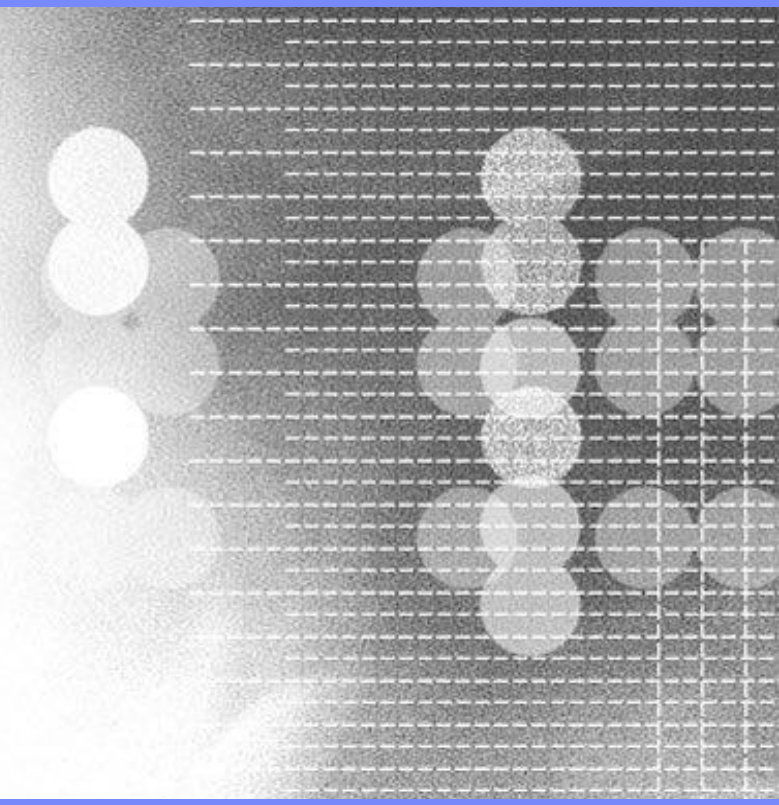
z/TPF EE V1.1
z/TPFDF V1.1
TPF Toolkit for WebSphere® Studio V3
TPF Operations Server V1.2

IBM Software Group

TPF Users Group Fall 2005

z/TPF Programming Model



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Venue : Main Tent

AIM Enterprise Platform Software
IBM z/Transaction Processing Facility Enterprise Edition 1.1.0

Agenda

- z/TPF Programming Model
- z/TPF PUT 01 Enhancements

What is z/TPF Programming Model?

- Large memory areas
- Large programs
- For assembler
  - Subroutines
  - Stack

How does this help you?

- Reduce cost of doing business
  - Improve productivity
    - Less resources required to develop a product
  - Improve quality
    - Less problems means less customer impact
    - Less resources required to correct problems

Large Memory – ECB Private Area

- ECB Private Area
  - Minimum size is 4 meg
  - Maximum size is 16 meg
- Consider: have ECB cache
  - Keep records in private area longer
    - Use DECBs
    - Don’t need to free up ECB data levels
  - Processes which retrieve the same record multiple times
  - Improve performance – less I/O needed

Large Memory - ECB Usage

- Consider: single ECB rather than multiple ECBs to do a task
  - If multiple ECBs are created due to lack of memory per ECB
  - Use DECBs
  - Use parallel I/O
  - Improve productivity - write less code
  - Improve quality – less code means less chance of errors
- Consider: allow ECB to dynamically move between I-Streams
  - Processes which don't use I-Stream unique fields or records (Globals)
  - Improve I-Stream utilization balance

Large Memory – ECB Usage

- Consider: longer running ECBs
  - More tasks can be synchronous
    - Park ECBs
    - Do not need to exit and create new ECBs when response is received
  - Rather than allowing 500 active ECBs, consider 1000 or 2000 or 5000 active ECBs
  - Improve productivity
    - Write less code
    - Easier to write code
      - Stack is maintained
      - ECB is maintained
      - ECB private area is maintained
  - Improve quality
    - Less code means less chance of errors
    - Less complexity means less chance of errors

Large Memory
Use Large Data Structures

- Use files rather than records
  - One API call gets complete file rather than finding many records
- Improves productivity
  - Less code needed
- Improves quality
  - Less code needed means less chance of errors
  - Less complexity means less chance of errors
- On DASD keep large data structures in the File System
  - Use Memory File System (MFS) for temporary files
  - Use Fixed File System (FFS) or Pool File System (PFS) for better performance
    - Data in FFS and PFS is processor unique

Large Memory
Use Large Data Structures

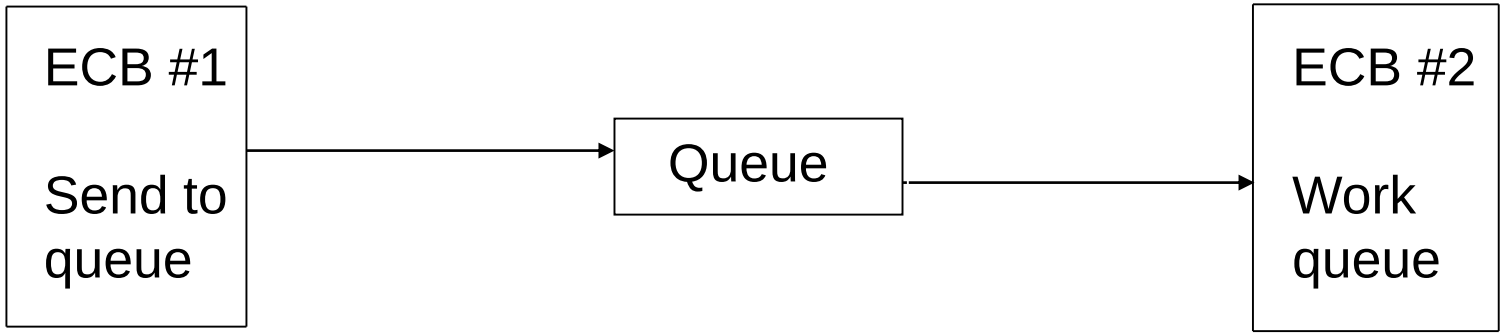
- For ECB unique data structures use ECB Heap
  - Use heap for file system accesses
- Two ECB Heaps
  - 64-bit ECB Heap
    - APIs
      - MALOC, CALOC, RALOC with HEAP=64 in assembler
      - malloc64(), calloc64(), realloc64() in C
  - 31-bit ECB Heap
    - APIs
      - MALOC, CALOC, RALOC with HEAP=31 (default) in assembler
      - malloc(), calloc(), reallloc() in C
    - Consider: 100 meg or 500 meg heap size
    - Consider: many ECBs each using large amounts of Heap
      - 1000 ECBs each using 100 meg = 10 gig

Large Memory
Use Large Data Structures

- For memory resident data use Format 2 Globals
  - Use files rather than 381, 1055, or 4K records
- Format 2 Globals
  - In core data structures
  - Fast access
  - No limits on number and size of globals
  - Easier to use than Format 1 globals in TPF 4.1

Large Memory Trace Log Example

- Trace log writes all ECB trace entries from one ECB to tape or file system.
  - Traced ECB puts trace entries into queue
  - Second ECB works on queue
  - Large memory allows for large amount of data on queue
    - 50 meg / 100 meg / 500 meg
  - Large in core data structure



Large Memory - ECB Trace

- Improve diagnostic capabilities
  - Improve quality – more trace data to help solve problems
- Consider: increase number of trace items per ECB
  - Set to 200, 500, 1000 or more trace items per ECB trace buffer
  - Keep more diagnostic data for every ECB
- Consider: define multiple trace groups
  - Each middleware package to have own trace group
  - For transactions which use services from multiple applications, have one trace group per application

Large Memory ECB Trace Information

- Add free form information to ECB trace
  - Function tpf_trace_info()
  - Up to 80 characters
- Consider: at various points in an application add free form text to trace
  - Can be fixed message – “Routine 1 entered” or “Routine 1 complete”
  - Can be variable message
    - Contents of a register or registers
    - Contents of a work area or a record
      - sprintf() to format line to use
      - WTOPC BUFFA=addr,DISP=NONE to format line in assembler
  - Build into the program design

Large Memory ECB Trace Information

- Always on diagnostics
  - Use in error paths
  - Use to keep track of status
    - In large loop call tpf_trace_info() every 1000 times thru a loop
  - Not good for high frequency mainline paths
    - Performance
    - Usually high frequency routines do not need diagnostics
      - Well tested

Large Programs

- Grow existing assembler programs
  - Keep like function in one program
- No need to split programs
  - Improve productivity
    - Do not need to go through steps to create a new program
- Use:
  - CLINKC
  - Multiple base registers
  - Single base register for first 4K only
    - No base register beyond first 4K
    - Constants in first 4K
  - Baseless program
  - CALLC

Large Programs / Subroutines CLINKC

- Standardized subroutine support for assembler
  - Improve quality – structured linkage reduces errors
- Macros are
  - CLINKC .. Call subroutine
  - SLINKC .. Start subroutine
  - RLINKC .. Return from subroutine
  - ELINKC .. End subroutine
- SLINKC saves registers R0 – R13 on entry
  - R14 is linkage register
  - R15 is pointer to stack
- RLINKC return restores R0 – R13
  - One register can be used to return information
  - Multiple RLNKCs can be coded for each SLINKC

CLINKC - example

```
                    CLINKC RTN=CPSI5000_ECBTRACE    COLLATE it
...
...
...
CPSI5000_ECBTRACE DS 0H
                    SLINKC BASE=R6
...
...
...
                    RLINKC ,                        Return
                    ELINKC
```

Large Programs / Subroutines Use of Relative instructions

- Assembler programs new routines may not need a base register
  - Branch instructions can use:
    - Branch Relative Under Condition - BRU or J
    - Branch Relative and Save - BRAS or JAS
    - Branch Relative Long – BRL
  - Avoid use of literals
    - Use immediate instructions
      - Load halfword immediate – LHI or LGHI
      - Add halfword immediate – AHI or AGHI
      - Multiply halfword immediate – MHI or MGHI
    - Constant handling
      - Use Load Address Relative Long (LARL) to point to constants
      - Put all constants in first 4K of program and use one base register

Branch Relative - example

- Need to insert code, but new code will cause the program to be larger than 4K
  - Instead insert new code at end of the program and jump to it

```
          JAS    R1,CLH1HLDA          GO READ IN KPT A W/ HOLD
...
...
...
CLH1HLDA DS     0H
         GETKC KPT=A,DATA=R7,ERROR=CLH1ER04,HOLD GET KPT A
         BR     R1                            RETURN
```

Large Programs - fork()

- Create a new process or ECB
  - New ECB starts after fork() call
  - New ECB has copy of original ECB:
    - Heap
    - Stack
    - Variables
  - New ECB does not have copy of
    - ECB
    - Traditional ECB private area
- Alternative to traditional TPF create ECB
  - CREMC / CREDC / CREXC / CREEC / SWISC
- Not intended for high frequency mainline paths
  - Copying heap, stack, and variables may be expensive
  - Use in lower frequency routines
- Available in TPF 4.1 and z/TPF
  - Larger memory in z/TPF allows more usage of fork()

fork() – example

```
/*****************************************************/
/* Create a child ECB to calculate inuse count       */
/*****************************************************/
pid = fork();
if ( pid == -1 ) {
   recount_err = TRUE;
   break;
}
else if ( !pid ) {
   /*****************************************************/
   /* It's is the child process here:                   */
   /*****************************************************/
   rc = bbld_recount(ipartOrdinal, lastUtility);
   postc(&eventInf, EVENT_CNT, rc);
   exit(0);
}
else {
   /*****************************************************/
   /* It is the parent process here:                    */
   /*****************************************************/
   evinc(&eventInf);
   ipartOrdinal++;
}  /* end of if-elseif-else */
```

fork() - Benefits

- Keep all code in same program
  - Don’t need to allocate a separate program
- Easy to pass data to child ECB
  - Don’t need to create special interface
    - Don’t need to rely on data in EBW area
    - Don’t need to rely on data level 0
  - Can use existing memory areas in parent ECB to pass data
    - Heap
    - Variables
- Improves productivity
- Improves quality

Large Programs - SWISC IMMEDIATE

- Switch a program to a specified I-Stream
  - Start immediately following the SWISC call
- APIs
  - SWISC TYPE=IMMEDIATE
  - swisc_immediate()
- Benefits
  - Don’t need to call a separate program
  - Keep all of the code in the same program
  - Improve productivity
  - Improve quality
- Consider:
  - fork() followed by swisc_immediate() to load balance new ECBs
  - Use when cycling through all I-Streams

SWISC IMMEDIATE - example

```
            CINFC R,CMMIST,F,REG=R14     I-STREAM STATUS TABLE
            DCTIST REG=R14               MAP I-STREAM TABLE
            XR    R5,R5                  CLEAR THE REGISTER
            ICM   R5,B'0011',ISTACTIS    GET NUMBER OF I-STREAMS
            DROP  R14
            XR    R0,R0                  CLEAR THE REGISTER
            USING DCTPFX,R0              PREFIXED PAGE
CVMNPFX1    DS    0H
            SWISC TYPE=IMMEDIATE,IS=R5   CHANGE I-STREAM
            ALG   R4,PFX2ILCTR           ADD VALUE TO IL CTR
            STG   R4,PFX2DLTHV           STORE NEW THRESHOLD
            BCT   R5,CVMNPFX1            LOOP FOR EACH I-STREAM
```

Large Programs / Subroutines Service Routines in Program

- Move macro service routines into program
  - Inline
  - Call routine in program
- Several IBM service routines are in FINIS
  - ALASC
  - CALLC
  - ENTxC (partial)
  - FLIPC
  - GLOBLC
- Improve performance
  - Reduce linkage costs

FLIPC - example

```
          FLIPC D0,DA                    ENSURE LEVEL 0 AVAILABLE
+         BRAS  R14,FLIPCDAD0
.....
+*-------------------------------------------------*
+*  FLIPC stub code.                               *
+*-------------------------------------------------*
+FLIPCDAD0  DS 0H
+         XC    CE1FAA(CE1FA1-CE1FA0),CE1FA0
+         XC    CE1FA0(CE1FA1-CE1FA0),CE1FAA
+         XC    CE1FAA(CE1FA1-CE1FA0),CE1FA0
+         XC    CE1CRA(CE1CR1-CE1CR0),CE1CR0
+         XC    CE1CR0(CE1CR1-CE1CR0),CE1CRA
+         XC    CE1CRA(CE1CR1-CE1CR0),CE1CR0
+         XC    CE1FXA(CE1FX1-CE1FX0),CE1FX0
+         XC    CE1FX0(CE1FX1-CE1FX0),CE1FXA
+         XC    CE1FXA(CE1FX1-CE1FX0),CE1FX0
+         XC    CE1SUD+10(1),CE1SUD+0
+         XC    CE1SUD+0(1),CE1SUD+10
+         XC    CE1SUD+10(1),CE1SUD+0
+         BR    R14
```

Subroutines - CALLC

- Ability to call a C function from assembler
  - Interface for legacy assembler to use C
- Ability to write a routine once and call regardless of programming language
    - Improves productivity
    - Improves quality
- Infrastructure to allow migration of applications from assembler to C
- Consider:
  - If a program needs to be split, write new support in C and use CALLC
  - If a common routine, write in C and have assembler macro do setup and CALLC
    - IBM GETKC macro does this

CALLC - example

```
         LG    R2,EBW008              Item pointer array
         LG    R4,EBW016              nbr of items to be collated
         LG    R5,EBW000              ptr to COOLL structure
*
*  Define prototype for tpf_collate_trace_items() function
*
         CPROC RETURN=i,tpf_collate_trace_items,(p,p,i)
*
         CALLC tpf_collate_trace_items(R5,R2,R4)
         LGR   R0,R15
```

CALLC – example in macro

```
          MACRO ,
&LABEL    RELKC &KPT=,&PROC=
....

          J     RELKCC&SYSNDX
          DS    0F
RELKCO&SYSNDX DC H'0'
              DC B'00000000'
              DC B'000&O(5)0000'
RELKCK&SYSNDX DC C'&KPT'
RELKCC&SYSNDX DS 0H
          CPROC RETURN=i,tpf_relkc,(c,i,i)
          LARL  R14,RELKCO&SYSNDX
          PUSH  USING
          USING RELKCO&SYSNDX,R14
          CALLC tpf_relkc(RELKCK&SYSNDX,RELKCO&SYSNDX,&PARM1)
```

Shared functions

- Can use in TPF 4.1 and z/TPF
- Easier to use in z/TPF
  - Creation
    - Library interface script is not needed
    - No need to run LIBI
  - Build
    - maketpf provides simple easy to use interface
  - No limits on library functions
    - TPF 4.1 limited to 1024 libraries
    - TPF 4.1 limited to 1024 functions per library
  - Improved debug capability
    - C function trace
    - Messages and trace includes module name, object name, and trace name
  - Improved performance over TPF 4.1 DLLs

Shared Functions - Examples

- Library CVV0 – alter core, display core
  - Collection of C functions used to alter and display core memory
    - acor_proc()
    - dcor_proc()
    - Contains 33 functions
  - Users
    - acor_proc() called by
      - ZACOR / ZADCA / ZACNF / ZAGBL
    - dcor_proc() called by
      - ZDCOR / ZDDCA / ZDCNF / ZDGBL

Shared Functions - Examples

- Library CVBV – disassembler
  - CVBV_Disassemble()
  - Contains 9 functions
- Users
  - Library CVV0
    - All of the users of CVV0
  - Debugger – CUDA
  - ZDPGM - CVBN

Shared Functions – Example makefile

```
#  DESCRIPTION.....  ALTER and DISPLAY package
APP := CVV0
APP_EXPORT := ALL

# External LIB References
LIBS := CVBV
LIBS += CNG0

# Environments needed for build
maketpf_env := base_rt
maketpf_env += system

# C segments
C_SRC := cvv0.c
CXX_SRC := cvv0f1.cpp

# Assembler segments
ASM_SRC := cvv0f2.asm
ASM_SRC += cvv1f1.asm

# Include maketpf build rules
include maketpf.rules
```

Shared Functions – Example makefile

```
##############################################################
# DESCRIPTION.. This is the makefile for ZDCOR               #
##############################################################
APP := CVV1
APP_ENTRY := CVV1
APP_EXPORT := ENTRY

# External LIB References
LIBS := CVV0

# Environments needed for build
maketpf_env := base_rt

# C segments
C_SRC := cvv1.c

# Include maketpf build rules
include maketpf.rules
```

Shared Functions - Benefits

- Write code once, use multiple times
  - Improves productivity
  - Improves quality
  - Reduces total cost to test
- Use of C functions provides well known standard interface which is highly flexible
  - Improves quality
- Migration from 31-bit to 64-bit is easier

Stack

- Available to all programs including assembler
- Ability to dynamically allocate more space on Stack
  - ALLOC in assembler
  - alloca() in C
- Consider:
  - Variables on the stack rather than in ECB
    - Handle variables in assembler like variables in C
    - Easier to make programs iterable
  - Save registers on stack rather than in ECB
  - Improve quality – work area is only used for this invocation of this ECB
    - Strong benefit when changing legacy assembler programs

Storage Protect Override

- Ability to write into Key 1 and Key 9 storage
  - Key 1 storage = ECB private area
  - Key 9 protected areas
    - Globals
    - Newly obtained system heap
- Use when updating protected areas and stack, ECB, or other parts of the private area
- APIs
  - GLMOD OVERRIDE=YES
  - KEYCC OVERRIDE=YES
  - tpf_stpoc()
- Cannot give up control when storage protect override is active
  - SERRC E,06401A
- Improve productivity
  - Less restrictions means less code is needed

tpf_stpoc() - example

```
 tpf_stpoc(TPF_STPOC_ON,NULL);
/*****************************************************************/
/*  Get lock for the queue and get the first entry.              */
/*****************************************************************/
   lockc(&(queue->itrqlock),LOCK_O_SPIN);

   data_blk=ctlg_Get_Next();
/*****************************************************************/
/*  Now that we have the block we unlock the queue.              */
/*****************************************************************/
   unlkc(&(queue->itrqlock));
/*****************************************************************/
/*  Turn on storage protection override.                         */
/*****************************************************************/
   tpf_stpoc(TPF_STPOC_OFF,NULL);
```

C Environment

- C environment exists for every ECB
  - No startup costs on enter to first C program
- Consider: write short lived highly accessed programs in C
  - Improve productivity – use high level language
  - Improve quality – use high level language

Other Enhancements

- ENTRC PRGM,SAVEREGS=YES
  - Saves R0 – R8 before PRGM is entered.
  - Restores R0 – R8 on return
  - Improves quality – data in registers are known

```
          TM     FM_AIB,AIB_UEXT      Is user exit active?
          BNO    NO_EXIT              No, continue
          ENTRC  UMEX,SAVEREGS=YES    Call user exit
NO_EXIT   DS     0H
```

Other Enhancements

- Extended Register Save
  - Ability to save / restore R10, R11, R12, R13 across general macros
    - Use more registers
  - BEGIN EREGSAVE=YES
    - Enables support in entire program
  - DEFBC EREGSAVE=YES
    - Enables support for a part of the program
  - Improves productivity – allows more registers to use

Other Enhancements

- Tag an ECB Heap buffer
  - To tag an ECB Heap buffer
    - tpf_eheap_tag()
    - EHEAPC FUNC=TAG,TAG=,ADDR=
  - Locate a tagged ECB Heap buffer
    - tpf_eheap_locate()
    - EHEAPC FUNC=LOCATE,TAG=,ADDR=
  - Improve productivity – write less code to keep track of ECB Heap buffers

DECB

- Exists in TPF 4.1 and z/TPF
- Must use for I/O with 8-byte file addresses
- Can be used for I/O with 4-byte file addresses
- Use when more than 16 ECB data levels are needed
- Use in commonly accessed utilities that do I/O
  - Alternative to DETAC / ATTAC
  - Do not need to determine whether an ECB data level is in use
    - Allocate a new DECB when needed
- Improve quality
  - Do not need to manage multiple uses of a specific ECB data level
  - Separate DECBs for each function

Performance Concerns

- Not all features are best for use in high frequency mainline routines
  - TPF File System (TFS)
    - FFS / MFS / PFS are reasonable to use in high frequency mainline routines
  - fork()
  - tpf_trace_info()
- In the lab we have experienced:
  - Most programs are not executed with high frequency
    - Consider using these features to improve productivity
  - Most development is not in high frequency routines
    - Commands
    - Error routines
    - Supporting functions
- If true in your environment, consider using these features

z/TPF PUT 01 Enhancements

- PJ30297 Short term pool logging
- PJ30422 Input list bypass
- Available now on the web

z/TPF Diagnostics

- Education session on Wednesday 10/19/2005
  - An Introduction to Dump and Trace Analysis on z/TPF
    - By Allan Feldman
    - Please bring your laptops
    - Please bring USB memory sticks which will be given out at the IBM hospitality suite Monday evening.

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