptor plug-in according to the registration sequence.

A simple BEA TSAM custom plug-in development example is provided as a guideline. The system environment is Solaris on Sparc. The functionality is basic and just prints out the metrics buffers. This plug-in works together with the BEA TSAM Agent default plug-in.

1. Create Plug-in Source Code
2. Build the Plug-in
3. Register the Plug-in
4. Enable BEA TSAM Monitoring
5. Run a Call and Check the Standard Output.

Create Plug-in Source Code

Listing 3-1 displays an example of the BEA TSAM plug-in `customplugin.c`.

Listing 3-1 BEA TSAM Agent `customplugin.c` Plug-in Source Code Example

```
#include <e_pif.h>
#include <tpadm.h>
#include <fml32.h>
```

```
#include <e_perf_mon.h>

static TM32I _TMDLLENTRY print_app(
       perf_mon_1 *,
       FBFR32 **,
       MONITORCTL *,
       TM32U);

static TM32I _TMDLLENTRY print_svc(
       perf_mon_1 *,
       FBFR32 **,
       MONITORCTL *,
       TM32U);

static TM32I _TMDLLENTRY print_sys(
       perf_mon_1 *,
       FBFR32 **,
       MONITORCTL *,
       TM32U);

static TM32I _TMDLLENTRY print_tran(
       perf_mon_1 *,
       FBFR32 **,
       MONITORCTL *,
       TM32U);

static TM32I _TMDLLENTRY plugin_destroy (
       _TCADEF,
       const struct _e_pif_instance_handles *,
       TM32U);

static TM32I _TMDLLENTRY plugin_copy (_TCADEF,
       void *,
       const struct _e_pif_interception_data *,
       struct _e_pif_instance_handles *,
       TM32U);

static const perf_mon_1 Vtblperfapp_1 = {
```

```
        print_app,
        print_svc,
        print_sys,
        print_tran,
};

static const _e_pif_plugin_info perf_mon_1_info = {
        { 1, 0 },                          /* interface major version */
        { 1, 0 },                          /* implementation */
        "abc/tuxedo/tsam",/* implementation id */
        ED_PERF_MON_INTF_ID,/* interface id */
        4,                          /* virtual table size */
        "ABC, Inc.",  /* vendor */
        "Custom Plug-in for BEA TSAM", /* product name */
        "1.0",                      /* vendor version */
        EF_PIF_SINGLETON,/* m_flags */
        plugin_destroy,
        plugin_copy
};

int _TMDLLENTRY
plugin_entry(_TCADEF, const char *pIId,
        const char *pImplId,
        const struct _e_pif_iversion *version,
        const struct _e_pif_data *pData,
        const struct _e_pif_interception_data *pInterceptionData,
        struct _e_pif_instance_handles *pI,
        TM32U flags)
{
        const char * const * regData = pData->regdata;
         char *logfile = NULL;

        pI->pVtbl = (void *) &Vtblperfapp_1;
        pI->pPluginInfo = (_e_pif_plugin_info *) &perf_mon_1_info;
        pI->pPrivData = NULL;
return (EE_SUCCESS);
}
```

```
static TM32I _TMDLLENTRY
plugin_destroy (_TCADEF, const struct _e_pif_instance_handles *pIhandles,
       TM32U flags)
{
       return(EE_SUCCESS);
}


static TM32I _TMDLLENTRY
plugin_copy (_TCADEF, void *iP,
       const struct _e_pif_interception_data *pInterceptionData,
       struct _e_pif_instance_handles *pIhandles,
       TM32U flags)
{
       return(EE_SUCCESS);
}
static TM32I _TMDLLENTRY print_app(perf_mon_1 * ip,FBFR32 **buf, MONITORCTL
* monctl, TM32U flags)
{
       Fprint32(*buf);
       return(0);
}

static TM32I _TMDLLENTRY print_svc(perf_mon_1 * ip,FBFR32 **buf, MONITORCTL
* monctl, TM32U flags)
{
       Fprint32(*buf);
       return(0);
}

static TM32I _TMDLLENTRY print_sys(perf_mon_1 * ip,FBFR32 **buf, MONITORCTL
* monctl, TM32U flags)
{
       Fprint32(*buf);
       return(0);
}
static TM32I _TMDLLENTRY print_tran(perf_mon_1 * ip,FBFR32 **buf,
```

```
MONITORCTL * monctl, TM32U flags)
{
       Fprint32(*buf);
       return(0);
}
```

Build the Plug-in

```
cc -c customplugin.c -I$TUXDIR/include
```

```
cc -G -KPIC -o customplugin.so -L$TUXDIR/lib -lfml customplugin.o
```

Register the Plug-in

To register the plug-in, do the following steps:

1. Shutdown your tuxedo application by “tmshutdown”
2. Compose a shell script named “`reg.sh`”
3. Run the script

   ```
   sh ./reg.sh
   ```

4. Boot your Tuxedo applications by "tmboot"

Listing 3-2 displays an example of the `reg.sh` shell script

Listing 3-2 reg.h Shell Script

```
#!/bin/sh
epifreg -r -p abc/tuxedo/tsam -i engine/performance/monitoring \
-o SYSTEM -v 1.0 \
-f $APPDIR/customplugin.so -e plugin_entry
epifregedt -s -k "SYSTEM/impl/bea/performance/monfan" \
-a InterceptionSeq=bea/performance/mongui \
-a InterceptionSeq=abc/tuxedo/tsam \
```

Enable BEA TSAM Monitoring

Enable TSAM Monitoring using the TMMONITOR environment variable: `tmadmin->chmo` or by using the BEA TSAM console

For more information, see the BEA TSAM Administration Guide.

Run a Call and Check the Standard Output.

You will find the metrics collected printed out.

Listing 3-3 displays the metrics print out.

Listing 3-3 Metrics Print Out Example

```
TA_MONDEPTH     1
TA_MONPROCTYPE  2
TA_MONMSGSIZE   6
TA_MONMSGQUEUED 1
TA_MONLASTTIMESEC       1189759850
TA_MONLASTTIMEUSEC      730754
TA_MONSTARTTIMESEC      1189759850
TA_MONSTARTTIMEUSEC     730754
TA_MONCORRID    JOLTDOM:bjsol18:72854 SITE1 client 9597 1 1
TA_MONMSGTYPE   ARQ
TA_MONSTAGE     Q2ME
TA_MONLOCATION  JOLTDOM:bjsol18:72854 SITE1 GROUP2 simpserv 18 9588
TA_MONSVCNAME   TOUPPER
TA_MONHOSTSVC   TOUPPER
TA_MONSVCSEQ    client-TOUPPER-18218-0
TA_MONPSVCSEQ   INITIATOR
TA_MONQID       14441475-00004.00018

TA_MONDEPTH     1
TA_MONPROCTYPE  2
TA_MONMSGSIZE   6
TA_MONLASTTIMESEC       1189759850
TA_MONLASTTIMEUSEC      730754
```

```
TA_MONSTARTTIMESEC      1189759850
TA_MONSTARTTIMEUSEC     730754
TA_MONERRNO     0
TA_MONURCODE    0
TA_MONCORRID    JOLTDOM:bjsol18:72854 SITE1 client 9597 1 1|
TA_MONMSGTYPE   ARP
TA_MONSTAGE     ME2Q
TA_MONLOCATION  JOLTDOM:bjsol18:72854 SITE1 GROUP2 simpserv 18 9588
TA_MONSVCNAME   TOUPPER
TA_MONHOSTSVC   TOUPPER
TA_MONSVCSEQ    client-TOUPPER-18218-0
TA_MONPSVCSEQ   INITIATOR
```

BEA TSAM Agent Plug-in Interface

All BEA TSAM Plug-in interface interface contents are defined in the `$TUXDIR/include/e_perf_mon.h` file. When you build a BEA TSAM Plug-in, this file must be included in your plug-in source code

. The `$TUXDIR/include/e_perf_mon.h` file definitions are as follows:

- Version and Interface Identifier
- Function Table
- Field Map Operation Facility

Version and Interface Identifier

Listing 3-4 provides a version and indentifier example.

Listing 3-4 Version and Interface Identifier

```
#define ED_PERF_MON_MAJOR_VERSION       1
#define ED_PERF_MON_MINOR_VERSION       0
/* Interfaces defined in this module */
#define ED_PERF_MON_INTF_ID "engine/performance/monitoring"
Value Definitions and Data Structure
```

Listing 3-5 displays the BEA TSAM framework and plug-in core data structure.

Listing 3-5 Core Data Structure

```
typedef struct {
unsigned char   fieldsmap[MAXMAPSIZE];
char monitoring_policy[MAXPOLICYLEN]; /* monitor policy of TMMONITOR */
char corr_id[MAXCORRIDLEN]; /* plug-in supplied correlation ID */
int ulen;
void * udata;
long mon_flag;
}  MONITORCTL;
```

Table 3-1 MONITORCTL Members

Members	Description
fieldsmap	Indicates which metrics field is available in the FML32 buffer passed from TSAM framework. Once it receives information from the TSAM Framework, is returns any changed or updated information if the plug-in makes changes to the required fields.
monitoring_policy	Internal use only
corr_id	It is used to bring the corralling ID from plug-in to TSAM framework
ulen	The data length of the application buffer.
udata	The application buffer. It is a typed buffer and only available for call path monitoring and service monitoring. tptypes(5) can be used to check the type and subtype.
mon_flag	The flag set both by TSAM framework and plug-in to indicate the requirement and changes.

Table 3-2 lists the MONITORCTL array sze definitions.

Table 3-4 lists the mon_flag Values.

Table 3-2 MONITORCTL Array Size Definitions

Array	Size Description
/* Size of fieldsmap*/	#define MAXMAPSIZE 128
/* Size of monitoring_policy */	#define MAXPOLICYLEN 128
/* Size of corr_id*/	#define MAXCORRIDLEN 256

Table 3-3 mon_flag Values

Members	Description
#define PI_CORRID_REQUIRED 0x00000001	PI_CORRID_REQUIRED is set by TSAM framework when a call path monitoring is started. It means the plug-in must supply a correlation ID to the framework by the corr_id member of MONITORCTL.
#define PI_EDITABLE_FIELDS 0x00000002 */	PI_EDITABLE_FIELDS is set by TSAM framework when the required fields of TMMONITOR specification is editable by the plug-in.
#define PI_EDITABLE_POLICY 0x00000004	PI_EDITABLE_POLICY internal use only.
#define PI_UPDATED_FIELDS 0x00000008	PI_UPDATED_FIELDS is set by the plug-in if PI_EDITABLE_FIELDS is set by TSAM framework and the plug-in is also changed the required fields by fieldsmap of MONITORCTL. TSAM framework will check this to update the data collection engine.

Table 3-3 mon_flag Values

Members	Description
#define PI_UPDATED_POLICY 0x00000010	PI_UPDATED_POLICY is internal use only.
#define PI_NOCALL 0x00000020	PI_NOCALL is internal use only.

Function Table

Listing 3-6 defines the plug-in implementation methods.

Listing 3-6 Function Table

```
typedef struct perf_mon_1_Vtbl {
       TM32I (_TMDLLENTRY *_ec_perf_mon_app) _((
                        struct perf_mon_1_Vtbl * ip,
                        FBFR32 **buf,
                        MONITORCTL *mon_ctl,
                        TM32U flags
       ));
       TM32I (_TMDLLENTRY *_ec_perf_mon_svc) _((
                        struct perf_mon_1_Vtbl * ip,
                        FBFR32 **buf,
                        MONITORCTL *mon_ctl,
                        TM32U flags
       ));
       TM32I (_TMDLLENTRY *_ec_perf_mon_sys) _((
                        struct perf_mon_1_Vtbl * ip,
                        FBFR32 **buf,
                        MONITORCTL *mon_ctl,
                        TM32U flags
       ));
       TM32I (_TMDLLENTRY *_ec_perf_mon_tran) _((
                        struct perf_mon_1_Vtbl * ip,
```

```
                        FBFR32 **buf,
                        MONITORCTL *mon_ctl,
                        TM32U flags
        ));
} perf_mon_1, *perf_mon_1_ptr;
```

Each method corresponds to a monitoring type. "**_ec_perf_mon_app**" is for call path monitoring, "**_ec_perf_mon_svc"** is for service monitoring, "**_ec_perf_mon_sys"** is for system server monitoring and "**_ec_perf_mon_tran"** is for transaction monitoring. Each method will be invoked at the corresponding monitoring type's monitoring points.The method arguments are:

- `struct perf_mon_1_Vtbl *ip`

  the virtual table pointer of this function table. **Custom plug-in need not handle this**.

- `FBFR32 **buf`

  the address of the metrics buffer in FML32 type.

- `MONITORCTL *mon_ctl`

  the control structure.

- `TM32U flags`

  the bits flag in a 32-byte, unsigned integer.

Field Map Operation Facility

The **fieldsmap** contains the quick reference of which metrics are stored in the **buf** parameter of the interface methods. A set of operation facilities are designed to check/set the **filedsmap** data.

```
#define BASENUM         30002401
```

BASENUM is the base number of TSAM FML32 metrics fields. The performance metrics are defined as Tuxedo built-in FML32 fields which are included `$TUXDIR/include/tpadm.h`.

```
#define IS_FIELDSET(FIELDSMAP, FIELDID)       ( FIELDSMAP[Fldno32(FIELDID)
-  BASENUM ])

#define SET_FIELD(FIELDSMAP, FIELDID)         { FIELDSMAP[Fldno32(FIELDID)
-  BASENUM ] = 1;}

#define UNSET_FIELD(FIELDSMAP, FIELDID)       { FIELDSMAP[Fldno32(FIELDID)
-  BASENUM ] = 0;}
```

IS_FIELDSET is used to determine a field is set or not in a "**fieldsmap**". **SET_FIELD** is used to set a field to a "**fieldsmap**" and **UNSET_FIELD** is to clear a field set in a "**fieldsmap**". These operation facilities can be used in the plug-in if it needs to relay the required field changes to thee BEA TSAM framework.

Other Help Header Files

- `$TUXDIR/include/e_pif.h`

  It is the Tuxedo general plug-in definition file. It must be included in the plug-in source code.

- `$TUXDIR/include/tpadm.h`

  It is the Tuxedo built-in FML32 fields definition files. All performance metrics are defined as FML32 fields.

- `$TUXDIR/include/fml32.h`

  The metrics collected are stored in a Tuxedo FML32 buffer. To access these items, FML32 routines must be used. So the "fml32.h" must be included.

BEA TSAM Agent Plug-in Implementation

BEA TSAM Agent plug-in implementation requires the following steps:

1. Define "perf_mon_1" in the "e_perf_mon.h" Function Table
2. Define the Plug-in Information Variable
3. Write the Plug-in Entry Routine

Define "perf_mon_1" in the "e_perf_mon.h" Function Table

Listing 3-7 shows a `perf_mon_1` defined in the `e_perf_mon.h` function table example.

Listing 3-7 Define a "perf_mon_1" defined in "e_perf_mon.h" Function Table

```
static const perf_mon_1 Vtblperfapp_1 = {
       print_app,
       print_svc,
       print_sys,
```

```
        print_tran,
};
```

Define the Plug-in Information Variable

Listing 3-8 shows how to define the plug-in information variable.

Listing 3-8 Define the Plug-in Information Variable

```
static const _e_pif_plugin_info perf_mon_1_info = {
        { 1, 0 }, /* interface version */
        { 1, 0 }, /* implementation version */
        "abc/tuxedo/tsam", /* implementation id */
        ED_PERF_MON_INTF_ID, /* interface id */
        4, /* virtual table size */
        "ABC, Inc.", /* vendor */
        "Custom Plug-in for BEA TSAM", /* product name */
        "1.0", /* vendor version */
        EF_PIF_SINGLETON,       /* m_flags */
        plugin_destroy,
        plugin_copy
};
```

The changeable members are “implementation version”, “implementation id”, “vendor”, “product name”, “vendor version”. Other items must be kept with same with the sample.

`plugin_destroy` and `plugin_copy` are the general Tuxedo plug-in routines for destroy and copy. For a BEA TSAM Plug-in, you can write two empty functions as shown in Listing 3-9.

Listing 3-9 plugin_destroy and plugin_copy

```
static TM32I _TMDLLENTRY
plugin_destroy (_TCADEF, const struct _e_pif_instance_handles *pIhandles,
TM32U flags)
{
```

```
        return(EE_SUCCESS);
}
static TM32I _TMDLLENTRY
plugin_copy (_TCADEF, void *iP,
        const struct _e_pif_interception_data *pInterceptionData,
        struct _e_pif_instance_handles *pIhandles, TM32U flags)
{
        return(EE_SUCCESS);
}
```

Write the Plug-in Entry Routine

Each plug-in must have an “entry” routine and specified in plug-in registration process. In this routine, the virtual function table and plug-in information structure must be supplied to the plug-in instance handler.

Listing 3-10 displays a plug-in routine example.

Listing 3-10 Plug-in Entry Routine

```
int _TMDLLENTRY
plugin_entry(_TCADEF, const char *pIId,
        const char *pImplId,
        const struct _e_pif_iversion *version,
        const struct _e_pif_data *pData,
        const struct _e_pif_interception_data *pInterceptionData,
        struct _e_pif_instance_handles *pI,
        TM32U flags)
{
const char * const * regData = pData->regdata;
char *logfile = NULL;
        pI->pVtbl = (void *) &Vtblperfapp_1;
        pI->pPluginInfo = (_e_pif_plugin_info *) &perf_mon_1_info;
        pI->pPrivData = NULL;
        return (EE_SUCCESS);
}
```

Note: It is recommends that you t to use the fixed process shown in the sample. The “entry” routine is called only once to instantiate the plug-in.

Writing Concrete Plug-in Implementations

The implementation function table is registered to Tuxedo in the “entry” routine. Then following chapters will focus on how to write TSAM plug-in based on the corresponding monitoring types.

WARNING: Do not make Tuxedo ATMI calls (except for FML32 operations, `tpalloc`/`tprealloc`/`tpfree` and `tptypes`) in the plug-in. It may result un-expected behavior as Tuxedo context may be compromised.

Call Path Monitoring Plug-in Routine

The call path monitoring plug-in routine are invoked at the monitoring points. For more information, see “BEA TSAM Agent Data Collection Framework” on page 2-1

A Basic Implementation

In this example, the routine prints out the passed FML32 buffer:

```
static TM32I _TMDLLENTRY print_app(perf_mon_1 * ip,FBFR32 **buf, MONITORCTL
* monctl, TM32U flags)

{

        Fprint32(*buf);

        return(0);

}
```

Understanding Current Monitoring Points

Call path monitoring is the most comprehensive Tuxedo application interceptor. It provides a variety of metrics for recording and analysis.

- Determine the monitoring stage

  The monitoring stage itself is a metric with the FML32 field name TA_MONSTAGE. Table 3-4 lists TA_MONSTAGE values.

Table 3-4 TA_MONSTAGE Values

Value	Description
STMO	A new call path monitoring is initiated. This is the first record for the current monitored call path.
ME2Q	Before a message is sent to the IPC. It could be a request message or reply message. For the monitoring “initiator”, “STMO” replaces “ME2Q” stage since they are at the same point.
ME2QFAIL	The request message sends a fail to IPC queue. This happens if the “call” fails immediately (there are no service entries, invalid arguments etc.).
Q2ME	Before a message is received from the IPC. It could be a request or reply message
ME2NET	Before a message sent to the network. It only applies to GWTDOMAIN. It could be a request message or reply message.
NET2ME	After a message is received from the network. It only applies to GWTDOMAIN. It could be a request message or reply message.

Listing 3-11 displays a judge monitoring stage example.

Listing 3-11 Judge Monitoring Stage

```
{
       char *stage;
       FLDLEN32 len;
       stage = Ffind32(*obuf, TA_MONSTAGE,0,&len);
       if (stage != NULL ) {
              if (strcmp(stage,”STMO”) == 0 ) {
                     /* ... */
              }else if (strcmp(stage,”Q2ME” == 0 ) {
                     /* ... */
              }
              /* other processment */
```

```
        }
}
```

For “STRING” field type, we recommend to use “Ffind32” routine to get a more fast process.

- Determine the message type

  For an application message transmitted in Tuxedo system, it has two choice, request message or reply message. The field TA_MONMSGTYPE indicates the message type.

Table 3-5 TA_MONMSGTYPE Values

Value	Description
ARQ	Request Message
ARP	Reply Message

- Determine current process location

  The monitoring points always are located in processes of Tuxedo applications. So understand current process is important. TSAM framework uses the field TA_MONLOCATION to tell the plug-in the process location of current monitoring point. The format of TA_MONLOCATION is different for Tuxedo client process and server process. The major goal is to provide enough information to locate the process uniquely in this Tuxedo domain.

Table 3-6 TA_MONLOCATION Format

Format	Description
Client Format	DOMAINID:master hostname:IPCKEY LMID processname processid Example: JOLTDOM:bjsol18:72854 SITE1 client 15391

Table 3-6 TA_MONLOCATION Format

Server Format	DOMAINID:master hostname:IPCKEY LMID group processname serverid processid Example: JOLTDOM:bjsol18:72854 SITE1 GROUP2 simpserv 18 9704
WSH/JSH[1]	DOMAINID:master hostname:IPCKEY LMID group processname processid Example: JOLTDOM:bjsol18:72854 SITE1 JOLTGRP JSH 9904

1. The group of WSH/JSH is the group of its listeners, that is WSL/JSL

Check Commonly Used Metrics

After get the necessary information on the monitoring stage, message type and process location, the next step is to check the common used metrics also carried in the FML32 buffer. The metrics will be available depending on the conditions mentioned above.

Table 3-7 TA_MONLOCATION Format Metrics

Field Name	Type	Description	Stage
TA_MONCORRID	string	The correlation ID of this monitored call path	All
TA_MONMSGSIZE	long	The message size of current message	All[1]
TA_MONMSGQUEUED	long	How many message queued on the server request IPC queue	Request Message Q2ME
TA_MONSTARTTIMESEC	long	The second part of timestamp when this call path monitoring is initiated. It is the number of seconds since epoch.	All
TA_MONSTARTTIMEUSEC	long	The microsecond part of the startup timestamp. It is always with TA_MONSTARTUTIMESEC to provide a more fine-grained time measurement.	All

Table 3-7 TA_MONLOCATION Format Metrics

TA_MONLASTTIMESEC	long	The second part of timestamp when the monitored message entering/leaving a transport. It is the number of seconds since epoch. A transport is the way carrying message, such as IPC queue and network. A typical usage is, • When a request is fetched from IPC queue, the TA_LASTTIMESEC indicates the timestamp when the request message was put into queue. • When a request is fetched from network, the TA_LASTTIMESEC indicates the timestamp when the peer process sent the message to network.	All
TA_MONLASTTIMEUSEC	long	The microsecond part of the last time timestamp. It is always with TA_MONLASTTIMESEC to provide a more fin-grained time measurement.	All
TA_MONLGTRID	string	The GTRID of current monitoring points if the call path involved in transaction.	Monitoring points involved transaction
TA_MONCLTADDR	string	The remote client address. If the monitoring is started from Tuxedo workstation client, WSH, JSH or GWWS, TSAM framework will attach the client ip address and port number to call path information propagation. The format is //ip address:port.	All
TA_MONDEPTH	short	The call path depth. A hop from one service to another is deemed the depth increased one. The start value at the initiator is 0.The detail can be referred at TSAM User Guide.	All
TA_MONERRNO	long	The error number set by Tuxedo infrastructure.	Reply Message
TA_MONURCODE	long	The urcode of tpreturn.	Reply Message

Table 3-7 TA_MONLOCATION Format Metrics

TA_MONSVCNAME	string	The service name of current monitoring points involved. For request message, it is the target service name and for reply message, it is the service which returns the reply.	All
TA_MONHOSTSVC	string	The service name of current service routine	Monitoring points in a application server.
TA_MONCALLFLAG	long	The call flags set in tpcall/tpacall	Request Message ME2Q STMO
TA_MONCALLMODE	short	The call type, 1 - tpacall, 2 - tpcall, 3 - tpforward	Request Message ME2Q STMO
TA_MONQID	string	The request queue id of server which provides current service. Its format is “physical queue key - Tuxedo logic queue name”. For example, 14444547-00004.00018	Request Message Q2ME
TA_MONLDOM	string	The local domain configuration. Its format is ldom:domainid. For example DOM1:FINANCE. The detail information of the “LDOM” and “DOMAINID” can be referred Tuxedo Manual of DMCONFIG.	ME2NET NET2ME
TA_MONRDOM	string	The remote domain configuration. Its format is same with TA_MONLDOM but the values are for remote domain.	ME2NET NET2ME
TA_MONWSENDPOINT	string	The web service end point URL of GWWS.	Reply Message ME2Q

1. For some self-describe buffer types, such as STRING, the size might be zero.

Change Required Fields

BEA TSAM Agent allows to reduce the metrics collected by specifying the required fields of TMMONITOR specification. TMMONITOR syntax consists of t hree parts: monitoring type, monitoring policy and required fields. They are separated by a colon. The usage of monitoring type and policy can be referred at TSAM User Guide. The required fields supported by call path monitoring and service monitoring.

- Call Path Monitoring

  `appfields=field1,field2,field3...`

- Service Monitoring

  `svcfields=field1,field2,field3...`

Note: The required fields option is only for custom plug-ins. It cannot apply to the BEA TSAM default plug-in. If required fields are used, the BEA TSAM default plug-in will not function normally, which means the BEA TSAM Manager cannot function normally. It also means you cannot use the BEA TSAM default plug-in together with custom plug-ins.

Normally, using required fields is not recommended.

The default behavior is all the available metrics are collected by the BEA TSAM framework.

If required fields are specified, only the specified and basic information is available in the metrics buffer.

To enable the TMMONITOR required fields, set TMMONITOR specifications in the environment variable or `tmadmin`. For example:

```
export
TMMONITOR=app::appfields=TA_MONSVCNAME,TA_MONSTAGE,TA_MONLOCATION
```

To change the required fields, the plug-in must see whether the mon_flag of MONITORCTL allows to change it.

```
if (monctl->monflag & PI_EDITABLE_FIELDS ) {
       UNSET_FIELD(monctl->fieldsmap,TA_MONLOCATION);
       SET_FIELD(monctl->fieldsmap,TA_MONMSGSIZE);
       SET_FIELD(monctl->fieldsmap,TA_MONLDOM);
       monctl->monflag |= PI_UPDATED_FIELDS;
}
```

The MONITORCTL monflag must be set to PI_UPDATED_FIELDS to tell the BEA TSAM framework to update the required fields. This change impacts all the monitoring points on the call path.

Generate Call Path Correlation ID

The correlation ID must be given by the plug-in at the monitoring initiating stage, which is the TA_MONSTAGE value is "STMO". The BEA TSAM framework sets PI_CORRID_REQUIRED in the MONITORCTL mon_flag. If no correlation ID is given, an error is reported. The BEA TSAM default plug-in provides the correlation ID also. Two scenarios need to consider,

- Working with the BEA TSAM default plug-in.

  The custom plug-in can skip the correlation ID generation. If the custom plug-in wants to overwrite the correlation ID generated by the BEA TSAM default plug-in, the interceptor sequence of custom plug-in must come after the BEA TSAM default plug-in.

- Working without The BEA TSAM default plug-in

  If the BEA TSAM default plug-in is removed fromthe Tuxedo plug-in framework, the custom plug-in must supply the correlation ID i. For example:

```
if (monctl->mon_flag & PI_CORRID_REQUIRED) {
        strcpy(monctl->corr_id, mygetid());
}
```

"mygetid()" is an assumed ID generation routine. The length of the new ID must not exceed the size of corr_id of MONITORCTL.

To help ID generation, the custom plug-in can use a BEA TSAM framework service to get a correlation ID. Listing 3-12 displays an ID generation example.

Listing 3-12 ID Generation Example

```
extern int _TMDLLENTRY  tmmon_getcorrid(char *obuf, int len);
...
if (monctl->mon_flag & PI_CORRID_REQUIRED) {
        char new_corrid[MAXCORRIDLEN];
        if (tmmon_getcorrid(new_corrid, sizeof(new_corrid)) == 0 ) {
                strpcy(monctl->corr_id,new_corrid);
        }
```

```
}
...
```

Note: When using the correlation ID generation routine of TSAM framework, libtux must be linked with the plug-in.

Service Monitoring Plug-in Routine

Service monitoring is a straightforward procedure. The data collection points are before and after the service routine invocation. The plug-in is invoked only when service execution is completed.

A Basic Implementation

In this example, the routine prints out the passed FML32 buffer:

```
static TM32I _TMDLLENTRY print_svc(perf_mon_1 * ip,FBFR32 **buf, MONITORCTL
* monctl, TM32U flags)
{
        Fprint32(*buf);
        return(0);
}
.
```

Check Commonly Used Metrics

Table 3-8 Service Monitoring Plug-in Routine Metrics

Field Name	Type	Description
TA_MONMSGWAITTIME	long	The request message waiting time in server's request IPC queue before execution. The unit is millisecond. The waiting time is computed in two scenarios, • Call Path Monitoring is enabled for this message. The waiting time is computed by considering the last time stamp of transport to this service. The waiting time is exact. • No Call Path Monitoring is enabled. The waiting time is computed based on average queue length and last service execution time and the dispatching thread number. This is an approximate value. It only applies to a server which provides similar services and the execution time is steady.
TA_MONMSGSIZE	long	The message size of reply message.
TA_MONMSGQUEUED	long	The number of messages queued on the server request IPC queue currently.
TA_MONLASTTIMESEC	long	The number of seconds since epoch when the service begin to execute
TA_MONLASTTIMEUSEC	long	The microsecond seconds since time seconds since epoch. It is used with TA_MONLASTTIMESEC
TA_MONERRNO	long	Tuxedo return error code, that is tperrno
TA_MONURCODE	long	The urcode of tpreturn.
TA_MONEXECTIME	long	The response time in millisecond of current service execution. It is computed by the BEA TSAM framework. Plug-in can also get the current time and the last time timestamp.
TA_MONSVCNAME	string	The service name.
TA_MONLOCATION	string	The process location of current process. It has same meaning in call path monitoring.

System Server Monitoring Plug-in Routine

BEA TSAM supports two Tuxedo built-in servers monitoring, GWTDOMAIN and BRIDGE. The monitoring focus on the throughput, outstanding request number and message number queued on network. The plug-in is invoked periodically by the BEA TSAM framework. The interval is specified by “sysinterval” policy of TMMONITOR specification. Data collection occurs on the on-going server operations.

A Basic Implementation

In this example, the routine prints out the passed FML32 buffer:

```
static TM32I _TMDLLENTRY print_sys(perf_mon_1 * ip,FBFR32 **buf, MONITORCTL
* monctl, TM32U flags)
{
        Fprint32(*buf);
        return(0);
}
```

Check Commonly Used Metrics

Table 3-9 System Server Monitoring Plug-in Routine Metrics

Field Name	Type	Description
TA_MONLOCATION	string	The process location of current process. It has same meaning in call path monitoring.
TA_MONLINKNUM	short	The number of network link connected to current server. If the value is more than 1, then the following statistics data on network link are in FML occurrences style. For example, TA_MONLINKADDR[0] is belong to the first network link, TA_MONLINKADDR[1] is belong to the second network link etc.
TA_MONLINKSTATUS	short	The status of the network link, three possible values, 1 - initialize stage. 0 - connected and is ok. -1 connection lost.

Table 3-9 System Server Monitoring Plug-in Routine Metrics

TA_MONNUMPEND	long	The number of messages queued on network buffer for this network link. The buffer is for Tuxedo network layer instead of system network stack. This is a snapshot value reflecting the number situation when plug-in is invoked.
TA_MONBYTESPEND	long	The number of messages bytes queued on network buffer. It is related with TA_MONNUMPEND but computing the data volume
TA_MONNUMWAITRPLY	long	The outstanding request number on this network link. That means how many request message are waiting for reply. It only applies to GWTDOMAIN. BRIDGE does not support this metric. This is a snapshot value.
TA_MONACCNUM	long	The accumulated message number for this network link between current plug-in invocation and last plug-in invocation which controlled by the “sysinterval” policy. This is a throughput value reflecting the accumulated information between an interval.
TA_MONACCBYTES	long	The accumulated message bytes. It is related TA_MONACCNUM but computing the data volume. This is a throughput value.
TA_MONLINKADDR	string	The link address, for GWTDOMAIN, it is the RDOM defined in UBBCONFIG. For BRIDGE, it is the remote host name.

Transaction Monitoring Plug-in Routine

BEA TSAM also traces critical routines invocation in XA transaction. The scope includes `tpbegin`,`tpcommit`, `tpabort`,xa_xxx calls and GWTDOMAINS transaction routines.

A Basic Implementation

In this example, the routine prints out the passed FML32 buffer:

```
static TM32I _TMDLLENTRY print_tran(perf_mon_1 * ip,FBFR32 **buf,
MONITORCTL * monctl, TM32U flags)

{

        Fprint32(*buf);
```

```
        return(0);
}
```

Check Commonly Used Metrics

Listing 3-10 lists the commonly used transaction monitoring plug-in routine metrics.

Table 3-10 Transaction Monitoring Plug-in Routine Metrics

Field Name	Type	Description
TA_MONXANAME	string	The routine name of a XA transaction, such as “tpbegin”, “xa_commit” etc.
TA_MONXACODE	long	The routine return code
TA_MONEXECTIME	long	The routine execution time in millisecond.
TA_MONRMID	long	The resource manager instance ID. It only applies to xa_xxx calls
TA_MONLGTRID	string	The global transaction ID of current transaction
TA_MONRGTRID	string	The parent transaction’s GTRID. It only applies to GWTDOMAIN when it is a network subordinator.
TA_MONLOCATION	string	The process location of current process. It has same meaning in call path monitoring.

Configure the Plug-in to Tuxedo

Note: The plug-in will run in Tuxedo infrastructure. It must be well tested before configure to Tuxedo production environment.

Register to Tuxedo

Tuxedo uses the `epifreg` command to register the plug-ins to the Tuxedo registry so that the infrastructure can invoke the plug-in at run time. BEA TSAM uses the BEA TSAM framework to invoke the plug-in.

Listing 3-13 shows how the `epifreg` command is used to invoke a plug-in.

Listing 3-13 Using epifreg to Invoke a Plug-in

```
epifreg -r -p abc/tuxedo/tsam -i engine/performance/monitoring \
```

```
          -o SYSTEM -v 1.0 -f /test/abc/customplugin.so -e plugin_entry
epifregedt -s -k "SYSTEM/impl/bea/performance/monfan" \
        -a InterceptionSeq=bea/performance/mongui \
          -a InterceptionSeq=abc/tuxedo/tsam
```

In this, there are two steps required to register the custom plug-in in Tuxedo.

1. Using “epifreg” to register the custom implementation to Tuxedo.
   a. “`-p`” option specifies the implementation id and it must be consistent the value specified in source code.
   b. “`-v`” indicates the version number.
   c. “`-f`” specifies the dynamic library path.
   d. “`-e`” specifies the “entry” routine described in the “General Steps” section.
2. Using “`epifregedt`” to change the fan-out plug-in “`InterceptionSeq`” attribute.

   BEA TSAM supports a Fan-out plug-in mechanism which means multiple plug-ins can work together. BEA TSAM Agent provides the Fan-out plug-in and a default interceptor plug-in. The custom plug-in is an additional interceptor plug-in.

   The “-a `InterceptionSeq=xxx`” option tells the Fan-out plug-in invokes the interceptor plug-in using the specified order. “xxx” is the implementation id. In this example, the Tuxedo default interceptor plug-in implementation ID, “`bea/performance/mongui`”, is invoked before the custom plug-in implementation ID “`abc/tuxedo/tsam`”.
3. If you have multiple custom plug-in developed, you need to register them first with “epifreg”, then modify the invocation sequence with “`epifregedt`” withthe proper “`InterceptionSeq`” sequence.

Un-register from Tuxedo

“`epifunreg`” can be used to un-register a specified plug-in, for example,

```
epifunreg -p abc/tuxedo/tsam
```

After unregistering the custom plug-in, you must use “`epifregedt`” to modify the Fan-out plug-in invocation again based on current available plug-ins. For example:

```
epifregedt -s -k "SYSTEM/impl/bea/performance/monfan" \
```

```
-a InterceptionSeq=bea/performance/mongui
```

Note: It is strongly recommended to register/unregister/modify the plug-in after shutting down a Tuxedo application.

BEA TSAM Agent Plug-in Development/Deployment Notes

- Do not use use Tuxedo ATMI calls in the plug-in except for the FML32 operations `tpalloc`/`tprealloc`/`tpfree` and `tptypes`. The monitoring points are embedded in the Tuxedo communication framework. Embedded ATMI calls may compromise current Tuxedo context.
- You do not need to free FML32 buffers; the BEA TSAM framework will free them. You can add fields as needed. If there is no memory space in the buffer, `tprealloc` must be used to extend the buffer space.

  Note: Changed buffer s are passed to the plug-in invocation sequence that is after the current one.
- If there is any information returned to the TSAM framework, such as new correlation ID and changed required fields, the latest plug-in changesl take effect.
- When using the BEA TSAM default plug-in, do not set required fields using TMMONITOR and the change them in the plug-in.
- Do not change the MONITORCTL udata. It is a read only interception of application messages. Any modification will result un-expected behavior.