Y2K22

NOTES ON JANUARY 6 2022 TRAINING

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The bug

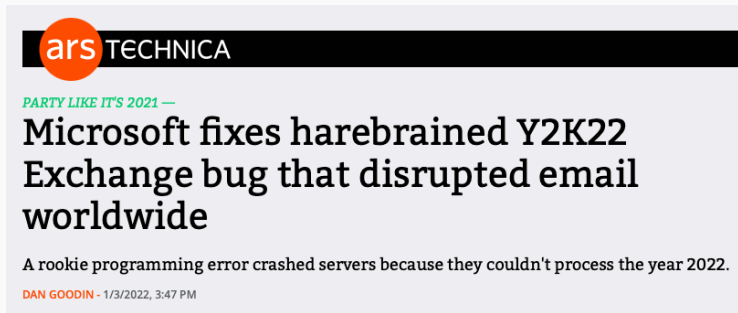Exchange Server (2016 and 2019) stopped accepting incoming mail as the new year, 2022, began.

Figure 1: *Ars Technica* headline. The term "harebrained" and others are quotations from people interviewed. [Goo22]

Exchange checks the version number of its anti-malware data file

A sequence of digits can mean different things. For this presentation, I will be distinguishing some meanings typographically

Example	Meaning
"12345"	The sequence of ASCII digits, "1", "2", …, "5"
12 345	The decimal numeric value twelve-thousand three-hundred forty five

Table 1: Typographic conventions

The AV version number is of the form YYMMDDHHmm. For example

- "2112315503"
- "2201000600"

- Programming languages have variables
- Variables have types
- A common type is `int32`.
- An `int32` can represent numbers from —2 147 483 648 through 2 147 483 647.
- Let's call 2 147 483 647 "MaxInt32".

- 2 112 315 503 is less than MaxInt32.
- 2 201 000 600 is greater than MaxInt32.
- Trying to putting a numerical value greater than MaxInt32 into an `int32` causes errors.

There is another kind of 32 bit integer type that doesn't handle negative values. It is often referred to as a `uint32`. It handles numerical values in the range from 0 through 4 294 967 295.

Had the programmer gone with an unsigned 32 bit int for the version number but kept the same versioning scheme, it would have bought 21 more years. The bug would show up on January 1, 2043. The version number on that day would be something like "`4301010000`".

(Place holder slide)

- Default `int` type is signed.
- A quick way to get something to work by deadline.
- One may know that this needs a more robust method when you first write it, and you naively expect that you (or someone) will get to fix it up later.

Our job is not to punish developers for boneheaded bugs. Our job is the give them the help and resources they need to avoid such bugs in the first place and to use teaching opportunities as they arise.

- There is an unsigned 64-bit integer type: `uint64`;
- A `uint64` can handle numerical values between 0 and 18 446 744 073 709 551 616;
- MaxUint64 is greater than 9 912 312 359. That is, it will be able to handle version "`9912312359`".

This is still not a proper fix.

- Even the smallest change to something like Exchange Server needs to be tested extensively;
- Changing to `uint64` might have weird side-effects elsewhere in Exchange;
- Deploying updates to Exchange is not a fun thing to do on New Year's Day and may break other things for some customers;
- The "easy fix" is still not a proper fix;
- Microsoft needed to do something immediately.

- Make 2021 have more days;
- A new version number for the January 1 AV data became "`20211232`";
- This trick will last up until the 99th day of the 99th month of 2021;
- If they stick to this representing dates, that lasts until January 2, 2046.

2024-05-08

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└─The bug

└─The quick and dirty fix

THE QUICK AND DIRTY FIX

- Make 2021 have more days;
- A new version number for the January 1 AV data became "20211232";
- This trick will last up until the 99th day of the 99th month of 2021;
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1. I have to wonder whether whoever came up with that was familiar with the censorship evading trick used in China of referring to May 35.

Timestamps as version strings

- Ordering: We want to be able to compare version strings to know which is larger;
- Increasing: We want them to get larger over time;
- Relative to now: Human readers may wish to see how long ago a version was created.

There are other things we may want, but those are the ones we will talk about.

- Typically easy to see which is larger;
- They increase over time;
- Human readers can compare them to current time.

DATE AND DATE STRINGS

- Typically easy to see which is larger;
- They increase over time;
- Human readers can compare them to current time.

1. Leap seconds are a thing. Networked computers should use TAI instead of UTC.

Timestamps as version strings

Total Ordering

Definition

A definition of a total ordering might go here. But it probably isn't useful.

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└─Timestamps as version strings
   └─Total Ordering
      └─Total ordering

TOTAL ORDERING

Definition
A definition of a total ordering might go here. But it probably isn't useful.

1. Anyone who could read the formal definition already knows what a total ordering is. So this is would be a pointless slide.

If you know what data format is being used

ISO "`2021-12-31`" is before "`2022-01-01`"

🇺🇸 short "`12/31/2021`" is before "`1/1/2022`"

MS AV "`20211231`" is before "`20220101`"

🇨🇦 "`Friday December 31, 2021`" is before
"`Saturday January 1, 2022`"

🇺🇦 "`п'ятниця 31 грудня 2021 р.`" is before
"`субота 1 січня 2022 р.`"

ISO : Can sort using ASCII string sorting;

MS AV : Can interpret as a number and sort numerically;

short : Must parse into components, but each component can be sorted numerically;

Long forms : Must be parsed into components. Ordering of month names must be known to sorting method.

2024-05-08

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└─Timestamps as version strings
  └─Total Ordering
    └─Shortcuts to sorting

SHORTCUTS TO SORTING

ISO	Can sort using ASCII string sorting;
MS AV	Can interpret as a number and sort numerically;
■ short	Must parse into components, but each component can be sorted numerically;
Long forms	: Must be parsed into components. Ordering of month names must be known to sorting method.

1. The directories in the source book club repo are named using ISO dates exactly because of this.

These date (or time) formats can be sorted without interpreting them as dates (or times)

ISO (e.g., `2022-11-14`)

MS AV (e.g., `20221114`)

Unix time (e.g., `1668471553`)

RESOURCES

Resources

- These slides
- Sources

[Goo22]   Dan Goodin. **"Microsoft fixes harebrained Y2K22 Exchange bug that disrupted email worldwide".** In: *Ars Technica* (Jan. 3, 2022). URL: `https://arstechnica.com/information-technology/2022/01/exchange-server-bug-gets-a-fix-after-ruining-admins-new-years-plans/` (visited on 10/30/2022).