

Progress lies within Backwards Compatibility breaks

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The PHP Foundation

2026-05-15, phpday 2026

Backwards compatibility is great!



Susanne Nilsson *"Country Road"* (2016) / CC BY-SA 2.0



Richard Szwejkowski "Birmingham 06-080821 3585" (2021) / CC BY-SA 2.0

```
1 use std::collections::HashSet;
2 use gp_algo::implementations::IMPLEMENTATIONS;
3
4 // Vitaly Bragilevsky
5 #[test]
6 fn test_smaller_cases() {
7     let cases : [(..., 3)] = [
8         (1, to_set(strs:&["()"])),
9         (2, to_set(strs:&["()", "()()"])),
10        (3, to_set(strs:&["()()()", "()()()", "((())", "(())()"]));
11
12    for (n : i32, expected : HashSet<String>) in cases {
13        for (name : &&str, gen : &GenerateParenthesesFn) in IMPLEMENTATIONS {
14            assert_eq!(HashSet::from_iter(gen(n)), expected, "We test {} on n={}", name, n);
15        }
16    }
17 }
```

test_smaller_cases()

Run Test ::tests

- Test Results 3 ms
- tests 3 ms
 - same_results_on_larger_cases 2 ms
 - test_smaller_cases 1 ms

✓ Tests passed: 2 of 2 tests - 3 ms

```
/Users/ksenia.starodubtseva/.cargo/bin/cargo test --color=always --profile test --package gp_algo
--test tests "" --no-fail-fast --format=json -Z unstable-options --show-output
Testing started at 22:15 ...
Finished `test` profile [unoptimized + debuginfo] target(s) in 0.33s
Running tests/tests.rs (target/debug/deps/tests-22e19419c2f92b7b)

Process finished with exit code 0
```



Breaking BC is necessary

Breaking BC is necessary

- Health & Safety issues
- Technological evolution
- Unforeseen externalities
- Unsafe usage
- Design mistakes
- Harmonisation
- Reduce future opportunity costs

Reluctance to BC breaks

Main reasons

- Migrating is expensive
- Migrating is difficult
- A note in the documentation should suffice
- Unnecessary maintenance burden

Outside of software



With Associates *"Fridge"* (2009) / CC BY-SA 2.0

Evolution of refrigerants

≤1920s Toxic gases e.g. ammonia, sulphur dioxide, chloromethane

1930s Use of chlorofluorocarbons (CFCs) [4] a non-toxic refrigerant

1970s Regulation of CFCs after discovery of ozone-depleting properties of CFCs

1980s Use of hydrochlorofluorocarbons (HCFCs) as a replacement for CFCs

1987 Adoption of **Montreal Protocol** [5]

- Phase-out ban for consumption & production of CFCs

1990s Use of hydrofluorocarbons (HFCs) non-ozone-depleting replacement for HCFCs

1997 Adoption of **Kyoto Protocol** [6]

- Reduction of consumption & production of HCFCs

2016 Adoption of **Kigali Amendment** to the Montreal Protocol [5]

- Reduction of consumption & production of HFCs of 80% over the next 30 years

2024 New EU Regulation on total phase out of HFCs by 2050 [7]

2025 UK Bans use of F-gasses with Global Warming Potential (GWP) ≥ 750 [8]



Okinawa did it twice! [10]

Changes to the national highway code

In the UK an average of 2 changes per year since 2015 [11]

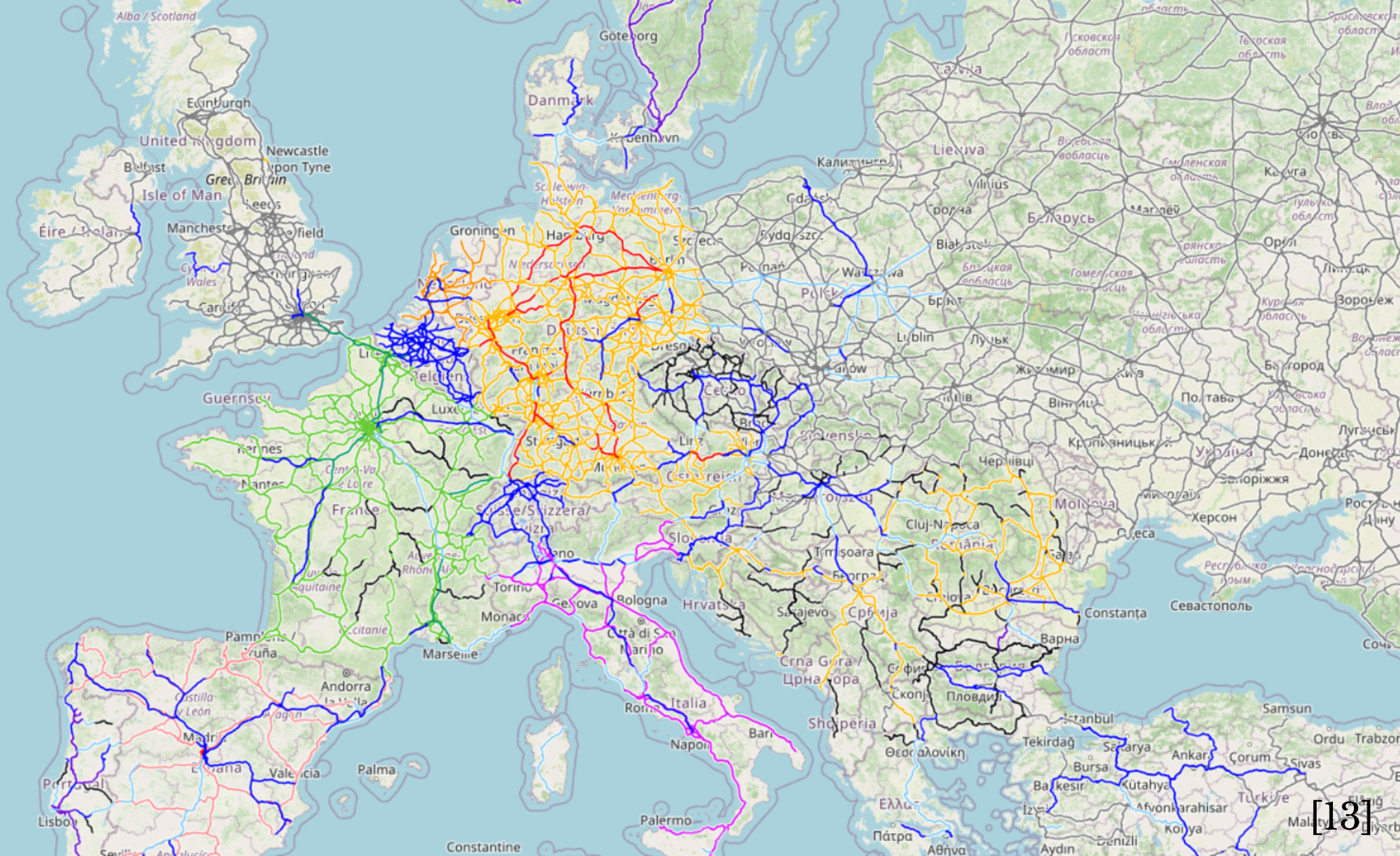
In France an average of 14.5 changes per year since 2001 [12]

45
N4

45
N5

02





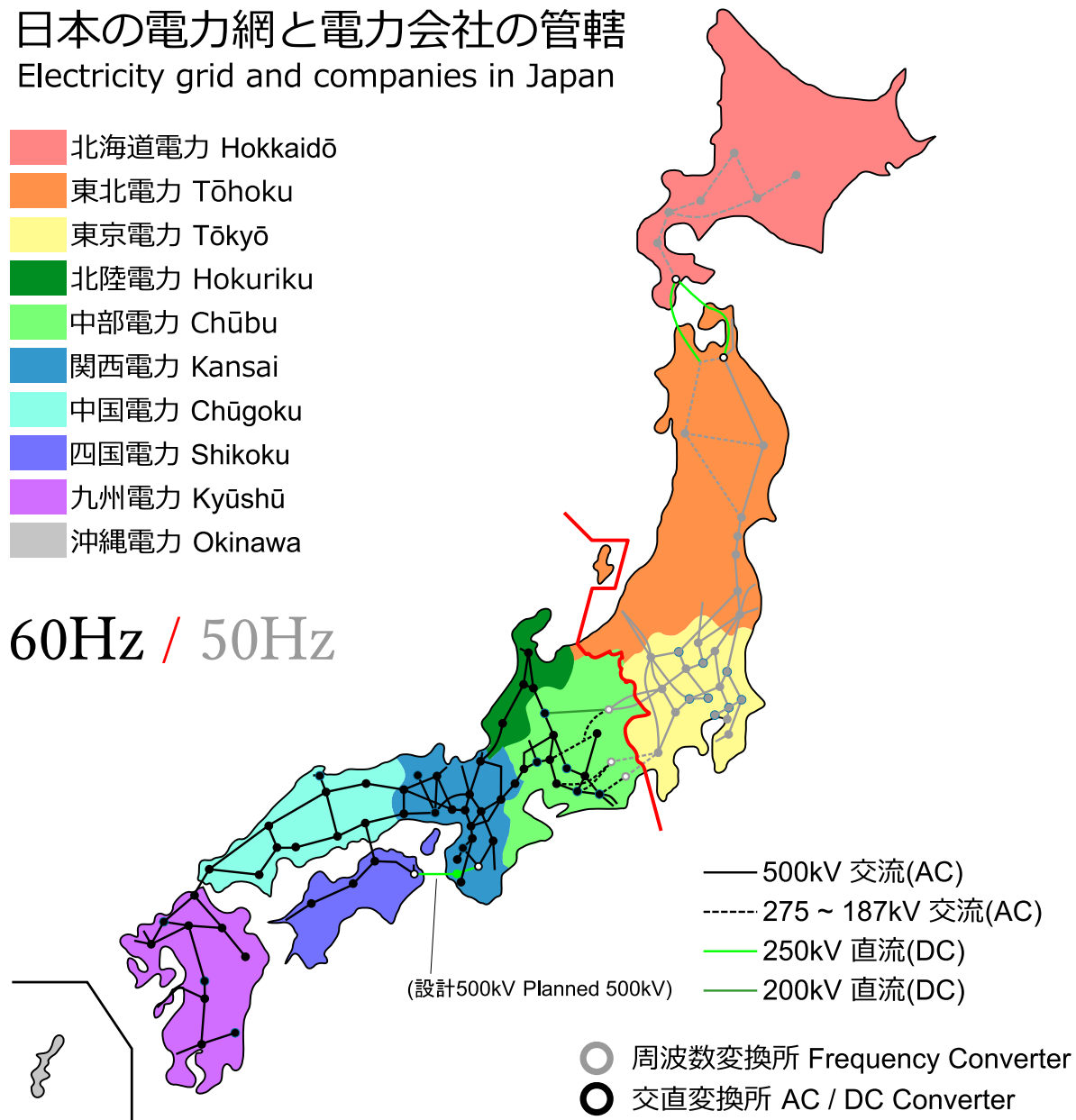


日本の電力網と電力会社の管轄

Electricity grid and companies in Japan

- 北海道電力 Hokkaidō
- 東北電力 Tōhoku
- 東京電力 Tōkyō
- 北陸電力 Hokuriku
- 中部電力 Chūbu
- 関西電力 Kansai
- 中国電力 Chūgoku
- 四国電力 Shikoku
- 九州電力 Kyūshū
- 沖縄電力 Okinawa

60Hz / 50Hz





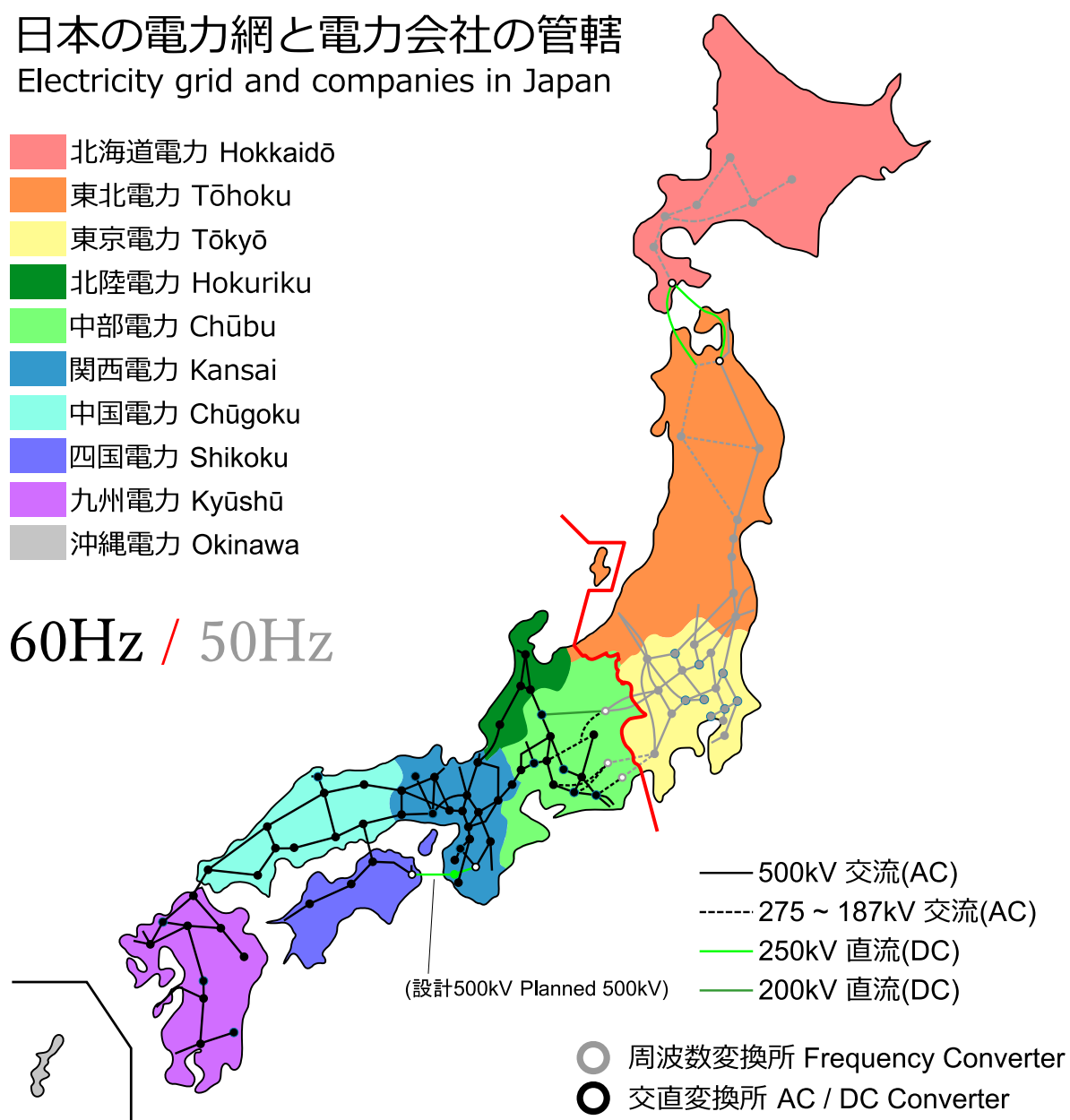


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60Hz / 50Hz



*Just maintain BC and engineer a
solution around it!*



Glenn Beltz *"United 737 MAX 8 Departs Santa Barbara"* (2024) / CC BY 2.0

Lion Air crash: officials say 189 onboard lost flight JT610 - as it happened

Boeing passenger plane went down shortly after take-off from Jakarta

Lion Air

Lion Air: Why did a brand-new Boeing jet crash 13 minutes after takeoff?

By [Blanca Britton](#), CNN

🕒 7 min read · Updated 5:24 AM EDT, Wed October 31, 2018

ing jet crash

Ethiopian Airlines plane crash kills all 157 people on board

The aircraft, carrying passengers from 35 countries, was only months old and of the same type involved in a previous disaster.

🕒 Sunday 10 March 2019 18:40, UK

By Blanca Brito
🕒 7 min read · Updated 5...

Lion
13

Lion
13

Ethiopian Airlines
people

Analysis

Ethiopian flight 302: second new Boeing
737 to crash in four months

Gwyn Topham

Transport correspondent

Confidence that a newer plane inevitably means a safer
plane in danger of being shaken

jet crash

157

months old and of the same

By Blanca Brito
7 min read · Updated

Ethiopian Airlines

second new Boeing

et crash

Ethiopian Airlines crash: anti-stall system 'engaged repeatedly'

Software may have redeployed without human input before plane went down, say sources

157

d and of the same

GWY
Transport

Confidence that a newer plane in danger of being shaken

Lion
13

The air type

Sunday

By Blanca Brito
7 min read · Updated

Maneuvering Characteristics Augmentation System



Dmitry Terekhov "Boeing-737-200" (2009) / CC BY-SA 2.0



Yamaguchi Yoshiaki "7 3 7 NG take off" (2006) / CC BY-SA 2.0



Glenn Beltz *"United 737 MAX 8 Departs Santa Barbara"* (2024) / CC BY 2.0

So why?

2006 Appoints teams for a “clean sheet” design replacing the 737 [25]

2010 Postponed decision about 737 replacement [26]

2010 Airbus announces the A320neo family of planes

2011 Boeing decides to re-engine the 737 due to competitive pressure of the A320neo

2016 First test flight

2017 Airworthiness approval via Supplemental Type Certificate of 737 certificate

- 10-15% of the cost of a clean-sheet design
- Faster delivery than a clean-sheet design
- Airline pilots would not require a new type certification

MCAS was a solution to not require pilot training and a new type certification.



Boeing Is Reportedly In Beginning Stages Of Developing 737 MAX Replacement



By [Aaron Bailey](#) — Published Sep 30, 2025, 2:27 AM EDT

Journalist - Aaron joins the Simple Flying team with 14 years of experience in the travel & tourism industry. He has a background in airports and travel consulting for global companies in New Zealand, Europe, and North America. An Avid traveler, Aaron has visited 52+ countries across five...

Versioning

Versioning

- International standards (e.g. ISO, EuroNorm) are versioned by years
- Country laws
 - ▶ Introduction year
 - ▶ Amendment to existing law
 - ▶ Removal
- Professional certificates (e.g. “Gaz Safe”, Simulator Assessments)

semver to the rescue!

Not all software uses semantic versioning

- Protocols (e.g. IETF RFCs)
- Most PLs
 - Including PHP
- End user software
- Linux kernel
- OS Versions

Did you know there is a version 2 of semver? [28]

*Does semver even solve the migration
problem?*

I absolutely detest SemVer because it has no way of doing graceful deprecation, which arises because it conflates implementation and interface.

A library that wants to do graceful deprecation will have three releases, *A*, *B*, and *C*, where *B* introduces a new API and *C* removes the old one.

C is a breaking change for anything coming from *A*.

C is a breaking change for anything using *B* and not moving to the new interfaces.

You really want a set of SemVers, for each interface you support.

So you actually have something like:

- *A* : {1.0}
- *B* : {1.1, 2.0}
- *C* : {2.1}

I have never seen a system using SemVer that supports this. [...]

What does “compatibility” even mean?

What does “compatibility” even mean?

Is something “incompatible” if:

- It removes a feature?
- It adds a feature?
- Changes the value of a constant?
- Changes an error message?
- Changes an error code?
- Changes an exception type?
- Changes the side effects?
- Changes internal implementation?

Is the “contract” about **observable** behaviour or **documented** behaviour?

BC breaks in software

Examples of BC breaks

- `goto` in PLs no longer allows jumping into functions
- `SameSite` cookie default changed to `Lax` from `None`. [30]
- Emails requiring server authentication and proof of no spoofing
- More modern hardware requirements for the Linux kernel [31]
- Discontinued APIs offered by providers

In PHP:

- Object passing by val to passing by pointer
- `register_globals`
- Magic quotes
- Type and Value input validation

One of the responsibilities, I think, we have as designers is to protect the player from themselves.

— Sid Meier [32, 41:34 - 41:41]

One of the responsibilities, I think, we
have as designers is to protect the
developers from themselves.

— Me

- Types
 - Refined types to constrain value
- Visibility
- Read-only / mutable keywords
- Enumerations
- `final` / `open`
- `#[\Override]` attribute
- `#[\NoDiscard]` attribute
- Rust's borrow checker
- Literal types & values
 - E.g. preventing SQL injections at compile time in Scala [33]
- Choreographic programming for deadlock-free concurrent programs [34], [35]

We need to embrace making changes

— Björkus Dorkus, C23 editor [36]

\$array < \$integer

\$\$variable_variables

md5 ()

\$string1 & \$string2

uniqid()

Wisdom from Pr. R. L. Ackoff

There are 4 ways of treating a problem

1. Absolving

There are 4 ways of treating a problem

1. Absolving
2. Resolving

There are 4 ways of treating a problem

1. Absolving
2. Resolving
3. Solving

There are 4 ways of treating a problem

1. Absolving
2. Resolving
3. Solving
4. Dissolving

By redesigning the system that has it, so
that the problem no longer exists.

— R. L. Ackoff, [37, 1:00:20-1:00:27]

Thank you!



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Bibliography

- [1] S. Nilsson, 'Country Road'. Accessed: Apr. 03, 2026. [Online]. Available: <https://www.flickr.com/photos/infomastern/26832682840/>
- [2] R. Szwejkowski, 'Birmingham 06-080821 3585'. Accessed: Apr. 03, 2026. [Online]. Available: <https://www.flickr.com/photos/68112440@N07/51367961740/>
- [3] W. Associates, 'Fridge'. Accessed: Apr. 05, 2026. [Online]. Available: <https://www.flickr.com/photos/withassociates/3459664237/>
- [4] 'Chlorofluorocarbon'. Jan. 20, 2026. Accessed: Apr. 05, 2026. [Online]. Available: <https://en.wikipedia.org/w/index.php?title=Chlorofluorocarbon&oldid=1333905245#History>
- [5] U. N. Environment, 'About Montreal Protocol'. Accessed: Apr. 05, 2026. [Online]. Available: <https://www.unep.org/ozonaction/who-we-are/about-montreal-protocol>

Bibliography

- [6] ‘The Kyoto Protocol | UNFCCC’. Accessed: Apr. 05, 2026. [Online]. Available: <https://unfccc.int/process-and-meetings/the-kyoto-protocol>
- [7] ‘Regulation (EU) 2024/573 of the European Parliament and of the Council of 7 February 2024 on fluorinated greenhouse gases, amending Directive (EU) 2019/1937 and repealing Regulation (EU) No 517/2014 (Text with EEA relevance)’. Accessed: Apr. 05, 2026. [Online]. Available: <http://data.europa.eu/eli/reg/2024/573/oj>
- [8] ‘Bans on F gas in new products and equipment: current and future’. Accessed: Apr. 05, 2026. [Online]. Available: <https://www.gov.uk/guidance/bans-on-f-gas-in-new-products-and-equipment-current-and-future>
- [9] J. Collsiöö, ‘English: en:Kungsgatan, Stockholm at the transition from the left to right-hand traffic, 3 September 1967, at. 4:50 in the morning.[1]’. Accessed: Apr.

Bibliography

- 06, 2026. [Online]. Available: https://commons.wikimedia.org/wiki/File:Kungsgatan_1967.jpg#/media/File:Kungsgatan_1967.jpg
- [10] ‘730 (transport)’. Dec. 10, 2025. Accessed: Apr. 08, 2026. [Online]. Available: [https://en.wikipedia.org/w/index.php?title=730_\(transport\)&oldid=1326737504](https://en.wikipedia.org/w/index.php?title=730_(transport)&oldid=1326737504)
- [11] ‘Updates - The Highway Code - Guidance - GOV.UK’. Accessed: Apr. 03, 2026. [Online]. Available: <https://www.gov.uk/guidance/the-highway-code/updates>
- [12] ‘Code de la route - Légifrance’. Accessed: Apr. 03, 2026. [Online]. Available: https://www.legifrance.gouv.fr/codes/texte_lc/LEGITEXT000006074228/2024-03-10/
- [13] ‘OpenRailwayMap’. Accessed: Apr. 05, 2026. [Online]. Available: <https://openrailwaymap.org/>

Bibliography

- [14] C. Aitchison, 'English: The Power Grid of Japan'. Accessed: Apr. 07, 2026. [Online]. Available: https://commons.wikimedia.org/wiki/File:Power_Grid_of_Japan.svg
- [15] U. S. N. photo, 'English: An SH-60F helicopter assigned to the Chargers of Helicopter Antisubmarine Squadron (HS) 14 from Naval Air Facility Atsugi flies over the port of Sendai to deliver more than 1,500 pounds of food to survivors of an 9.0 magnitude earthquake and a tsunami (2011 Tōhoku earthquake and tsunami). The citizens of Ebina City, Japan, donated the food, and the U.S. Military provided earthquake and tsunami relief support.'. Accessed: Apr. 07, 2026. [Online]. Available: https://commons.wikimedia.org/wiki/File:SH-60B_helicopter_flies_over_Sendai.jpg
- [16] D. Globe, 'English: The Fukushima I Nuclear Power Plant after the 2011 Tōhoku earthquake and tsunami. Reactor 1 to 4 from right to left. 한국어: 2011년 토호쿠 대 지진 및 쓰나미 뒤에 후쿠시마 원자력발전소(오른쪽에서 왼쪽으로 1호기에서 4호

- 7|)'. Accessed: Apr. 07, 2026. [Online]. Available: https://commons.wikimedia.org/wiki/File:Fukushima_I_by_Digital_Globe.jpg
- [17] G. Beltz, 'United 737 MAX 8 Departs Santa Barbara'. Accessed: Apr. 03, 2026. [Online]. Available: <https://www.flickr.com/photos/n28307/54240971940/>
- [18] N. Zhou, 'Lion Air crash: officials say 189 onboard lost flight JT610 – as it happened', *the Guardian*, Oct. 2018, Accessed: Apr. 06, 2026. [Online]. Available: <http://www.theguardian.com/world/live/2018/oct/29/lion-air-crash-rescue-teams-search-waters-off-jakarta-for-flight-jt610>
- [19] B. Britton, 'Why did a brand-new Boeing jet crash 13 minutes after takeoff?'. Accessed: Apr. 06, 2026. [Online]. Available: <https://www.cnn.com/2018/10/30/asia/lion-air-plane-why-did-it-crash-intl>

Bibliography

- [20] ‘Ethiopian Airlines plane crash kills all 157 people on board’. Accessed: Apr. 06, 2026. [Online]. Available: <https://news.sky.com/story/ethiopian-airlines-plane-with-157-people-on-board-crashes-11660677>
- [21] G. Topham, ‘Ethiopian flight 302: second new Boeing 737 to crash in four months’, *The Guardian*, Mar. 2019, Accessed: Apr. 06, 2026. [Online]. Available: <https://www.theguardian.com/world/2019/mar/10/ethiopian-flight-302-second-new-boeing-737-max-8-to-crash-in-four-months>
- [22] Reuters, ‘Ethiopian Airlines crash: anti-stall system 'engaged repeatedly'’, *The Guardian*, Apr. 2019, Accessed: Apr. 06, 2026. [Online]. Available: <https://www.theguardian.com/business/2019/apr/03/ethiopian-airlines-crash-boeing-software-engaged-repeatedly>
- [23] Dmitry Terekhov, ‘Boeing-737-200’. Accessed: Apr. 03, 2026. [Online]. Available: <https://www.flickr.com/photos/44400809@N07/4080679175/>

Bibliography

- [24] Y. Yoshiaki, ‘737 NG take off’. Accessed: Apr. 08, 2026. [Online]. Available: <https://www.flickr.com/photos/woinary/212256368/>
- [25] FlightGlobal, ‘Boeing firms up 737 replacement studies by appointing team - FlightGlobal’. Accessed: Apr. 07, 2026. [Online]. Available: <https://www.flightglobal.com/ops-safety/2006/03/boeing-firms-up-737-replacement-studies-by-appointing-team/>
- [26] ‘737 decision may slip to 2011: Credit Suisse’. Accessed: Apr. 07, 2026. [Online]. Available: <https://www.flightglobal.com/fleets/2010/06/737-decision-may-slip-to-2011-credit-suisse/>
- [27] A. Bailey, ‘Boeing Is Reportedly In Beginning Stages Of Developing 737 MAX Replacement’. Accessed: Apr. 07, 2026. [Online]. Available: <https://simpleflying.com/boeing-beginning-stages-developing-737-max-replacement/>

Bibliography

- [28] T. Preston-Werner, ‘Semantic Versioning 2.0.0’. Accessed: Apr. 07, 2026. [Online]. Available: <https://semver.org/>
- [29] D. Chisnall, ‘David Chisnall "I absolutely detest SemVer"’. Accessed: Apr. 05, 2026. [Online]. Available: https://infosec.exchange/@david_chisnall/116305789278136887
- [30] ‘Cookies default to SameSite=Lax - Chrome Platform Status’. Accessed: May 09, 2026. [Online]. Available: <https://chromestatus.com/feature/5088147346030592>
- [31] M. Larabel, ‘AMD K5 CPUs The Latest To Be Retired With Linux's Aging & Stagnate Hardware Support’. Accessed: May 09, 2026. [Online]. Available: <https://www.phoronix.com/news/AMD-K5-CPU>

- [32] GameSpot, ‘GDC 2010: Sid Meier Keynote - "Everything You Know is Wrong"’. Accessed: Apr. 05, 2026. [Online]. Available: <https://www.youtube.com/watch?v=bY7aRJE-oOY>
- [33] ‘Literal types, what they are good for?’. Accessed: Apr. 07, 2026. [Online]. Available: <https://slideslive.com/38907881/literal-types-what-they-are-good-for?ref=og-meta-tags>
- [34] S. Giallorenzo, F. Montesi, and M. Peressotti, ‘Choral: Object-oriented Choreographic Programming’, *ACM Transactions on Programming Languages and Systems*, vol. 46, no. 1, pp. 1–59, Mar. 2024, doi: 10.1145/3632398.
- [35] G. Shen, S. Kashiwa, and L. Kuper, ‘HasChor: Functional Choreographic Programming for All (Functional Pearl)’, *HasChor*, vol. 7, no. ICFP, pp. 207:541–207:565, Aug. 2023, doi: 10.1145/3607849.

Bibliography

- [36] 'C is So Back: Unbreaking the Charter - Björkus Dorkus - NDC TechTown 2023'. Accessed: Apr. 07, 2026. [Online]. Available: <https://www.youtube.com/watch?v=zLyz4kJvkvQ>
- [37] 'Systems Thinking, Learning, and Problem Solving by Russell L. Ackoff'. Accessed: May 12, 2026. [Online]. Available: <https://www.youtube.com/watch?v=O9TE9HWFo6U>