YDBAIM

Application Independent Metadata

YottaDB® – https://yottadb.com

- A mature, high performance, hierarchical key-value, language-agnostic, NoSQL database whose code base scales up to mission-critical applications like large real-time core-banking and electronic health records, and also scales down to run on platforms like the Raspberry Pi Zero, as well as everything in-between.

- *Rock Solid. Lightning Fast. Secure. Pick any three.*

Metadata – Data About Data

- *Content-based access*

- What

  – Cross references

  – Statistics

- Why

  – Performance

History & Goals

- All applications need metadata

- But keep reinventing the wheel
  - Error prone and duplicates resources
  - YottaDB did it for Octo

- YDBAIM (Application Independent Metadata) intended to meet needs of all applications

Sample Use Case

- Histories-R-Us Support gets a call

    "Hi, I'm George, a former US President. I need to correct my record…"

- Application needs to find the record

Former US Presidents

```
^USPresidents(1789,1797)="George||Washington"
^USPresidents(1797,1801)="John||Adams"
^USPresidents(1801,1809)="Thomas||Jefferson"
^USPresidents(1809,1817)="James||Madison"
…
^USPresidents(1993,2001)="Bill||Clinton"
^USPresidents(2001,2009)="George|W.|Bush"
^USPresidents(2009,2017)="Barack||Obama"
^USPresidents(2017,2021)="Donald||Trump"
```

Find Presidents Named George

```
YDB>s x=$$XREFDATA^%YDBAIM("^USPresidents",2,"|",1,,,,2)

YDB>w x
^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65
YDB>f  s y1=$o(@x@(1,"George",y1)) q:""=y1  zwr ^USPresidents(y1,$o(^USPresidents(y1,"")))
^USPresidents(1789,1797)="George||Washington"
^USPresidents(1989,1993)="George|H.W.|Bush"
^USPresidents(2001,2009)="George|W.|Bush"

YDB>zwr @x@(1,"George",*)
^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(1,"George",1789,1797)=""
^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(1,"George",1989,1993)=""
^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(1,"George",2001,2009)=""

YDB>; Note: abbreviated keywords & functions preferable to shrinking font
```

Triggers Maintain Consistency

```
YDB>w ^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(3)
#101
YDB>w $d(^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(1,"Zaphod"))
0
YDB>s ^USPresidents(4241,4245)="Zaphod||Beeblebrox"

YDB>w $d(^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(1,"Zaphod"))
10
YDB>s y1="" f  s y1=$o(@x@(1,"Zaphod",y1)) q:""=y1  zwr ^USPresidents(y1,$o(^USPresidents(y1,"")))
^USPresidents(4241,4245)="Zaphod||Beeblebrox"

YDB>k ^USPresidents(4241,4245)

YDB>s y1="" f  s y1=$o(@x@(1,"Zaphod",y1)) q:""=y1  zwr ^USPresidents(y1,$o(^USPresidents(y1,"")))

YDB>
```

XREFDATA^%YDBAIM()

```
YDB>w $t(XREFDATA^%YDBAIM)
XREFDATA(gbl,xsub,sep,pnum,nmonly,zpiece,omitfix,stat,type)
YDB>
```

0 ⇒ flat global schema (default)
1 ⇒ Fileman schema (coming soon)
Future schema mappings as needed

0 ⇒ no statistics (default)
1 ⇒ count of each value
2 ⇒ count of each value & no of values

Global
Variable

Omit fixed subscripts in metadata
(Default is 1, to omit fixed)

Subscript
Specification

Piece
Separator

Piece separator is byte, not character
(For UTF-8 applications)

Piece
Selection

Return only metadata variable name
(Don't set triggers or compute metadata)

^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65

- Prefix: `^%ydbAIMD`

- Suffix `f1x7fSMuGT4HtAEXAx0g65`
  - 22 character alphanumeric 128-bit MurmurHash3 (https://en.wikipedia.org/wiki/MurmurHash)
  - Computed from function parameters – $ZYSUFFIX()
  - Excellent statistical properties for non-cryptographic use

Subscript Specification

- # of subscripts or local array passed by reference

- ZWRITE format for combinations of ranges & values

```
YDB>s s=2,s(1)=":1800;2001"

YDB>s y=$$XREFDATA^%YDBAIM("^USPresidents",.s,"|","1:3",,,,2)

YDB>w y
^%ydbAIMDMtkn6f1ervr5dYFLRAar4D
YDB>f  s y1=$o(@y@(1,"George",y1)) q:""=y1  zwr ^USPresidents(y1,$o(^USPresidents(y1,"")))
^USPresidents(1789,1797)="George||Washington"
^USPresidents(2001,2009)="George|W.|Bush"

YDB>
```

Piece Selection

- Flexible – one piece, ranges of pieces, or combinations

- Added pieces to metadata when needed

```
YDB>k s s s(2)="1918:1941"

YDB>s z1=$$XREFDATA^%YDBAIM("^USPresidents",.s,"|","1;3",,,,,2) w z1
^%ydbAIMDFSuiy4FQTl32zhzsalGaAA
YDB>zwr @z1@(2,*) ; only contains metadata about metadata
^%ydbAIMDFSuiy4FQTl32zhzsalGaAA(2)="|"

YDB>s z2=$$XREFDATA^%YDBAIM("^USPresidents",.s,"|",2,,,,2) w z2 ; note z1=z2
^%ydbAIMDFSuiy4FQTl32zhzsalGaAA
YDB>zwr @z2@(2,*) ; now contains metadata and metadata about metadata
^%ydbAIMDFSuiy4FQTl32zhzsalGaAA(2)="|"
^%ydbAIMDFSuiy4FQTl32zhzsalGaAA(2,"",1913,1921)=""
^%ydbAIMDFSuiy4FQTl32zhzsalGaAA(2,"",1923,1929)=""
^%ydbAIMDFSuiy4FQTl32zhzsalGaAA(2,"",1929,1933)=""
^%ydbAIMDFSuiy4FQTl32zhzsalGaAA(2,"G.",1921,1923)=""

YDB>
```

Avoiding Indirection

- ## Write code without metadata

- ## Compute metadata only when needed

```
YDB>d UNXREFDATA^%YDBAIM zwr ^?1"%ydbAIMD".E

YDB>set x=$$XREFDATA^%YDBAIM("^USPresidents",2,"|","1;3",1,,,2) w x," ",$d(@x)
^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65 0
YDB>i '$e($g(^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(3)),4)&$$XREFDATA^%YDBAIM("^USPresidents",2,"|","1;3",,,,2)

YDB>w ^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(3)
#101
YDB>
```

Statistics

- ## Two types of statistics

```
YDB>s x=$$XREFDATA^%YDBAIM("^USPresidents",2,"|","1:3",,,,2)

YDB>s z="" f i=1:1:5  s z=$o(@x@(-1,z)) zwr @x@(-1,z) ; count of each value
^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(-1,"Abraham")=1
^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(-1,"Andrew")=2
^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(-1,"Barack")=1
^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(-1,"Benjamin")=1
^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(-1,"Bill")=1

YDB>zwr ^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(-3:-1),^(11) ; # of distinct values & # of total values
^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(-3)=39
^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(-2)=14
^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(-1)=31
^%ydbAIMDf1x7fSMuGT4HtAEXAx0g65(11)=135

YDB>
```

Operational Considerations

- Journaling & replication unnecessary for AIM globals
  - Generate on demand as needed
- Put in a separate region and delete on crash recovery
- Use MM access method for maximum performance
- Sourcing `ydb_env_set` does this for YDBAIM region

Status & Roadmap

- Code is production grade & usable today

- Coming...
  - Metadata for Fileman files
  - C API
  - Documentation in plugins manual
  - APIs for other supported languages

Y⬡tta**DB**

Thank You!

K.S. Bhaskar
bhaskar@yottadb.com