Recovery of Firebird databases

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Corruption reasons

- Reasons
  - Misadministration
  - Hardware failures
  - Bugs
  - +Ransomware

- **The actual reason often remains undiscovered**
- **In this ppt we are focused on fixing**

Database: pages, volumes, and delta

| header | PIP | | Pointer | Index root | | Data | Data | Data | | Transactions | | .... |

0   10….0

Database file 0

Volume 2

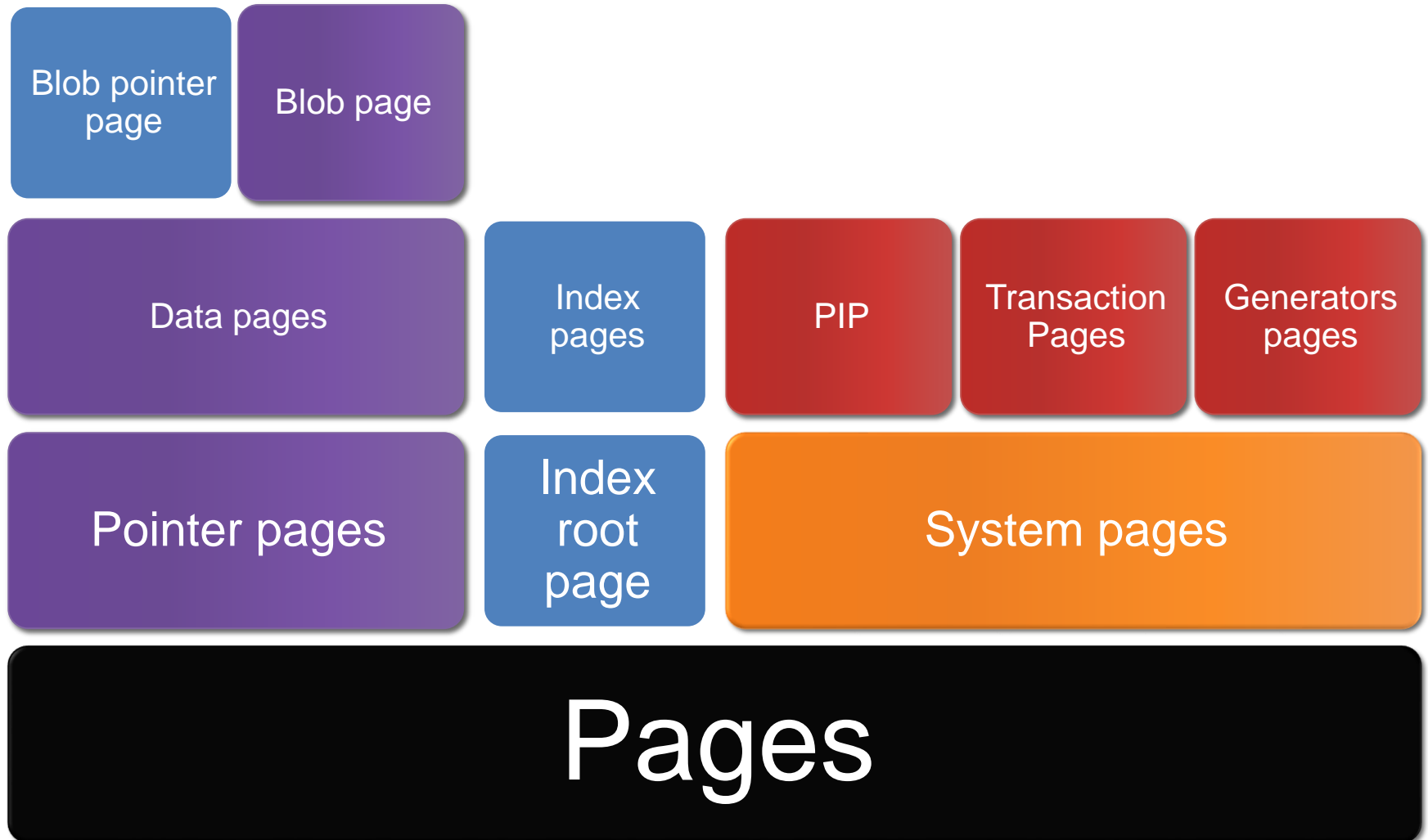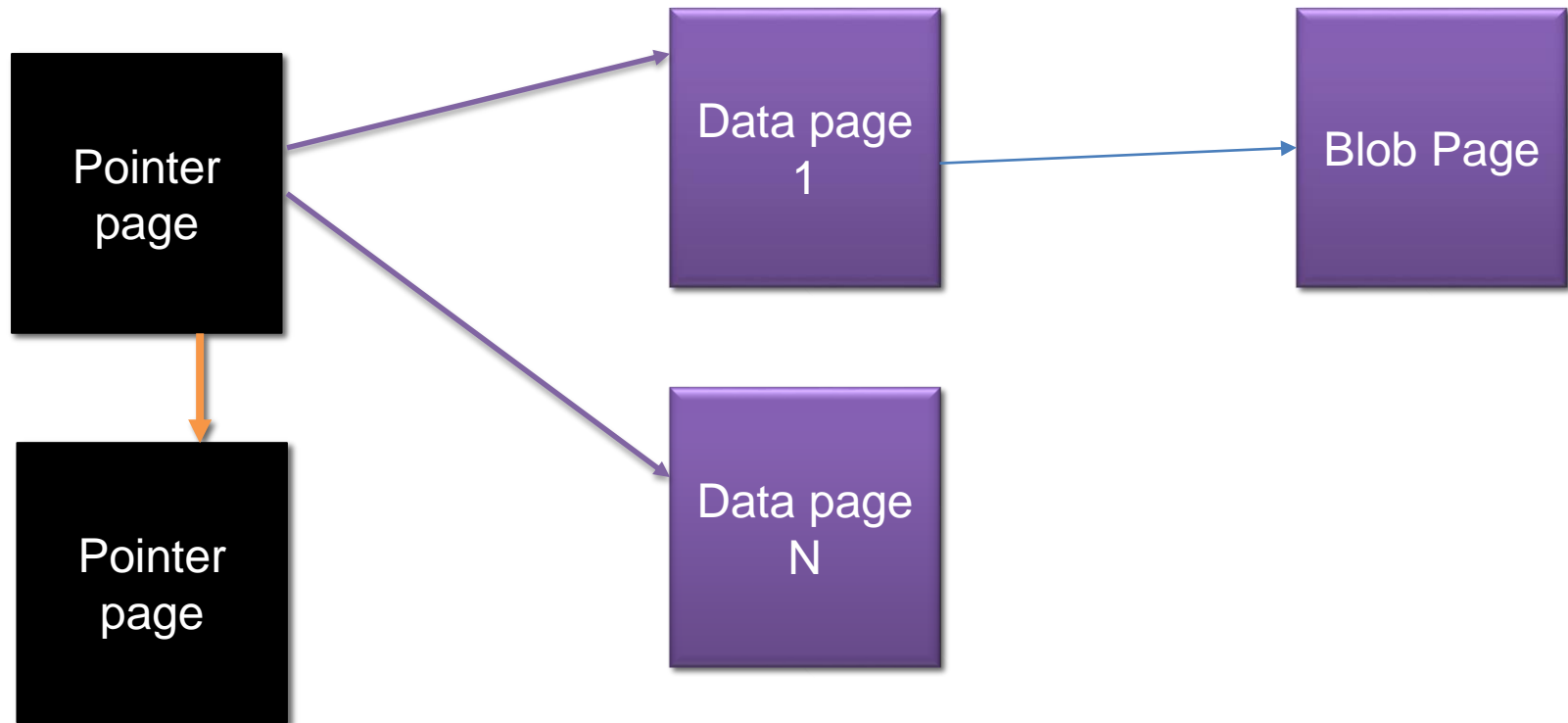10….1   20….0

Delta file

30….0

Database structure – page level

Blob pointer page	Blob page

Data pages	Index pages	PIP	Transaction Pages	Generators pages

Pointer pages	Index root page	System pages

Pages

Pages in Firebird

- System data pages
  - Contains information about tables, indices, stored procedures. This information is used to store and read user data pages
- User data pages
  - Contains actual users data

- Indices?
  - Indices always can be recreated
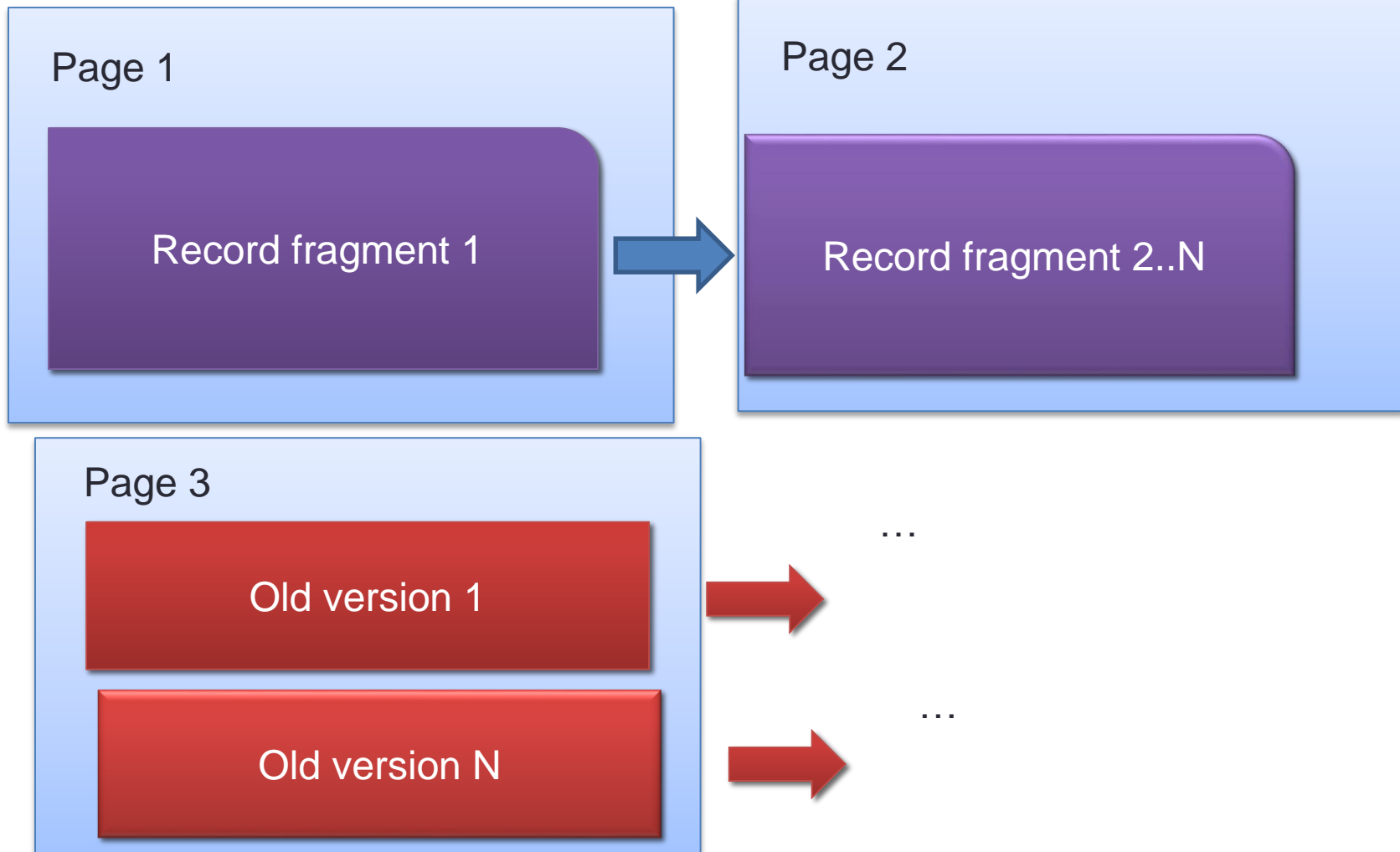 - System indices can be a problem
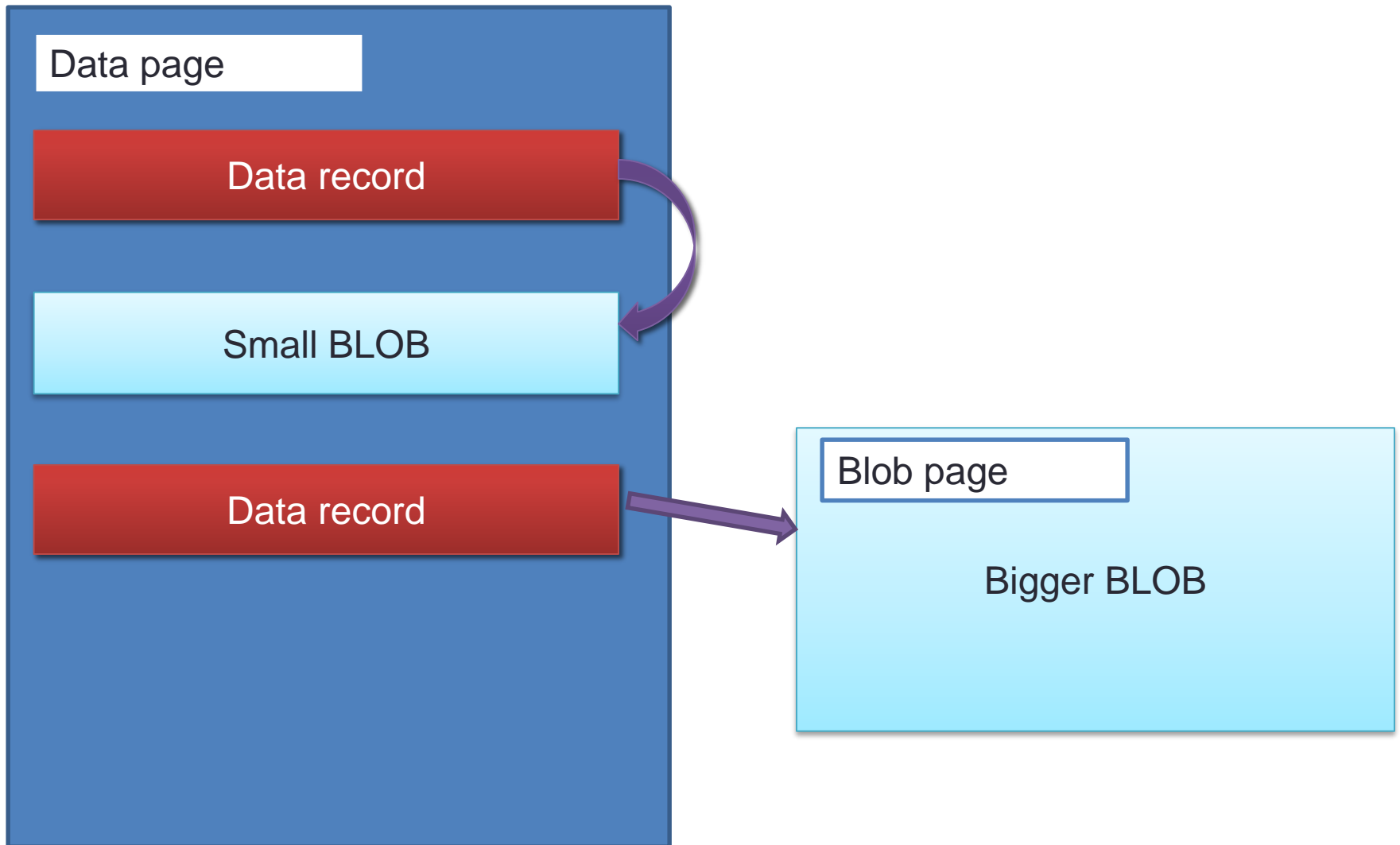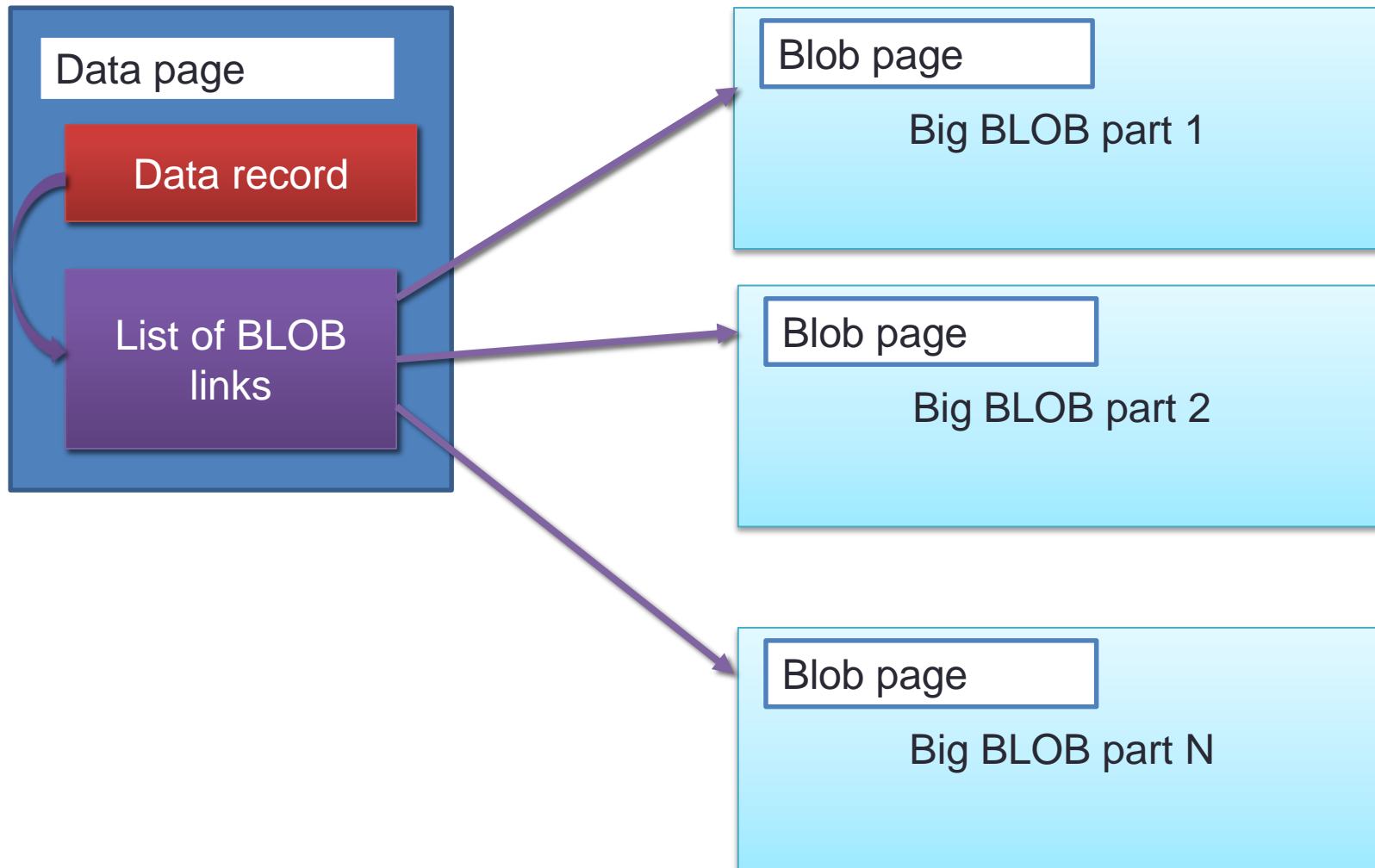
Pages tree for data storing

Pointer page

Pointer page

Data page 1

Data page N

Blob Page

Record on data page

Data page

Record 1

Record 2

Record 3

Small BLOB

Record N

Record fragments and versions

Blob storing

Data page

Data record

Small BLOB

Data record

Blob page

Bigger BLOB

Big BLOB storing

Data page

Data record

List of BLOB links

Blob page

Big BLOB part 1

Blob page

Big BLOB part 2

Blob page

Big BLOB part N

Pages tree for storing data
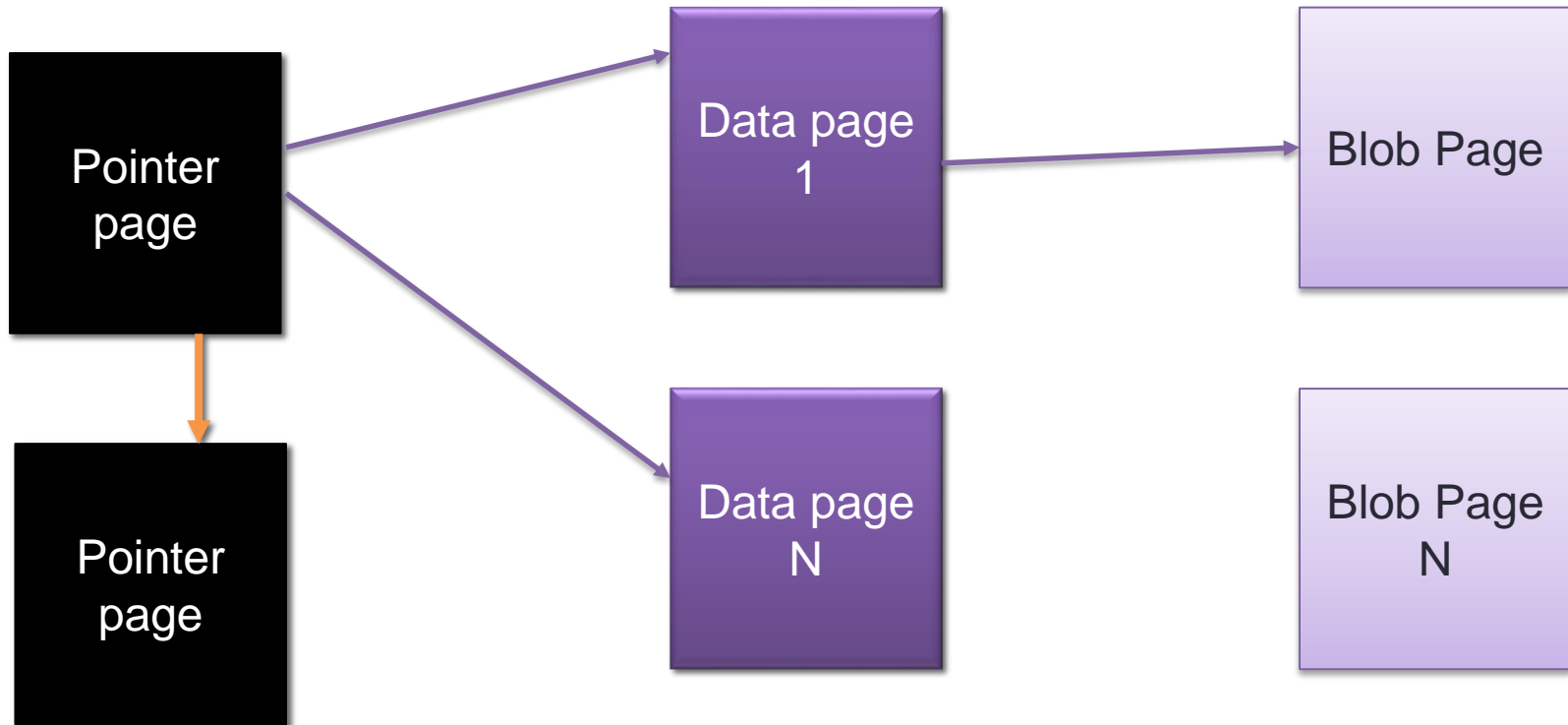
Record-level

Record header	Record data (RLE compressed)

RDB$FORMATS

RDB$FIELDS

RDB$RELATIONS

RDB$RELATION_FIELDS

Page level corruptions

Pointer page → Data page 1 → Blob Page

Pointer page → Data page N

Blob Page N
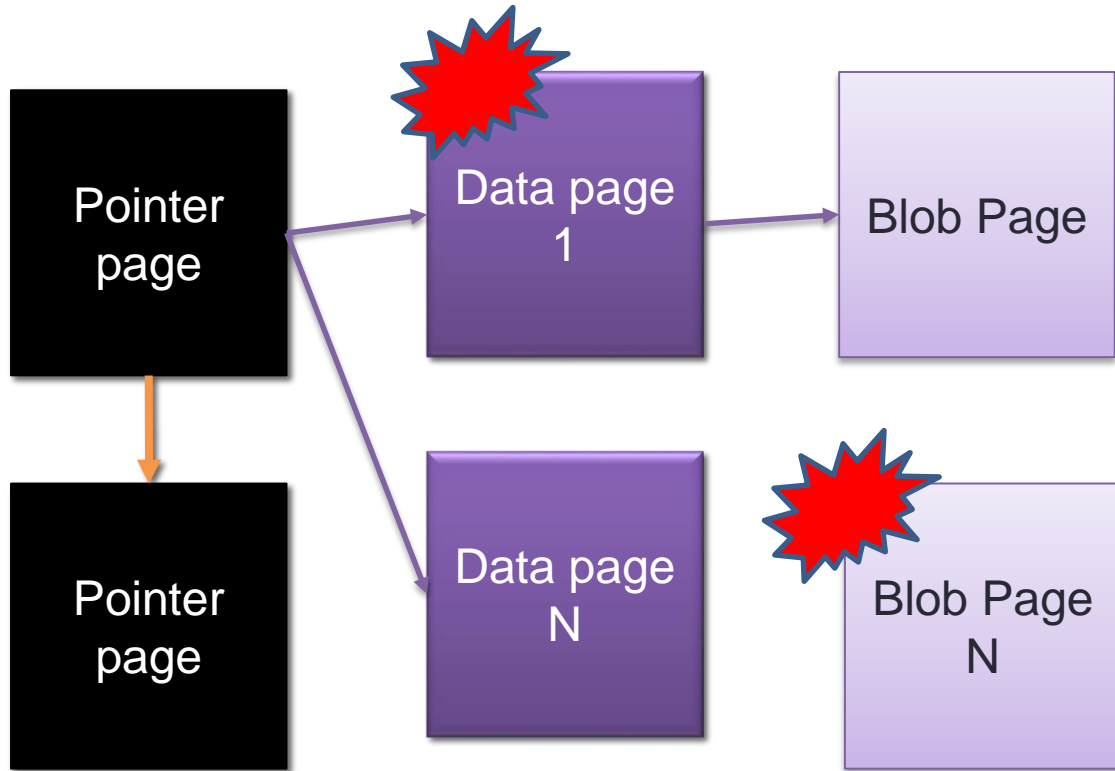
- Wrong page type
- Page was not found
- BLOB not found

Record level corruptions

Data page

Record 1

Record 2

Record 3

Small BLOB

Record N

- Wrong record length
- Bad record fragment
- Applied differences does not fit
- Cannot get BLOB segment

Ransomware «corruption»
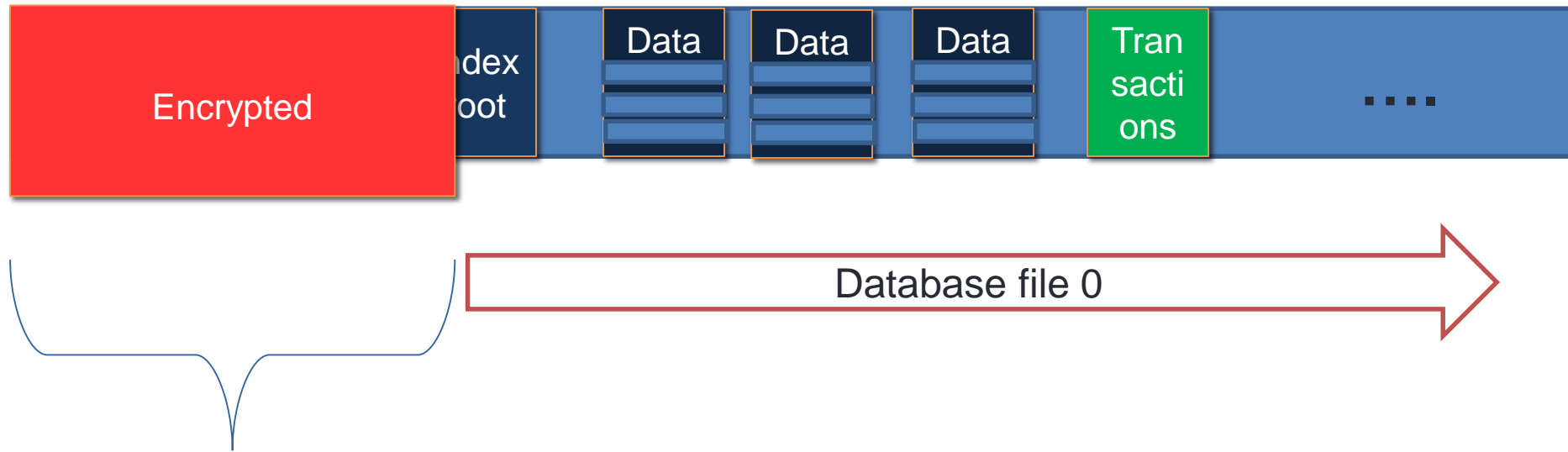
- Several ransomware viruses encrypts only ~1Mb of the database file
- In this case recovery if possible if database is protected by HQbird FBDataGuard or old database with the same metadata exists

What corruption means for Firebird?

- For some reason Firebird engines cannot read one or several pages and fails to build database image
  - For HDD corruptions - many pages
  - RAM corruptions – few pages

Corruptions appear at:
1. Users screen ("internal Firebird software consistency check" error message)
2. In firebird.log

Heavy and Easy corruptions

- Easy corruptions
  - Users data are corrupted (partially)
  - User's indices corrupted
- Heavy corruptions
  - System data are damaged (We can't read users data!)

STANDARD MEANS TO RECOVER DATABASE

gfix, gbak

Standard way to recover

- Stop Firebird server.
- Make a copy of Firebird database.
- Start Firebird server and run the following commands:

gfix.exe -v -full

gfix.exe -mend –ig

gbak -b –g -v

- If backup completed successfully, restore database:
  gbak -c -v -user SYSDBA -pass masterkey
  path_to_backup path_to_database

Tips

1. Try to run them all, even if gfix shows errors.
2. Always use switch –ig for gbak to ignore checksum errors
3. Always use switch –g for gbak to suppress garbage collection (and to workaround index errors)
4. Use –v switch to have detailed output

Restore errors

- After fixing corruptions it's a often to see "Cannot commit index" error at restore step.
  - In Firebird 2.0 and later this comes as a warning and database will be not brought on-line

- 1) IBDataPump (free tool) http://www.clevercomponents.com/demo/datapump/IBPump.zip
  2) Create only metadata database
- gbak -c -m
- 3) Run IBDataPump and set partially repaired database as Source, and fresh empty database as target

Effectiveness

- Gbak+Gfix can recover almost all easy corruptions
- What they cannot do:
  - Heavy corruptions with a lot of losses
  - System data corruptions

ADVANCED TOOLS FROM IBSURGEON

# FirstAID – Direct Fix (versions 2.5, 3.0, 4.0 beta)

- Walks through page structures
- Recreate missed links if possible
- Delete wrong (incomplete) links

- Advantages
  - Fast
  - Recovers database to the workable state
- Disadvantages
 - Cannot fix database with bad metadata, from ransomware
- Demo

FBFirstAID – Extractor

- Extracts data from badly corrupted database
    - Ransomware
    - Heavy corruptions
    - Merge deltas for corrupted nbackup
    - Can borrow metadata from good database
- Disadvantages
    - Long time to export for big databases (1Gb/5 min)
    - Requires good metadata

FirstAID Extractor: Extraction
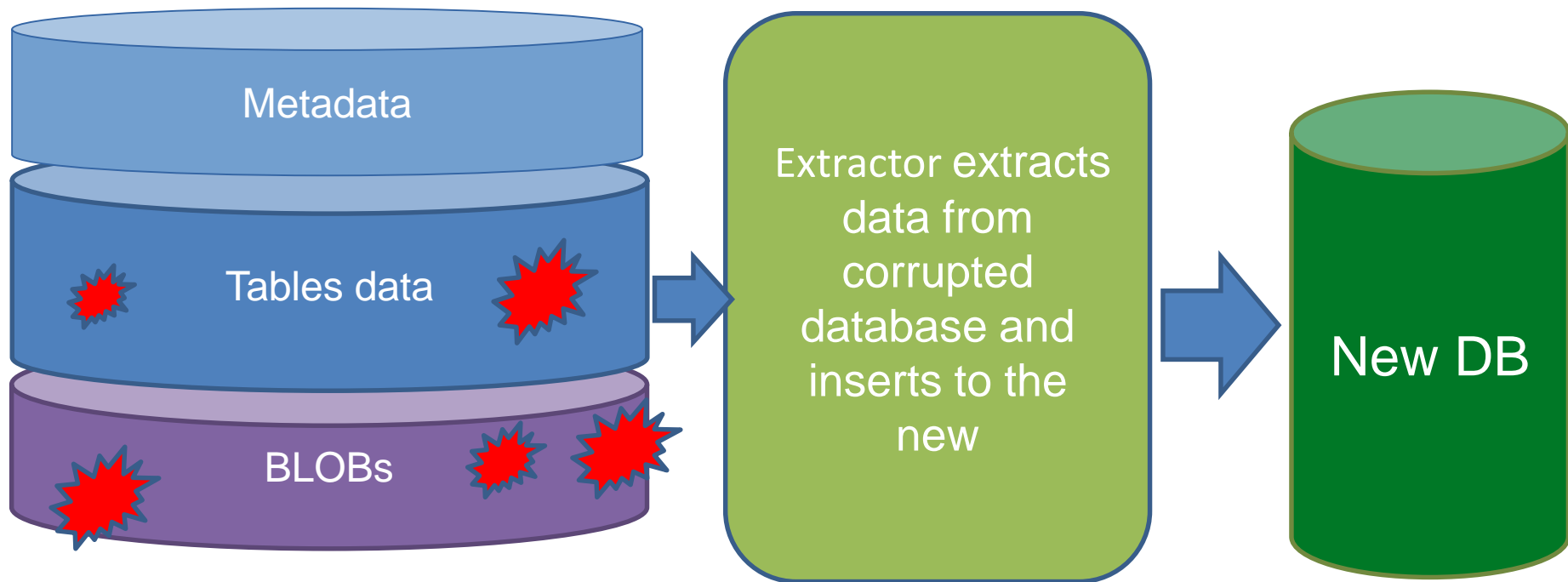
FirstAID Extractor: External Metadata
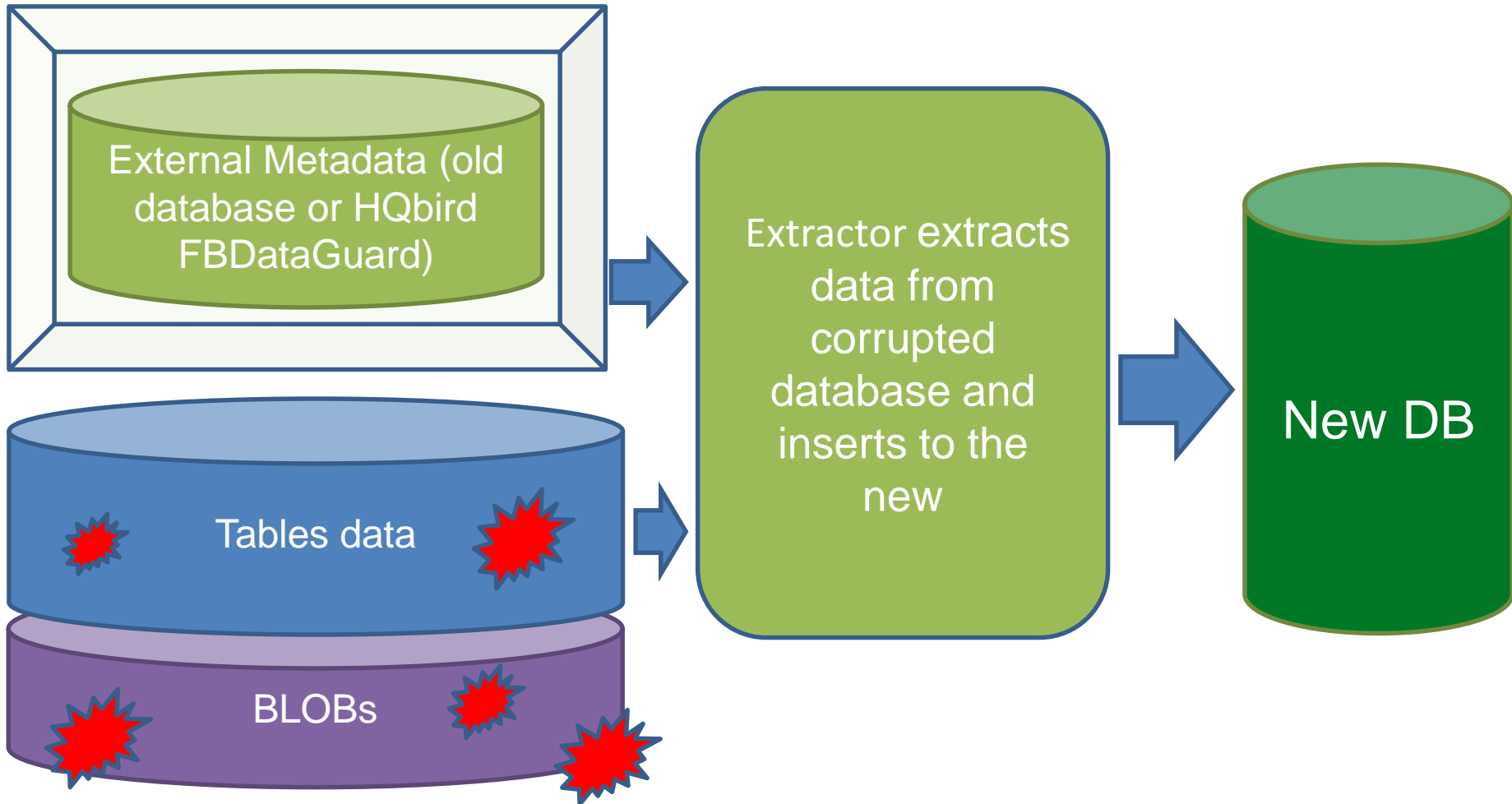
Effectiveness

- 99% success rates
    - Ransomware with encrypted beginning
    - HDD corruptions: bad blocks, lost less
    - Record-level corruptions
    - Nbackup failures
- 1%
    - Ransomware with 50%+ encryption
    - Heavy HDD corruptions
    - Corrupted metadata

Thank you

- Questions?
- support@ib-aid.com