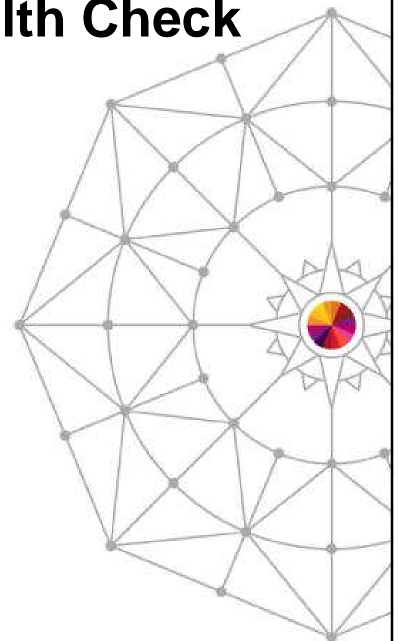
Write a Dynamic Severity Health Check and Avoid Assembler



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(presented by Marna Walle)

March 10th, 2014
Session 15291

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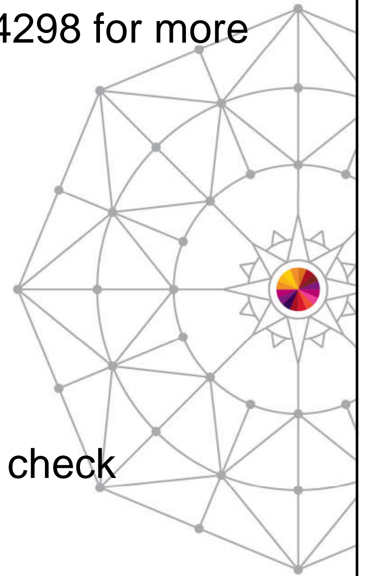
- The term Health Checker is used as short form of “IBM Health Checker for z/OS” in this presentation.
- The term “health check” or just “check” is used as short form of “health check for the IBM Health Checker for z/OS” in this presentation.

Agenda

- **Part 1:** Brief introduction (see recent session #14298 for more details)
  - Health Checker and health checks
  - Check exceptions
  - Check exception severity
  - Dynamic severity
  - Check implementation languages
- **Part 2:** Walkthrough for a fully functional sample check
  - for a “resource X”,
  - using dynamic severity,
  - written in METAL C.



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Health Checker in z/OS

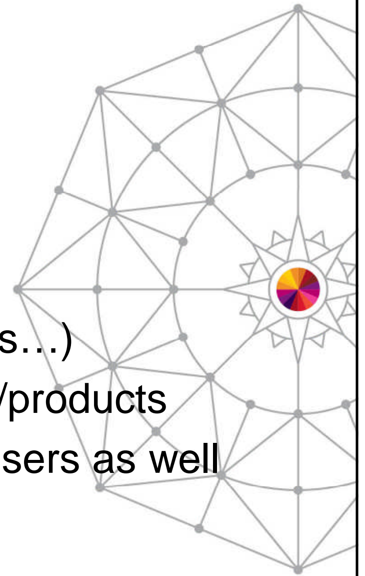
- A component of MVS that identifies potential problems before they impact your system's availability or, in worst cases, cause outages

- Inspects active z/OS and sysplex settings and definitions
  - for deviations from best practices
  - for getting close to critical thresholds
  - for recommended and required migration actions

- Informs the system programmer via detailed messages

Health Checker vs. health checks

- One "Health Checker" framework
  - backed by system address space, HZSPROC
- Many health checks
  - Framework "plug-ins"
  - Do the actual "checking" (inspection of settings…)
  - Owned by separate/independent components/products
  - Not just from IBM (~200), but from ISVs and users as well



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Check exceptions

- System programmer gets alerted via check exceptions
  - Summary text via WTO on console

```
*SY40 *HZS0003E CHECK(IBMXCF,XCF_CDS_SPOF):
*IXCH0242E One or more couple data sets have a single point of failure.
```

  - Details in check's message buffer

```
…
IOSPF252I Volumes CPLPKP (0485) and CPLPKA (0487) share the
same physical control unit.
…
* High Severity Exception *

IXCH0242E One or more couple data sets have a single point of failure.

  Explanation:  The couple data set configuration has one or more single
    points of failure.  A failure at one of these points could result in
    loss of a couple data set, system, or even the entire sysplex.
…
```


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Check exception severity

- Each exception has severity associated with it
  - HIGH, MEDIUM, LOW… based on urgency to fix
  - Default severity defined at ADD CHECK time
- Different severity, different exception message ID
  - HZS0003E – HIGH
  - HZS0002E – MEDIUM
  - HZS0001I – LOW
- Multiline, with automation friendly generic message first

```
*SY40 *HZS0003E CHECK(IBMXCF,XCF_CDS_SPOF):
*IXCH0242E One or more couple data sets have a single point of failure.
```


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Dynamic severity

- Allows check routine to adjust severity at run time
  - Available in z/OS V1R13 and higher
- For "dynamic" settings, like thresholds, limits, …
  - vs. "fixed", on/off, … type settings
- Check typically supports check parameters to associate different thresholds with different severities

```
CHECK(IBMVSM,VSM_CSA_THRESHOLD)
PARM('CSA_HIGH(95%),CSA_MED(80%),CSA_LOW(60%),ECSA_HIGH(90%)
   ,ECSA_MED(70%)')
```


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Dynamic severity…

- Needs to be explicitly enabled and exploited…
  - On ADD CHECK via ALLOWDYNSEV(YES)
  - In check routine, via new SEVERITY parameter of message service HZSFMSG:

```
HZSFMSG REQUEST={CHECKMSG|DIRECTMSG} ...

       |-- SEVERITY = SYSTEM
...--|----------------------------------------------
       |-- SEVERITY = NONE
       |-- SEVERITY = LOW
       |-- SEVERITY = MED
       |-- SEVERITY = HI
       |-- SEVERITY = VALUE , SEVERITYVAL = severityval
```

For pre-R13 compatibility and ALLOWDYNSEV(NO)

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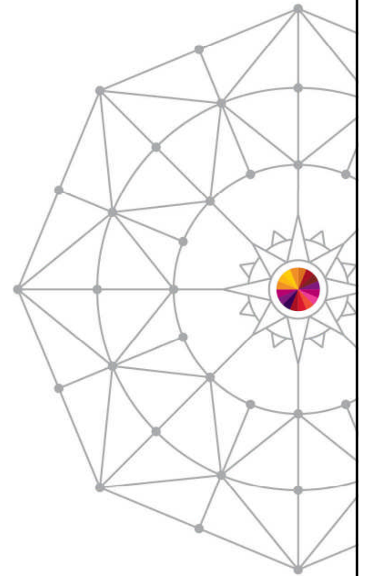
Dynamic severity…

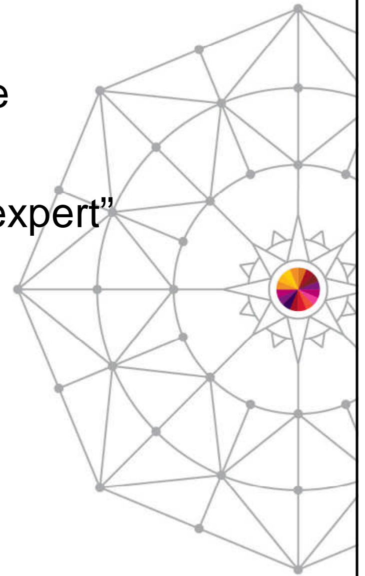
- More IBM health checks are exploiting it
  - For example:
    (IBMASM,ASM_PLPA_COMMON_SIZE)
    (IBMASM,ASM_PLPA_COMMON_USAGE)
    (IBMASM,ASM_LOCAL_SLOT_USAGE)
    (IBMVSM,VSM_CSA_THRESHOLD)
    (IBMVSM,VSM_SQA_THRESHOLD)
    …now optionally support dynamic severity



Check implementation languages

- High Level Assembler (HLASM)
  - First available check implementation language
  - Best performance, finest control
  - “hardest” language, unless Assembler/MVS “expert”

- PLX (IBM only)
  - “real” high-level language, less error prone
  - Good performance



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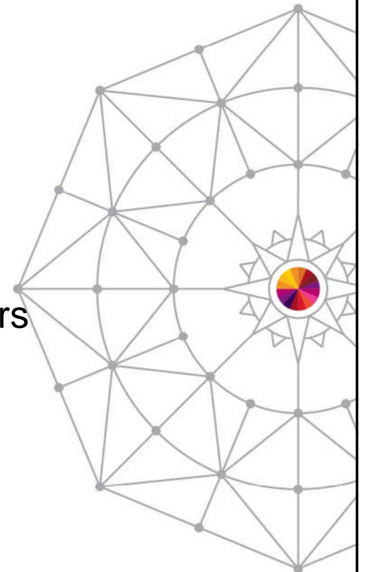
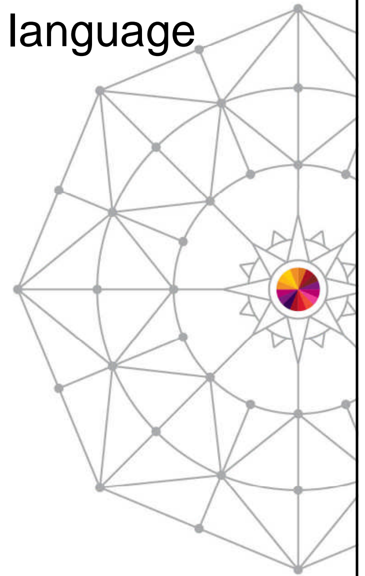
Implementation languages…

- (METAL-) C
  - “real” high level language, less error prone
  - Good performance
  - Health Checker services accessed via embedded Assembler (__asm)
    - But HC data structures fully mapped in C headers
- System REXX
  - “Easiest” language
  - “Simple” protocol with Health Checker
  - Performance can be optimized by compiling the REXX exec



Implementation languages…

- Regardless of chosen check implementation language
  - No apparent difference for end-user
  - All follow the same “protocol”
  - Use the same services
    - Some services provided via wrappers for convenience (REXX)



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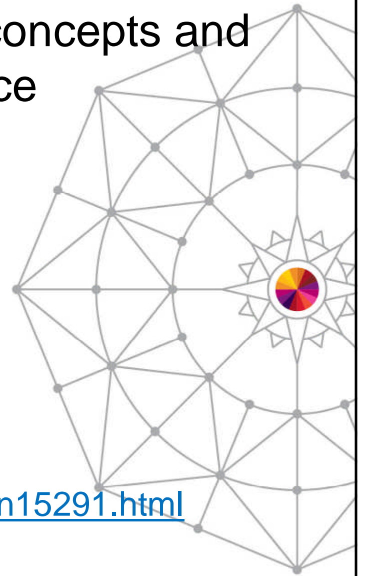
Part 2: Sample health check

- Will visit and reiterate general health check concepts and dynamic severity while walking through source

- Full source code available on SHARE site
  - Check routine source
  - JCL script to build check routine
  - HZSPRMxx parmlib member to ADD

  https://share.confex.com/share/122/webprogram/Session15291.html



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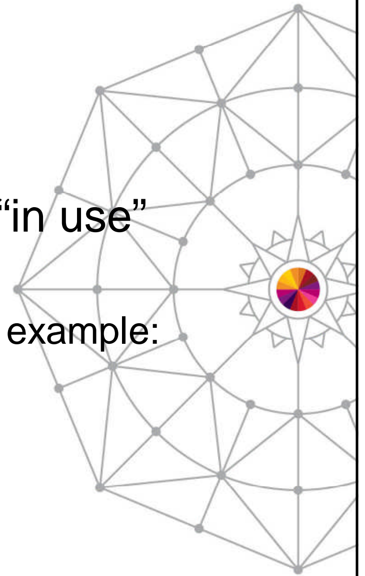
Check purpose

- Check is for single system resource (“X”)
  - For example a certain, “rare” memory type

- Check warns about near “exhaustion” / high “in use”
  - With increasing urgency / severity
    - Customizable via THRESHOLD parameters, for example:

```
PARM('THRESHOLD_HIGH(85%)'
      'THRESHOLD_MED(75%)'
      'THRESHOLD_LOW(60%)')
```



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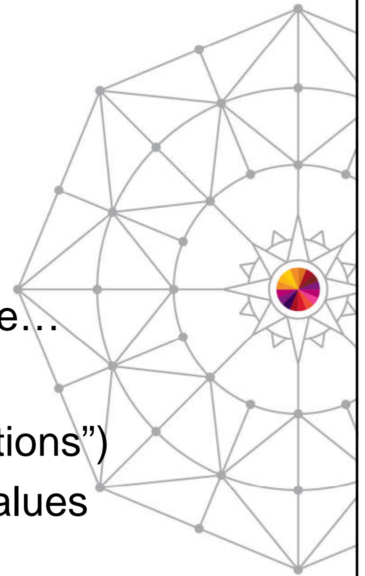
Mainline

```
int main(HZSPQE* pPQE)
{
 tSeverityThresholds *pSevThresholds =
         (tSeverityThresholds *) &(pPQE->ChkWork);

 switch(pPQE->Function_Code)
 {
      case HZSPQE_Function_Code_Init:
         SetDefaultSevThresholds(pSevThresholds);
      break;

      case HZSPQE_Function_Code_Check:
      {
        if (pPQE->LookAtParms)
        {
            if (RC_OK != ParseParmString(pPQE->ParmLen
                                        ,pPQE->ParmArea
                                        ,pSevThresholds))
                goto endMain;
        }

        uint8_t curLevel = getCurrentResourceLevel(pPQE->Check_Count);

        CompareCurrentVsThresholdsAndReport(curLevel,pSevThresholds);
      }
      break;
 }

 endMain:
  /* chance to cleanup temporary resources... */

 return 0; /* Failures should be reported through HZSFMSG */
}
```

Mainline – HZSPQE

```
int main(HZSPQE* pPQE)
{
 tSeverityThresholds *pSevThresholds =
          (tSeverityThresholds *) &(pPQE->ChkWork);
```

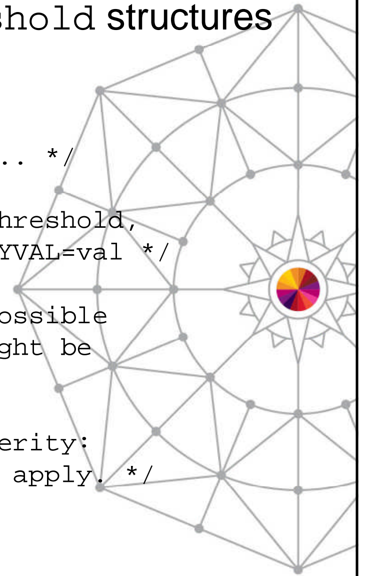
- HZSPQE is the “check control block”
  - Contains all kinds of check attributes and more…
- Includes a 2K work area
  - Preserved between check calls (“runs” / “iterations”)
  - Good spot to save current check parameter values



Mainline – Check parameters

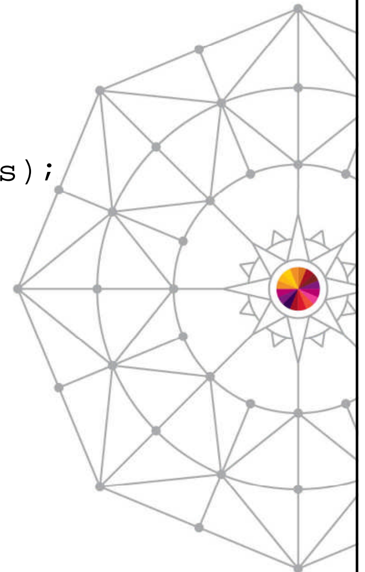
- Mapped as 4-element array of `tOneSeverityThreshold` structures

```
typedef struct
{
    /* const */ char parmName[16]; /* "THRESHOLD_HIGH  ", ... */

    /* const */ uint8_t severityVal; /* Severity for this threshold,
                         ready to use for HZSFMSG ... SEVERITYVAL=val */

    uint8_t isActive; /* We always keep track of all four possible
                         parameters, but not all of them might be
                         "active" / are actually used. */

    uint8_t minPercent; /* The threshold value for this severity:
                           Lower limit for this severity to apply. */

    uint8_t _align;
} tOneSeverityThreshold;

typedef tOneSeverityThreshold tSeverityThresholds[THRESHOLD_COUNT];
```



Mainline – Function code

```
switch(pPQE->Function_Code)
 {
      case HZSPQE_Function_Code_Init:
         SetDefaultSevThresholds(pSevThresholds);
      break;
```



- Tells the check what to do when called by Health Checker framework
  - For example: Chance to initialize, once, before very first "real" check run

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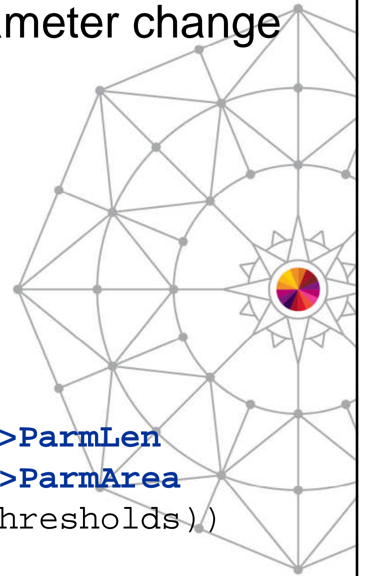
Mainline – Function code…

- Main, "run" code also gets indication for parameter change / first time…



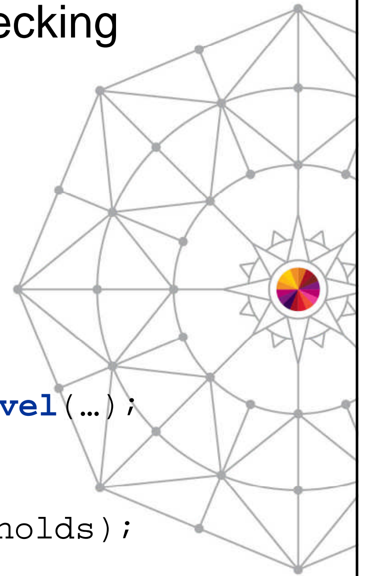
```
switch(pPQE->Function_Code)
{
 …
     case HZSPQE_Function_Code_Check:
     {
       if (pPQE->LookAtParms)
       {
           if (RC_OK != ParseParmString(pPQE->ParmLen
                                        ,pPQE->ParmArea
                                        ,pSevThresholds))
               goto endMain;
       }
```

Mainline – Function code…

- … and of course to actually “run” / do the checking

```
switch(pPQE->Function_Code)
{
  …
     case HZSPQE_Function_Code_Check:
     {
       if (pPQE->LookAtParms)
         …
       uint8_t curLevel = getCurrentResourceLevel(…);

       CompareCurrentVsThresholdsAndReport
                                   (curLevel,pSevThresholds);
     }
```



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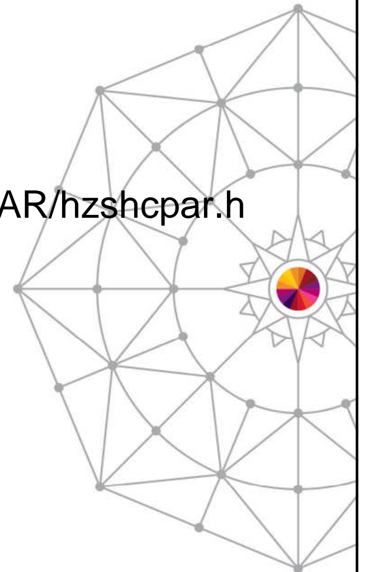
Details – Parameter Parsing

- Check gets reference to PARM string
  - As specified on ADD CHECK or UPDATE CHECK
  - Via HZSPQE fields (PQE_)ParmLen, (PQE_)ParmArea

- Health Checker offers parsing service HZSCPARS
  - Supports keyword+value or positional parameters
  - Supports parameter existence check
  - Supports parameter format check (numeric, percent,…)
  - Supports check for unsupported parameters

Details – Typical use of HZSCPARS

1. HZSCPARS REQUEST=PARSE
   - Tokenize the PARM string
   - Return reference to internal control block
     - Individual sub structures mapped by HZSZCPAR/hzshcpar.h



2. HZSCPARS REQUEST=CHECKPARM
   - Check existence of single parameter
   - Validate key+value vs. positional format
   - Validate number of allowed values
   - Return reference to first value control block

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Details – Typical use of HZSCPARS…

3. HZSCPARS REQUEST={CHECKDEC|CHECKHEX|CHECKCHAR}
   - For individual values of single parameters
   - Validate valid numeric value/text-length range and format
   - Returns reference to info area with binary numeric value…

4. HZSCPARS REQUEST=FREE
   - Release internal parsing control block from step 1.
     - After done with all parameters and values (steps 2./3.)

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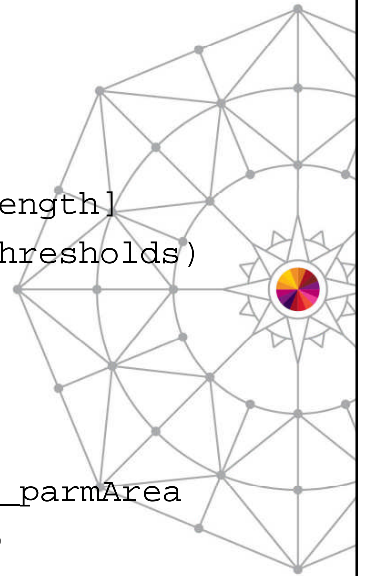
Details – Function ParseParmString

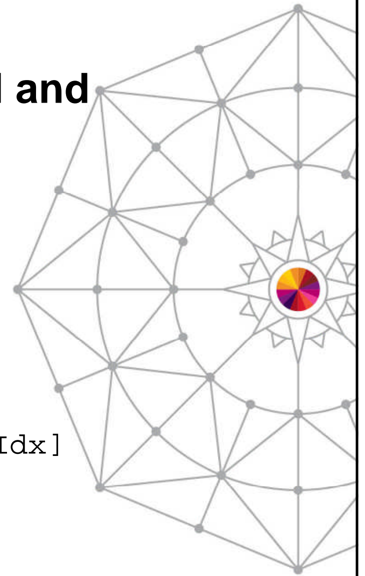
- **Start with HZSCPARS REQUEST=PARSE**

```
static int ParseParmString
                (int16_t in_parmLen
                ,char io_parmArea[HZSPQE_ParmLength]
                ,tSeverityThresholds *io_pSevThresholds)
{
 HzsCParArea* pCParArea = 0;

 /* Initialize parsing */
  switch(IssueHzsCPars_ParseInit(in_parmLen,io_parmArea
                                 ,&pCParArea))
  …<error handling>
```



Details – Function ParseParmString…

- Loop through the possible parameters
  - Uses HZSCPARS REQUEST=CHECKPARM and REQUEST=CHECKDEC under the covers

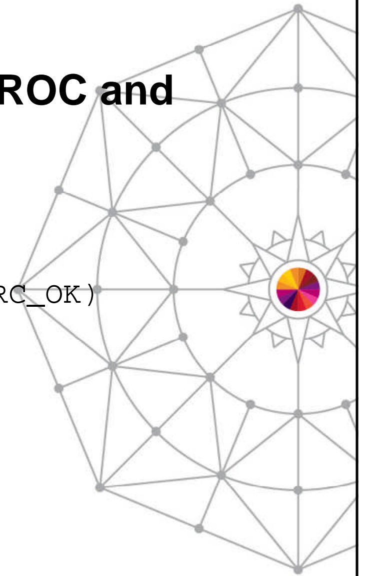


```
for(int thresholdIdx = THRESHOLDIDX_HIGH;
   thresholdIdx <= THRESHOLDIDX_NONE;
   ++thresholdIdx)
{
   switch(FindAndValidateOneThreshold
                 (&(*io_pSevThresholds)[thresholdIdx]
                 ,&prevPercentValue
                 ,pCParArea))
   …<error handling>
}
```

Details – Function ParseParmString…

- **Some cleanup and defaults…**
  - **Uses HZSCPARS REQUEST=CHECKNOTPROC and REQUEST=FREE**

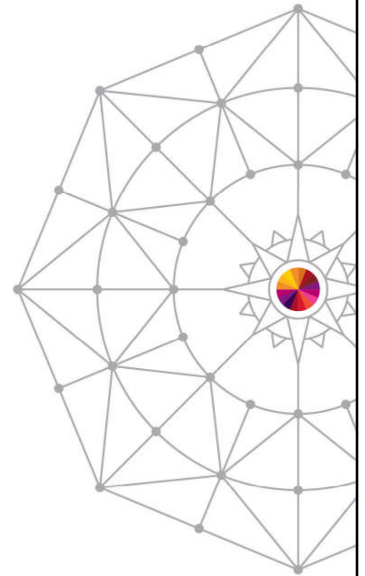
```
/* Any unsupported parameters specified? */
 if (IssueHzsCPars_CheckNotProcessed(pCParArea) != RC_OK)
      …<error handling>

if (!foundAtLeastOneParm)
      SetDefaultSevThresholds(io_pSevThresholds);

if (IssueHzsCPars_Free(&pCParArea) != RC_OK)
     …<error handling>
```



Low-level details

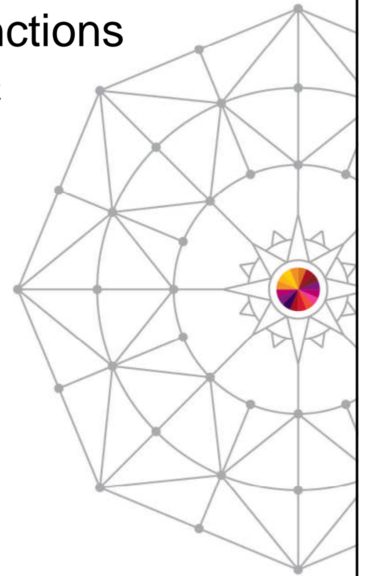
- Encapsulated in “simple” functions

```
static void SetDefaultSevThresholds
static int ParseParmString
static int FindAndValidateOneThreshold
static int IssueHzsCPars_ParseInit
static int IssueHzsCPars_CheckParm_CheckDec
static int IssueHzsCPars_CheckNotProcessed
static int IssueHzsCPars_Free
static uint8_t getCurrentResourceLevel
static void CompareCurrentVsThresholdsAndReport
static void ReportCheckSuccess
static void ReportCheckException
static void ReportParmValueTooLarge
static void IssueStopDueToBadParm
static void IssueStopDueToError
static void AbendWithRsn
```



Low-level details – Assembler use

- A prime example for wrapping in “simple” functions
  - Leaves “high-level” check logic in (METAL-) C
- For example: Use of service HZSCPARS



```
static int IssueHzsCPars_ParseInit
                (uint32_t in_parmLen
                ,char* in_parmArea
                ,HzsCParArea* *out_ppCParArea)
{
    int32_t hzsRC;
    int32_t hzsRsn;

    __asm(" HZSCPARS PLISTVER=MAX MF=L" : "DS"(plHZSCPARS));
```

Low-level details – Assembler use…

- HZSCPARS fills in the "real" parmlist for you
  - Like all HZS services

```
__asm(" HZSCPARS REQUEST=PARSE,"
        "PARM=(%5),"
        "PARMLEN=%4,"
        "TOUPPER=YES,"
        "CPARAREAADDR=%2,"
        "PARMFORMAT=KEYWORD,"
        "RETCODE=%1,"
        "RSNCODE=%0,"
        "MF=(E,(%3))"
      : "=m"(hzsRsn)
       ,"=m"(hzsRC)
       ,"=m"(*out_ppCParArea)
      : "r"(&plHZSCPARS)
       ,"m"(in_parmLen)
       ,"r"(in_parmArea)
      );
```

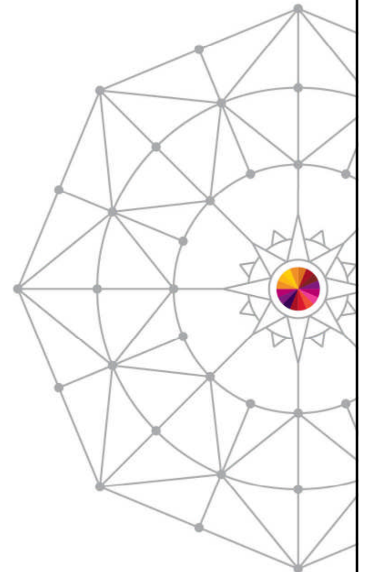
"register" form

"storage" form

"output"

"input"

__asm parameters (start with %0)



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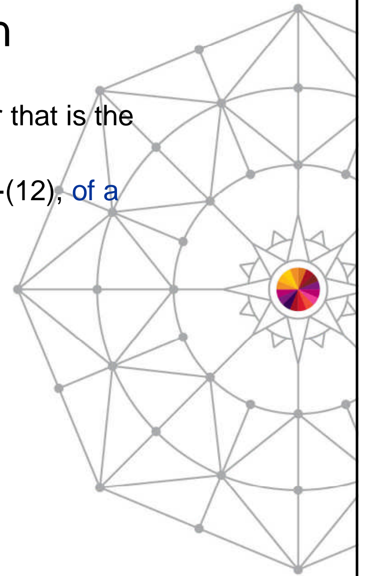
Low-level details – HLASM to __asm



- From the HZSCPARS service documentation

  ,PARMLEN=*parmlen*
  When REQUEST=PARSE is specified, a required input parameter that is the length of the input parameter.
  To code: Specify the **RS-type address**, or address in register (2)-(12), of a fullword field, or specify a literal decimal value.

- __asm invocation:

```
uint32_t in_parmLen
...
__asm(" HZSCPARS REQUEST=PARSE,"
          "PARMLEN=%4,"
         : …
         : …
         ,"m"(in_parmLen)
```

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Low-level details – HLASM to __asm

- From the HZSCPARS service documentation

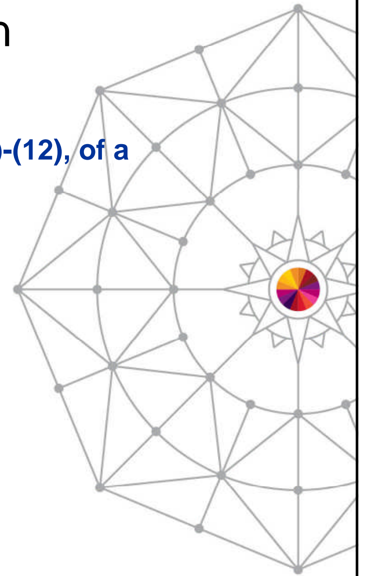
  ,PARM=*parm*

  …

  To code: Specify the RS-type address, or **address in register (2)-(12), of a character field.**

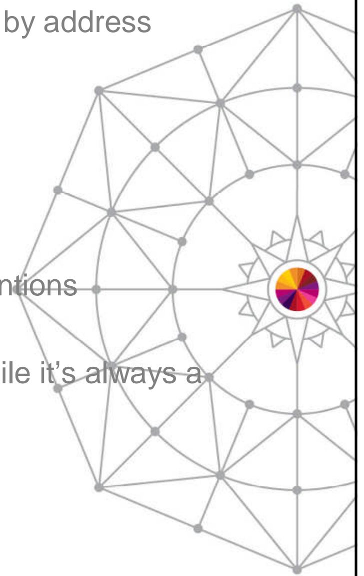
- __asm invocation:

```
char* in_parmArea
…
__asm(" HZSCPARS REQUEST=PARSE,"
          "PARM=(%5),"
         : …
         : …
         ,"r"(in_parmArea)
```



BACKUP – METAL C __asm Notes

- Mark service output parameters as output (“=“), even while passed by address
  - C compiler might “optimize” output away otherwise
  - Alternatively declare C variables used for output as “volatile”
- Be careful when using function parameters in __asm calls
  - OK for data types with size being a multiple of 4
  - uint16_t for example should be copied into uint32_t first
  - Otherwise offset might be off due MVS linkage / parmlist conventions
- Use char* instead of char[ ] in function parameter list
  - Char[ ] makes it tempting to use as “storage operand”, even while it’s always a pointer
- Qualify assembler literals with appropriate length / extension
  - For example =A for 4-byte address, =AD for 8-byte address
- ARMODE is tricky
  - Needs lots of manual setting of ALETs,
  - …including for R3 (literal pool) and R10 (static data)
  - Be "safe" and construct all __far pointers explicitly via __set_far_...



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Low-level details – Assembler use…

- Error handling
  - C constants available for RC/RSN
  - Check practice: Use HZSFMSG to report and “disable”
- So, concluding our HZSCPARS REQUEST=PARSE example via C function `IssueHzsCPars_ParseInit`:

```
if (hzsRC != 0)
{
    if (hzsRsn == HzsCParsRsn_NoParms)
        return INITPARSE_OK_EMPTY;

    IssueStopDueToBadParm();
    return INITPARSE_ERROR;
}

return INITPARSE_OK;
```


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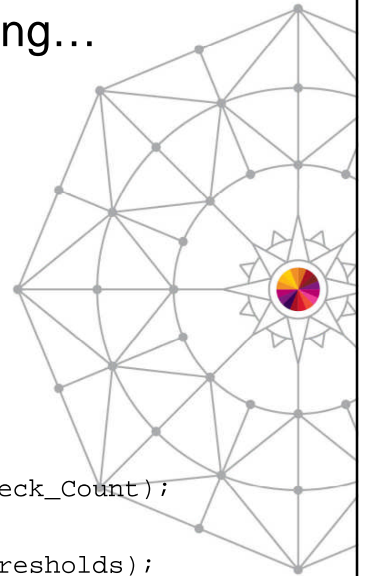
Back to `main`

- Now that we have “covered” parameter parsing…

```
case HZSPQE_Function_Code_Check:
     {
       if (pPQE->LookAtParms)
       {
            if (RC_OK != ParseParmString(pPQE->ParmLen
                                        ,pPQE->ParmArea
                                        ,pSevThresholds))
                 goto endMain;
       }

       uint8_t curLevel = getCurrentResourceLevel(pPQE->Check_Count);

       CompareCurrentVsThresholdsAndReport(curLevel,pSevThresholds);
     }
     break;
```



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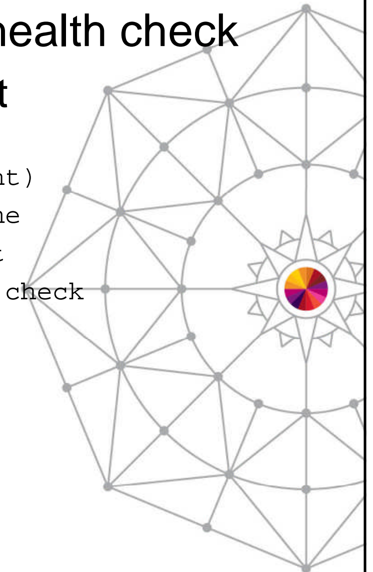
The core of your check

- Deals with the one “unique” feature of your health check
  - The setting/configuration option it is looking at



```
static uint8_t getCurrentResourceLevel(int32_t in_checkCount)
{    /* vary the "current", dummy resource level based on the
      * check iteration number, so that we can see different
      * check exception severities etc. when re-running the check
      */
    switch(in_checkCount%4)
    {
     case 1: return 90;
     case 2: return 80;
     case 3: return 70;
     default: return 50;
    }
}
```

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More “mechanics”

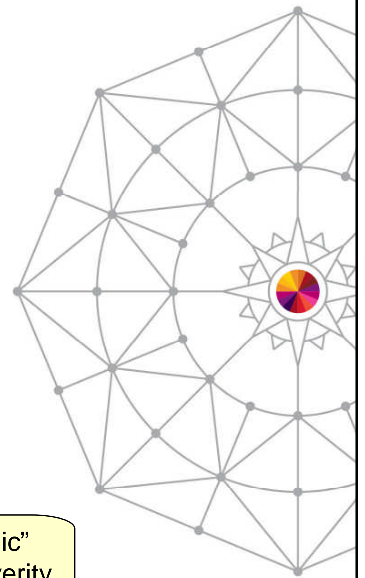
- A check always reports on its findings
  - for every check run (“iteration”)
  - via message service HZSFMSG
- “Success” / “All is well”
  - With brief description of what has been checked
- “Exception” message
  - With details on what was has been found “wrong”
  - With details on how to respond to it / fix it
  - With references to in-depth documentation

```
static void CompareCurrentVsThresholdsAndReport
                (uint8_t in_curPercentage
                ,tSeverityThresholds *in_pSevThresholds)
{
 int foundException = 0;

 for(int thresholdIdx = THRESHOLDIDX_HIGH;
         thresholdIdx <= THRESHOLDIDX_NONE;
         ++thresholdIdx)
 {
     tOneSeverityThreshold* pCurSevThreshold =
             &((*in_pSevThresholds)[thresholdIdx]);

     if (pCurSevThreshold->isActive &&
         in_curPercentage >= pCurSevThreshold->minPercent)
     {
         ReportCheckException(pCurSevThreshold->severityVal
                             ,in_curPercentage);
         foundException = 1;
         break;
     }
 }
 if (!foundException)
     ReportCheckSuccess(in_curPercentage);
}
```

Our “dynamic” exception severity



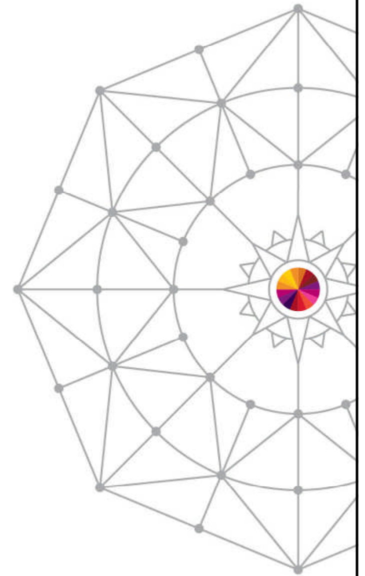
```
static const char SUCC_TEXT[] = "Resource X is good at %i%%.";

static void ReportCheckSuccess(uint8_t in_curPercentage)
{
    int32_t hzsRC;
    int32_t hzsRsn;
    uint16_t succLen;
    char succBuffer[sizeof(SUCC_TEXT)+10];

    snprintf(succBuffer,sizeof(succBuffer),SUCC_TEXT,in_curPercentage);

    succLen = strlen(succBuffer);

    __asm(" HZSFMSG PLISTVER=MAX MF=L" : "DS"(plHZSFMSG));
    __asm(" HZSFMSG REQUEST=DIRECTMSG,"
               "REASON=CHECKINFO,"
               "ID==CL8'SHRH002I',"
               "IDLEN=8,"
               "TEXT=%4,"
               "TEXTLEN=%3,"
               "RETCODE=%1,"
               "RSNCODE=%0,"
               "MF=(E,(%2),COMPLETE)"
          : "=m"(hzsRsn)
           ,"=m"(hzsRC)
          : "r"(&plHZSFMSG)
          , "m"(succLen)
          , "m"(succBuffer)
          );
    if (hzsRC) IssueStopDueToError(hzsRsn);
}
```



A word on DIRECTMSG and exceptions

- The exception message routine **ReportCheckException** is more involved.
  - Needs to pass more information for that one HZSFMSG call.
- The sample still uses DIRECTMSG
  - Embeds message text directly into check routine source code.
  - Allows “stand-alone” delivery of check
- DIRECTMSG mainly intended for REXX checks though.
- Other checks should (eventually) use a message table
  - Encapsulates message data.
  - Check routine just references via <msgnum> value.

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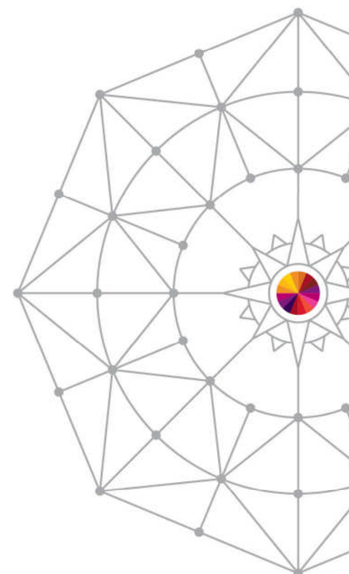
```
static void ReportCheckException(uint8_t in_severityVal
                                ,uint8_t in_curPercentage)
{
…
 fixedLenInput.SeverityVal = in_severityVal;
…
__asm(" HZSFMSG REQUEST=DIRECTMSG,"
                   "REASON=CHECKEXCEPTION,"
                   "SEVERITY=VALUE,"
                   "SEVERITYVAL=16(%1),"
                   "ID==CL8'SHRH001E',"
                   "IDLEN=8,"
                   "TEXT=(%2),"
                   "TEXTLEN=8(%1),"
                   "EXPL=(%3),"
                   "EXPLLEN=10(%1),"
                   "SPRESP=(%4),"
                   "SPRESPLEN=12(%1),"
                   "REFDOC=(%5),"
                   "REFDOCLEN=14(%1),"
                   "RETCODE=0(%1),"
                   "RSNCODE=4(%1),"
                   "MF=(E,(%0),COMPLETE)"
             :
             : "r"(&plHZSFMSG)
             , "r"(&fixedLenInput)
             , "r"(&EXCP_SUMMARY)
             , "r"(&ExplBuffer)
             , "r"(&EXCP_SPRESP)
             , "r"(&EXCP_REFDOC)
             );
```



…and we did not even use the remaining SYSACT, ORESP, PROBD, SOURCE, AUTOMATION parameters and their LEN values…

Build it

- Download JCL sample build script from SHARE
  - See also similar SYS1.SAMPLIB(GTZSHCKJ)
  - See also z/OS Unix: /usr/lpp/bcp/samples/hzssmake.mk

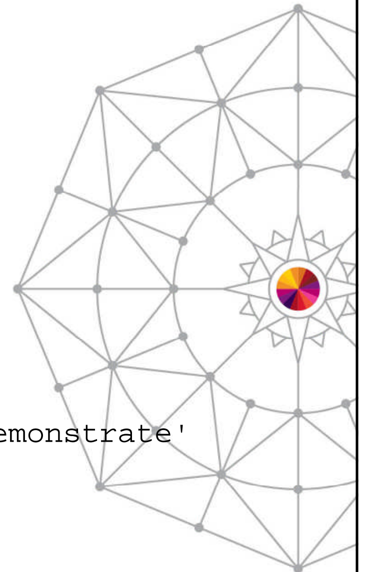
```
//SHRDSVHJ JOB TIME=NOLIMIT,REGION=0K,NOTIFY=&SYSUID
//* Sample JCL for building the sample health check SHRDSVHC.
//* Parameters
// SET CSRCMBR=SHRDSVHC
…
//* METAL C to HLASM
// SET PARM1='/METAL NOARMODE LIST LO NOSE SE(/usr/include/metal)'
//COMPILE EXEC PGM=CCNDRVR,REGION=192M,PARM='&PARM1.&PARM2.'
…
//* HLASM to object module
//ASSEMB    EXEC PGM=ASMA90,
//          PARM='RENT,GOFF,LIST(133),FLAG(PAGE0)',
…
//* Object module to load module
//BIND      EXEC PGM=HEWL,
//          PARM='RENT,AC=1,EP=&CSRCMBR.,AMODE=31',
```

Gives use load module “SHRDSVHC”

Register and Run

- For example via HZSPRMxx:

```
ADDREP CHECK(SHARESAMPLE,SHARE_DYNSEV_THRESHOLD)
                      CHECKROUTINE(SHRDSVHC)
                      MESSAGETABLE(*NONE)
                      ALLOWDYNSEV(YES)
                      PARM('THRESHOLD_HIGH(85%)'
                           'THRESHOLD_MED(75%)'
                           'THRESHOLD_LOW(60%)')
                      DATE(20140204)
                      REASON('A sample check to demonstrate'
                             'dynamic severity')
                      SEVERITY(MEDIUM)
                      INTERVAL(01:00)
```



- MODIFY HZSPROC,ADD,PARMLIB=xx

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Register and Run – Alternatives

- MODIFY HZSPROC is only “temporary”
  - Does not survive a restart of system nor Health Checker.
- Make “permanent” by adding HZSPRMxx suffix to system parameter HZS in IEASYSxx (recommended)
  - or to the HZSPRM parameter of procedure HZSPROC.
- Or: Write own HZSADDCHECK dynamic exit routine
  - Need product code to register with exit…
  - See also /usr/lpp/bcp/samples/hzscadd.c (METAL C).
  - See also SYS1.SAMPLIB(HZSSADCK) (HLASM)

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See it run

- By default a check gets run right away when ADDed:

```
- SY40   f hzsproc,add,parmlib=ud
 *SY40  *HZS0003E CHECK(SHARESAMPLE,SHARE_DYNSEV_THRESHOLD):
 *SHRH001E Resource X is nearing exhaustion
  SY40   HZS0403I ADD PARMLIB PROCESSING HAS BEEN COMPLETED
```

- "Manual" run possible besides INTERVAL scheduling:

```
- SY40   f hzsproc,run,check(SHARESAMPLE,SHARE_DYNSEV_THRESHOLD)
  SY40   HZS0400I CHECK(SHARESAMPLE,SHARE_DYNSEV_THRESHOLD):
  RUN PROCESSING HAS BEEN COMPLETED
  SY40   HZS0002E CHECK(SHARESAMPLE,SHARE_DYNSEV_THRESHOLD):
  SHRH001E Resource X is nearing exhaustion
```

- Note the "dynamic" severity (first HIGH, then MEDIUM)

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Check iteration details via SDSF CK

```
SDSF HEALTH CHECKER DISPLAY  SY40
COMMAND INPUT ===>
NP NAME                      CheckOwner   State             Status
   RSM_REAL                  IBMRSM       ACTIVE(ENABLED)   SUCCESSFUL
   RSM_RSU                   IBMRSM       ACTIVE(ENABLED)   SUCCESSFUL
   SDUMP_AUTO_ALLOCATION     IBMSDUMP     ACTIVE(ENABLED)   EXCEPTION-MEDIUM
   SDUMP_AVAILABLE           IBMSDUMP     ACTIVE(ENABLED)   SUCCESSFUL
S  SHARE_DYNSEV_THRESHOLD    SHARESAMPLE  ACTIVE(ENABLED)   EXCEPTION-HIGH
   SLIP_PER                  IBMSLIP      ACTIVE(ENABLED)   SUCCESSFUL
   SMS_CDS_REUSE_OPTION      IBMSMS       ACTIVE(ENABLED)   SUCCESSFUL
   SMS_CDS_SEPARATE_VOLUMES  IBMSMS       ACTIVE(ENABLED)   EXCEPTION-MEDIUM
   SUP_LCCA_ABOVE_16M        IBMSUP       ACTIVE(ENABLED)   SUCCESSFUL
```

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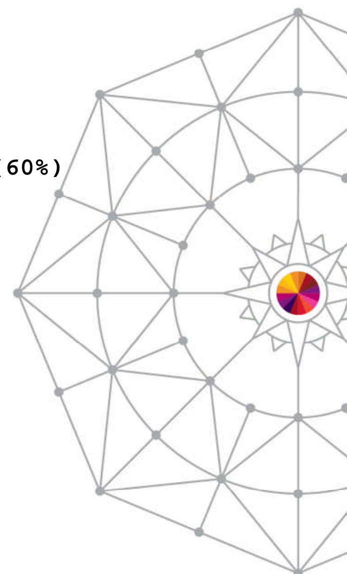
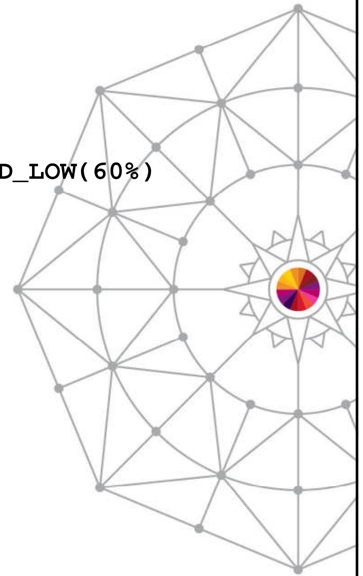
SDSF Message Buffer display – Exception

```
CHECK(SHARESAMPLE,SHARE_DYNSEV_THRESHOLD)
SYSPLEX:    PLEX1     SYSTEM: SY40
START TIME: 02/20/2014 11:19:36.446817
CHECK DATE: 20140204  CHECK SEVERITY: MEDIUM-DYNAMIC
CHECK PARM: THRESHOLD_HIGH(85%),THRESHOLD_MED(75%),THRESHOLD_LOW(60%)

* High Severity Exception *

SHRH001E Resource X is nearing exhaustion

  Explanation:  90% of resource X is in use

  System Programmer Response:  Make more X available

  Reference Documentation:  See book Y about resource X

  Check Reason:  A sample check to demonstrate dynamic severity

END TIME: 02/20/2014 11:19:36.465733  STATUS: EXCEPTION-HIGH
```



SDSF Message Buffer display – Success

```
CHECK(SHARESAMPLE,SHARE_DYNSEV_THRESHOLD)
SYSPLEX:    PLEX1     SYSTEM: SY40
START TIME: 02/20/2014 11:22:10.684570
CHECK DATE: 20140204  CHECK SEVERITY: MEDIUM-DYNAMIC
CHECK PARM: THRESHOLD_HIGH(85%),THRESHOLD_MED(75%),THRESHOLD_LOW(60%)

SHRH002I Resource X is good at 50%.

END TIME: 02/20/2014 11:22:10.684907  STATUS: SUCCESSFUL
```



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References

- SHARE Anaheim 2014 – Session 15291
  - Download slides and sample check source / JCL / HZSPRMxx
- SHARE Anaheim 2014 – Session 15114
  - Health Checker V2.1 updates and check writing details and comparisons
- SHARE Boston 2013 – Session 14298
  - Health Checker introduction + REXX check writing
- “IBM Health Checker for z/OS User's Guide” (SC23-6843)
  - Guide and Reference
  - Includes an inventory of IBM supplied health checks
- “Exploiting the Health Checker for z/OS infrastructure”
  - Health Checker “hands-on” Redpaper 4590
- Metal C Programming Guide and Reference (SC14-7313)
- Health Checker framework contact and to direct questions about individual health checks: Ulrich Thiemann (thiemanu@us.ibm.com)