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zdsfs -
Direct Linux access to
z/OS data sets

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Why you want to use zdsfs

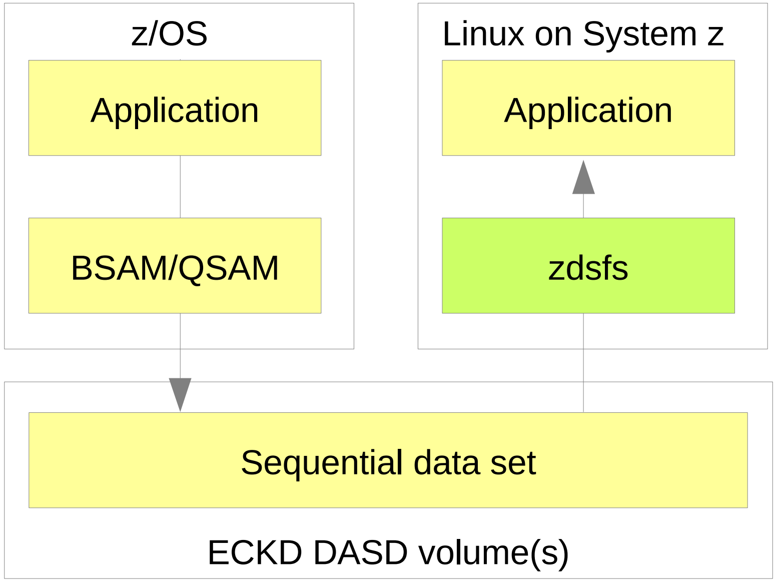
- **Lots of data stored and processed on z/OS**
  - Linux on System z is nearby
- **Significantly improve processing time for batch applications working with data generated in z/OS**
- **Easier to implement new applications and business processes on Linux**
  - larger community
  - a lot more pre build software
- **Reduce z/OS CPU cycles**
- **Extract Transfer Load (ETL) requires a lot CPU cycles**
  - sometimes more than warehousing itself
  - offload to Linux

Overview

- **Goal**
  - Transfer bulk data from z/OS to Linux on System z
  - Faster than networked transfer (e.g. FTP, NFS)
  - Use less CPU cycles than networked transfer

- **NOT intended for CONCURRENT access**
  - Not a cluster file system

- **Approach**
  - Read records from DASD volumes
  - Translate into Linux file system semantics
    - Physical Sequential data set → File
    - Partitioned data set → Directory containing members as files



Linux disk layout

- **Block devices → directly addressable sectors of fixed size**
- **Smallest unit is one sector**
  - size is a power of 2 → usually between 512 and 4096 bytes
  - for current Linux systems the upper limit is the memory page size
- **Applications mostly do not use block devices directly**
  - use of a filesystem

DASD and z/OS

- **Direct Access Storage Device – DASD**
  - matrix of tracks, addressable via cylinder and head number
  - within each track the OS or application can store records of an arbitrary size
  - results in an variable number of records per track
  - each record has count, key and data field – CKD
  - today Extended Count Key Data - ECKD is in use

- **z/OS makes full use of the flexibility of ECKD DASD**
  - Data set consists of one ore more extents
    - extents are areas of consecutive tracks on a DASD
  - each data set can have records of variable size
  - the Volume Table of Content (VTOC) describes each data set, its extents and parameters
  - one data set can be distributed over several DASD devices

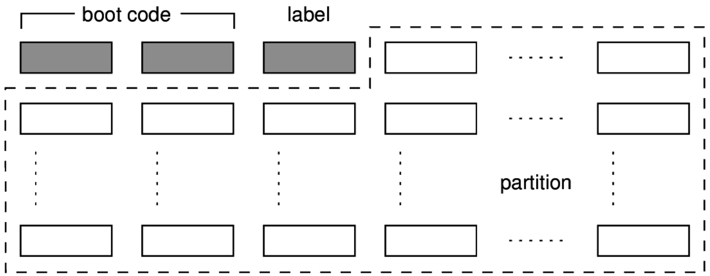
Linux on System z use of ECKD DASD

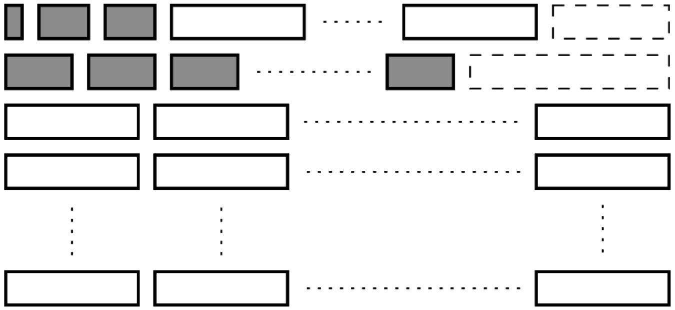
Linux disk Layout – LDL

- Similar to Linux disks
- Fixed block size
- Not usable by other System z OS

Compatible disk Layout – CDL

- Different record size in first tracks
- Fixed block size for data tracks
- Has VTOC and is readable by z/OS
  - – partitions are seen as a dataset





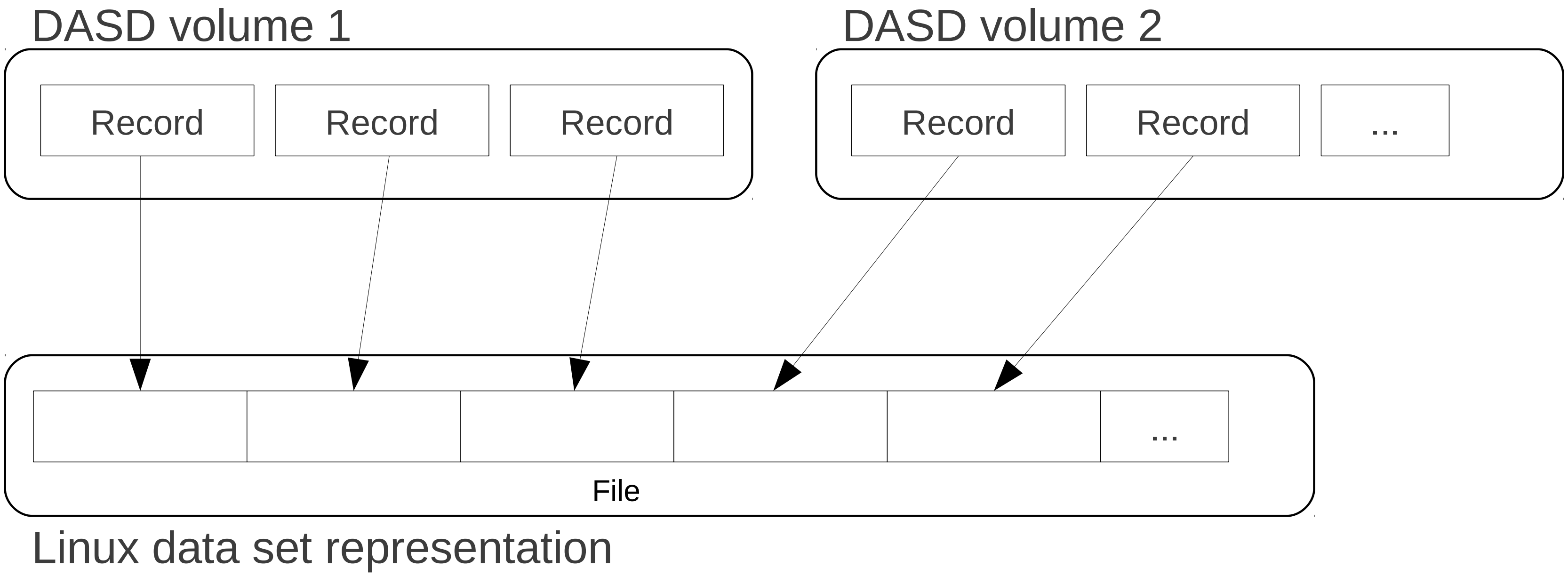
Linux on System z feature - raw track access

- **Read and write full track images including Count and Key values**
- **Track has a well known size → 58786 byte for a DASD of type 3390**
- **Disk is mapped to a sequence of tracks of a fixed size**
- **Page size for Linux on System z is 4096 byte**
  - block size is 4096 byte, too
  - need to map a track to 16 separate 4096 byte blocks
  - but not directly accessible
- **Accessing such a device like a normal block device will most likely end up in I/O errors**
  - need to use DIRECT_IO to bypass most of the block layer optimizations
  - track alignment
- **But this still gives only raw data and no understanding of the low level data formats like:**
  - ECKD track layout
  - VTOC layout
  - z/OS data set layout

zdsfs

- **Filesystem in Userspace (FUSE)**
  - – enables user space filesystems
- **Supported data sets:**
  - – physical sequential data sets (PS)
  - – partitioned data sets (PDS)
- **Other data set formats like VSAM or extended format data sets are not supported**
- **Limited to basic operations:**
  - – readdir
  - – stat
  - – open
  - – read
  - – seek
- **Optimized for sequential read access**
  - – random access possible but with performance impact
- **Option to include record descriptor words in data stream**
- **PS data sets → simple files**
- **PDS data sets → directories with members as files**
- **One or more DASD devices possible**

Record mapping

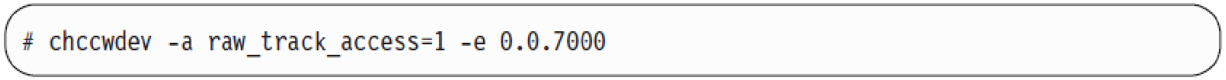


Limitations

- **Data set format restrictions**
  - No VSAM
  - No Extended-Format data sets
- **Access not controlled by z/OS authorization mechanisms**
  - Use of DASDs dedicated to data transfer recommended
  - Linux authorization mechanisms apply
- **Access not logged by z/OS auditing mechanism**
  - Users must consider “z/OS write to DASD = read by Linux”
- **No catalog access**
  - Users need to specify the DASDs on which a data set is located
- **Complex usage**
- **One-way data transfer only**
- **File size (total data set size) only approximated (number and size of extends)**

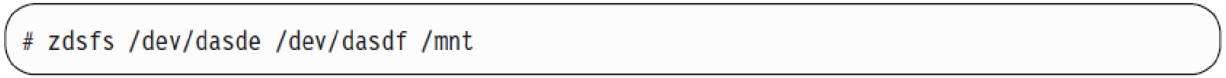
Usage

- z/OS: Write data set to DASDs
- z/OS: Set DASDs offline to ensure consistent on-disk state of data set
- Linux: Set DASD online in raw-track-access-mode



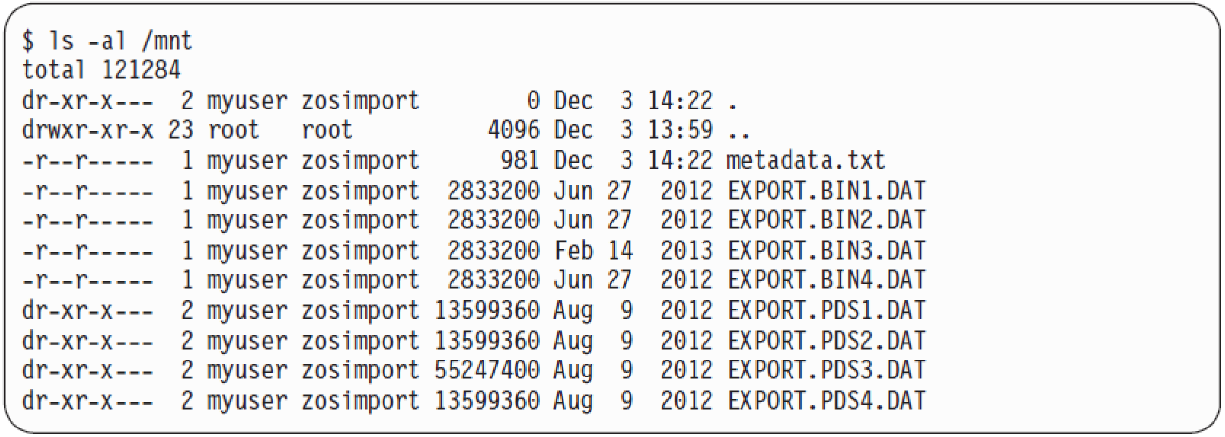
```
# chccwdev -a raw_track_access=1 -e 0.0.7000
```

- Linux: Run zdsfs to “mount” the data set



```
# zdsfs /dev/dasde /dev/dasdf /mnt
```

- Linux: Access data set



```
$ ls -al /mnt
total 121284
dr-xr-x---  2 myuser zosimport        0 Dec  3 14:22 .
drwxr-xr-x 23 root   root          4096 Dec  3 13:59 ..
-r--r-----  1 myuser zosimport      981 Dec  3 14:22 metadata.txt
-r--r-----  1 myuser zosimport  2833200 Jun 27  2012 EXPORT.BIN1.DAT
-r--r-----  1 myuser zosimport  2833200 Jun 27  2012 EXPORT.BIN2.DAT
-r--r-----  1 myuser zosimport  2833200 Feb 14  2013 EXPORT.BIN3.DAT
-r--r-----  1 myuser zosimport  2833200 Jun 27  2012 EXPORT.BIN4.DAT
dr-xr-x---  2 myuser zosimport 13599360 Aug  9  2012 EXPORT.PDS1.DAT
dr-xr-x---  2 myuser zosimport 13599360 Aug  9  2012 EXPORT.PDS2.DAT
dr-xr-x---  2 myuser zosimport 55247400 Aug  9  2012 EXPORT.PDS3.DAT
dr-xr-x---  2 myuser zosimport 13599360 Aug  9  2012 EXPORT.PDS4.DAT
```

zdsfs options

- **-o ignore_incomplete**
  - Represents all complete data sets in the file system, even if there are incomplete data sets
- **-o rdw**
  - Keeps record descriptor words (RDWs) of data sets that are stored by using the z/OS concept of variable record lengths
- **-o tracks=<n>**
  - Specifies the track buffer size in tracks
  - Increasing the track buffer size might improve your system performance
- **-o seekbuffer=<s>**
  - Sets the maximum seek history buffer size in bytes
  - Speed up the performance of a seek operation

Dataset Meta data

Static meta data provided in two ways:

- **File “metadata.txt” in top level of mounted directory:**

```
# cat metadata.txt
dsn=WEIN.TEST2.TXT,recfm=FB,lrecl=80,dsorg=PS
dsn=WEIN.WEIN.DASDECKD.C,recfm=F,lrecl=100,dsorg=PS
dsn=WEIN.DASDECKD.C,recfm=F,lrecl=100,dsorg=PS
dsn=WEIN.DASDECK2.C,recfm=F,lrecl=100,dsorg=PS
```

  – advantage: can be copied along with the data sets

- **Via extended file attributes:**

```
# getfattr -d WEIN.DASDECKD.C
# file: WEIN.DASDECKD.C
user.dsorg="PS"
user.lrecl="100"
user.recfm="F"
```

  – advantage: generic tools and APIs available

Attention

Set devices in z/OS offline before mounting them in Linux.

Through zdsfs file system the whole DASD is accessible in Linux but the access is not controlled by z/OS auditing mechanisms.

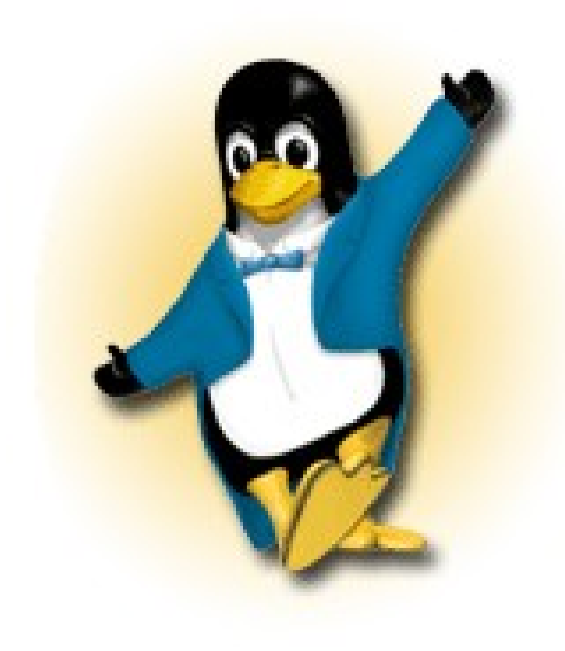
To avoid security problems the disk may be dedicated in z/OS only for providing data to Linux.

Further reading

- **Device Drivers, Features, and Commands (Kernel 3.12) - SC33-8411-23**

  http://public.dhe.ibm.com/software/dw/linux390/docu/l312dd23.pdf

Questions?



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