

ENTERPRISE BLOCKCHAIN PROTOCOLS

EVOLUTION INDEX 2020



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EXECUTIVE SUMMARY

This index is targeted at giving a neutral and objective view into the state of the global enterprise blockchain development landscape as of the beginning of 2020.

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The underlying research aims to provide a transparent and consistent way of measuring the growth of these software projects, with a particular focus on developer activity and engagement. This focus was chosen as it provides distinct signals to understand how these software platforms and their communities are emerging and evolving.

Key findings:

- 2015** The earliest an enterprise blockchain protocol went online on GitHub.
- 86%** Corda and Hyperledger Fabric account for 86% of the total number of unique developers that pushed code, and are the most consistently active over time.
- 17,561** Number of unique developers taking part in Hyperledger Fabric’s developer community, compared to Corda’s 5,678. Meanwhile, Corda developers have made twice as many code contributions tallying at 30,382 pushes vs. Fabric’s 12,439 pushes.
- ETH** Protocols that are tied to larger communities, such as Quorum being a fork of Ethereum, or Hyperledger projects’ relation to the Linux Foundation, tend to see a higher amount of attention through easier activity—for example, repository starring.
- R3** Protocols with backing by larger companies with resources to dedicate to hiring full-time developers, such as R3 to Corda, IBM to Hyperledger Fabric, or ConsenSys to Hyperledger Besu, have more consistent, engaged developers that frequently push code.
- 2x** Increase in Quorum contributors in 2019. Quorum development had been mostly stagnant before 2018. However, from mid-2018 and all through 2019, the protocol has steadily increased two times in the average number of contributors.
- Besu** Recently sprung into existence with a community of engaged developers.
- 83%** Scale of Sawtooth’s decline in development activity in 2019. Both MultiChain and Hyperledger Sawtooth have not seen much growth over the years, with Sawtooth activity declining 83% in 2019.

INTRODUCTION

Recent years have seen the increasing interest in blockchain technology turn into actual use cases and applications in various industries.

See [Boston Consulting Group: Capturing the Value of Blockchain](#)¹

While public blockchain networks are always up to scrutiny, with no shortage of reports as to their activity at any given moment, the private permissioned blockchain networks—the likelier candidates for enterprise adoption—have remained largely unquantified.

As part of this report, we are focusing on the publicly available developer data of the six leading enterprise blockchain protocols.

The protocols analyzed:

- [Besu](#)²: live on GitHub starting starting October 2018 as [Pantheon](#)³.
- [Corda](#)⁴: live on GitHub starting October 2016.
- [Fabric](#)⁵: live on GitHub starting August 2016.
- [MultiChain](#)⁶: live on GitHub starting November 2015.
- [Quorum](#)⁷: live on GitHub starting November 2016.
- [Sawtooth](#)⁸: live on GitHub starting May 2016.



1. Jan Philipp Bender, Kaj Burchardi, and Neil Shepherd. "Capturing the Value of Blockchain." BCG.com. <https://www.bcg.com/publications/2019/capturing-blockchain-value.aspx> (accessed January 17, 2020).

2. Hyperledger Besu. HYPERLEDGER.org. <https://www.hyperledger.org/projects/besu> (accessed January 17, 2020).

3. PegaSys Pantheon. GitHub.com. <https://github.com/PegaSysEng/pantheon> (accessed January 17, 2020).

4. Corda. Corda.net. <https://www.corda.net/> (accessed January 17, 2020).

5. Hyperledger Fabric. HYPERLEDGER.org. <https://www.hyperledger.org/projects/fabric> (accessed January 17, 2020).

6. MultiChain. MultiChain.com. <https://www.multichain.com/> (accessed January 17, 2020).

7. Quorum. GoQuorum.com. <https://www.goquorum.com/> (accessed January 17, 2020).

8. Hyperledger Sawtooth. HYPERLEDGER.org. <https://www.hyperledger.org/projects/sawtooth> (accessed January 17, 2020).

METHODOLOGY

The research focuses on general-purpose blockchain protocols and tracks only open-source protocols hosted on GitHub.

One exception to this is Hyperledger Fabric that moved to full-time operation on GitHub in November 2019. Before November 2019, Hyperledger Fabric used Gerrit as their primary collaboration tool and GitHub as a mirror. This report takes this into account and includes the data automatically pushed from Gerrit to GitHub in the analysis.

Hyperledger Besu was known as Pantheon until August 2019, when it became a part of Hyperledger. This report takes this into account and analyzes both the previous Pantheon and the current Hyperledger Besu as one project.

The protocol developer data used is retrieved from the historical GitHub data collected by [GH Archive](#)⁹ from 2011 until the end of 2019.

The GH Archive project collects and stores all [GitHub events](#)¹⁰—collectively called *activity*—triggered by any GitHub account. This means that any time a developer does anything on GitHub relative to an open repository, it triggers an event, gets recorded, and is stored for anyone curious to explore it.

The data analyzed is from the moment the protocol went online on GitHub until the end of 2019.

While the full list of GitHub events is significantly long, this report uses only the events exhibited by the analyzed protocols.

The events are:

- CommitCommentEvent — a comment on a commit is provided.
- CreateEvent — a branch or a tag is created.
- DeleteEvent — a branch or a tag is deleted.
- ForkEvent — a repository is forked.
- GollumEvent — a Wiki page is created or updated.
- IssueCommentEvent — an issue comment is created, edited, or deleted.
- IssuesEvent — an issue is manipulated in any way: created, edited, labeled, etc.
- MemberEvent — an account is added to or removed from a repository.
- PublicEvent — a private repository is made public.
- PullRequestEvent — a pull request is manipulated in any way: created, edited, assigned, etc.
- PullRequestReviewCommentEvent — a comment on a pull request is created, edited, or deleted.
- PushEvent — a commit is pushed to a branch.
- ReleaseEvent — a release is manipulated in any way: created, edited, published, etc. WatchEvent — a repository is starred.

The events comprise the *activity* on GitHub.

For convenience, the protocol names are shortened to one-word names where necessary; for example, Hyperledger Besu is Besu.

9. GH Archive. [GHArchive.org](https://www.gharchive.org/). <https://www.gharchive.org/> (accessed January 17, 2020).

10. GitHub Developer. [Developer.GitHub.com](https://developer.github.com/v3/activity/events/). <https://developer.github.com/v3/activity/events/> (accessed January 17, 2020)

ENTERPRISE BLOCKCHAIN DEVELOPMENT ANALYSIS

First, let's have a look at the total developer numbers tracked for each protocol.

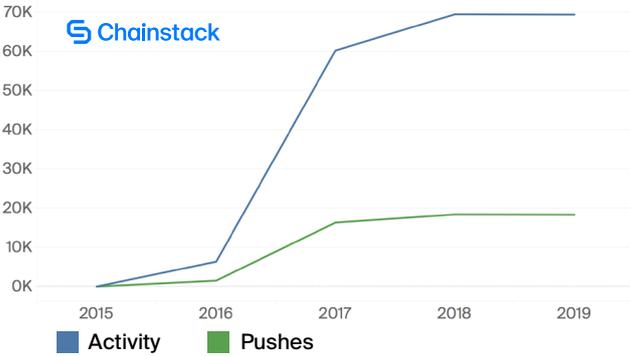
	Besu	Corda	Fabric	MultiChain	Quorum	Sawtooth
Total developers	639	4,904	17,561	1,129	5,678	2,523

Total activity and total pushes

Collectively, push activity makes up 26% of total activity, the rest of which can be accounted for by comments, stars, forks and other interactions with the repositories.

Despite some fluctuation and anomalies, pushes and all other activity appear to have stabilized as of late 2017-early 2018, with ~70,000 events per year across all protocols, of which ~20,000 are code pushes.

[View interactive version](#)

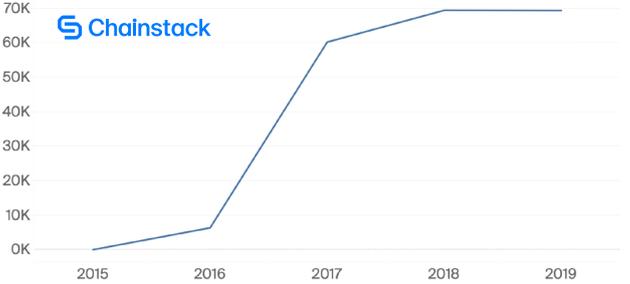


Total activity over time

This is the total developer activity for all protocols from 2015 to 2019.

The overall engagement across all selected protocols has plateaued, although the nature of the developer activity has shifted considerably over time as we will see further on in the report.

[View interactive version](#)

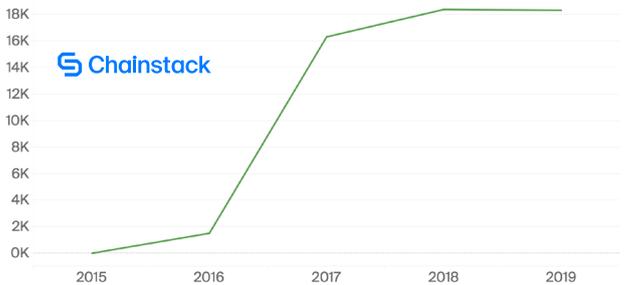


Total pushes over time

Any engagement with a repository from any developer account on GitHub is great to see to understand the network effect of a project as it shows generally the level of interest developers have for a project. However, any activity is not the core aspect of what actually makes a protocol. Pushes to the protocol repositories are what make the protocols.

The collective push activity is fairly consistent demonstrating relative development maturity.

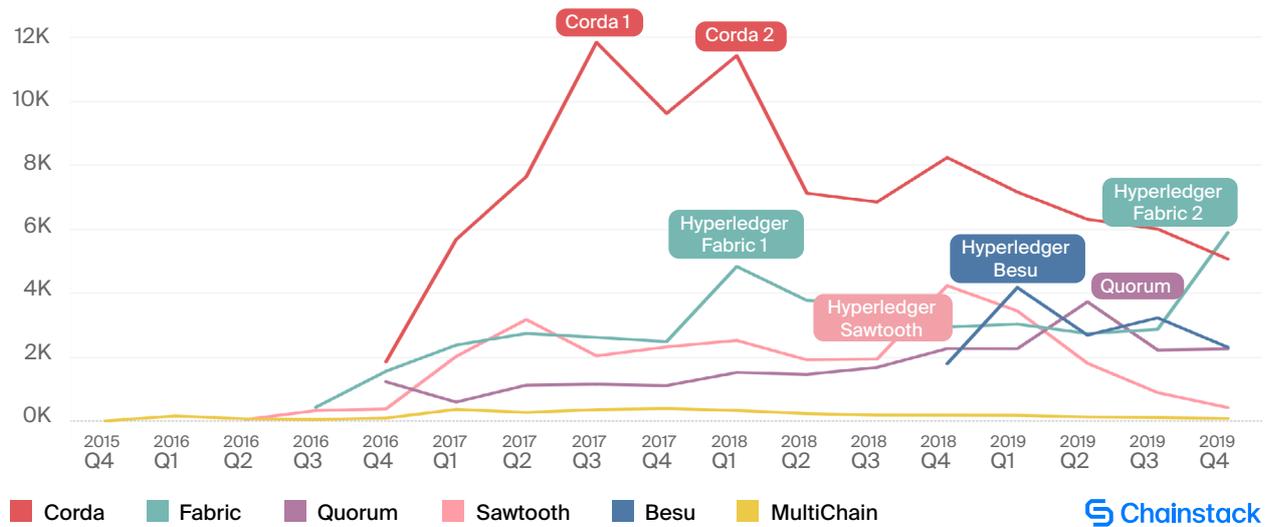
[View interactive version](#)



Total activity per protocol over time

[View interactive version](#)

A look at the total activity over time, but this time on the protocol level.



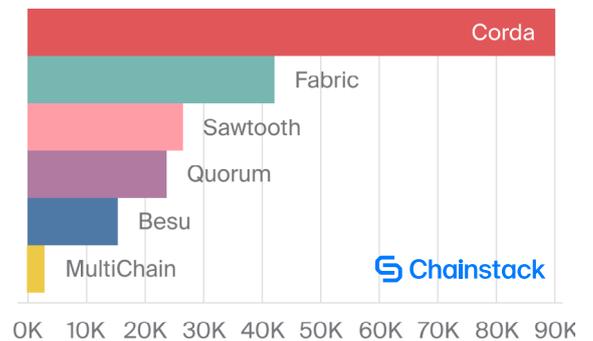
Spike events:

- **Corda 1** – 1,630 pushes and 2,345 pull request events, including pull request comments, in September 2017. This is when CordaCon, R3's annual developer conference around Corda launched.
- **Corda 2** – a single Corda developer did 3,076 pushes in January 2018.
- **Hyperledger Fabric 1** – project repositories on GitHub were starred a total of 1,126 times in March 2018. This was an eventful month for Hyperledger that included the release of Hyperledger Fabric 1.1, the announcement of Ripple joining the Hyperledger Consortium, and attendance of several conferences around the world.
- **Hyperledger Fabric 2** – the project moved from Gerrit to GitHub for code contribution in November 2019. Previously, all code contribution was on Gerrit, and the GitHub repositories were read-only mirrors.
- **Hyperledger Besu** – 1,202 events around pull requests in February 2019 when the first protocol version was released, named Pantheon v1.0 at the time.
- **Quorum** – 813 pushes in April 2019.
- **Hyperledger Sawtooth** – 943 events for issues and pull requests in March 2017; 1230 events for issues, pull requests, and forks in October 2018.

Total activity per protocol compared

Not all protocols are created equal. Let's have a look at how they stack up in the network effect—a total activity of all developers that engaged with the projects.

[View interactive version](#)

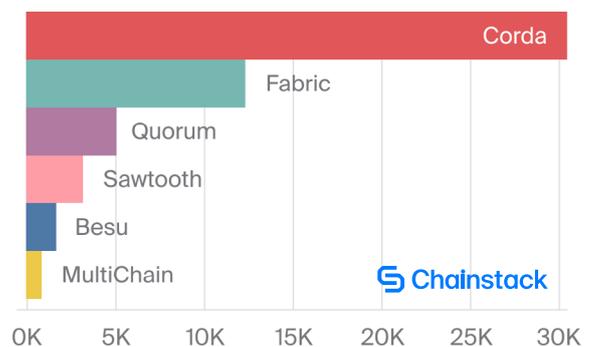


Total pushes per protocol compared

Again, total developer engagement is not the only thing that makes the protocols what they are today.

Let's have a look at what actually builds the protocols—the pushes.

[View interactive version](#)



Total unique developers engaged

Now let's look at the unique developers engaged per protocol and how they stack up.

A unique developer is someone who interacted at least once with a protocol's repository by triggering a GitHub event.

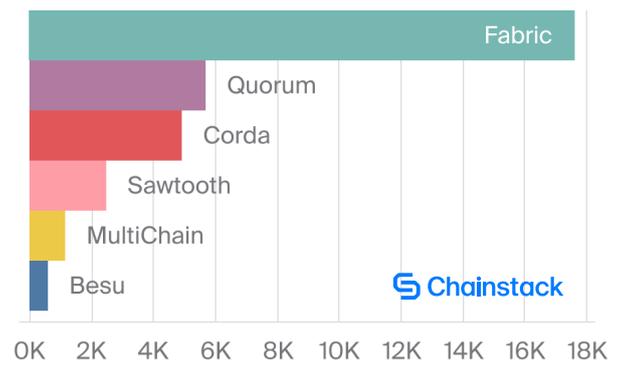
The top three protocols that developers engage with are Hyperledger Fabric, Quorum, and Corda accounting for 86% of total unique developer numbers.

Hyperledger Fabric is the undisputed leader here, which makes sense as it is supported by the Linux Foundation—one of the most known technology consortia. Hyperledger Fabric represents 54% of the total developers engaged.

Quorum, being a fork of Ethereum, is likely benefiting from the Ethereum development communities.

Corda, having been built from scratch and not coming from a traditional technology organization, has impressive developer engagement numbers.

[View interactive version](#)



Total unique developers pushed

A look at the total unique developers that actually pushed code to the project repositories.

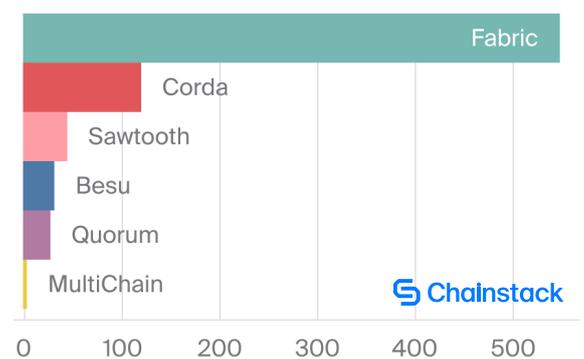
A unique developer is someone who pushed code at least once to a protocol's repository.

When compared to *Total unique developers engaged*, this chart of unique developers who actually pushed code to project repositories paints a relatively different picture for the protocols.

Hyperledger Fabric remains the undisputed leader, representing 71% of all contributors, while Corda moves up from the third place in *developers engaged* to the second place in *developers pushed*.

Quorum drops four spots and shifts from the second place in *developers engaged* to the sixth place in *developers pushed*.

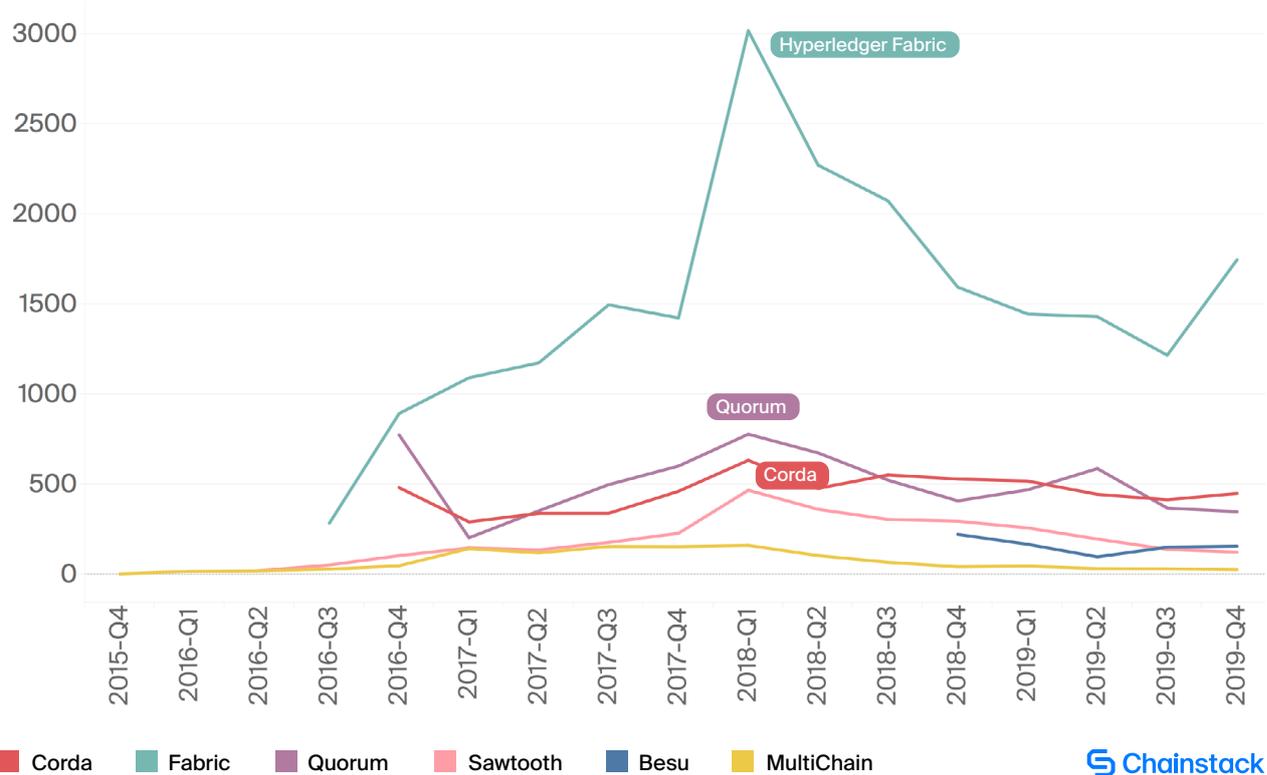
[View interactive version](#)



Unique developers engaged over time

[View interactive version](#)

A look at how the unique developer numbers that exhibit any activity change over time for each protocol.



Spike events:

- **Corda** – 301 developers starred the project repositories in December 2016.
- **Quorum** – 611 developers starred the project repositories right at the start of the project in November 2016.
- **Hyperledger Fabric** – 989 developers starred the project repositories in March 2018, when Hyperledger Fabric 1.1 was released, and Hyperledger saw Ripple joining the consortium, as well as Hyperledger attending a number of conferences around the world.

For extra data points, let's break down and compare the activity numbers and unique developer numbers for all protocols.

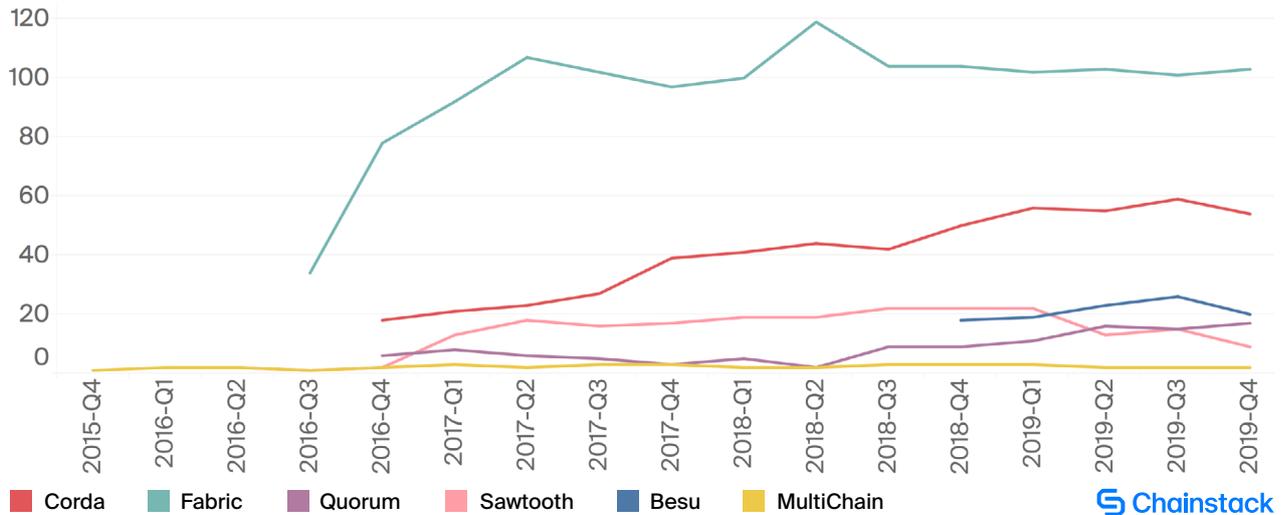
Protocol activity vs. unique developers engaged year-to-year

	Besu		Corda		Fabric		MultiChain		Quorum		Sawtooth	
	Activity	Unique developers	Activity	Unique developers	Activity	Unique developers	Activity	Unique developers	Activity	Unique developers	Activity	Unique developers
2015							18	7				
2016			1,867	485	2,019	1,331	423	108	1,242	778	799	306
2017			34,867	1,318	10,267	4,676	1,439	559	4,036	1,552	9,617	641
2018	1,806	225	33,723	1,956	15,280	8,280	985	372	6,985	2,184	10,668	1,263
2019	12,463	463	24,618	1,514	14,594	5,224	552	134	10,531	1,586	6,620	620

Unique developers pushed over time

[View interactive version](#)

A look how at the unique developer numbers that pushed code change over time for each protocol.



Hyperledger Fabric has been fairly consistent in the number of developers that push code every quarter, with a spike in Q2 of 2018. Overall, there are many more developers pushing code than any other protocol.

Corda has seen a slow and steady increase in developers since its inception, while Quorum, having had a consistently low developer count for almost two years, is seeing its number of developers contributing code picking up as of Q2-Q3 2018.

Hyperledger Sawtooth, having been stable for some time, is seeing a sharp decline in contributors.

For extra data points, let's break down and compare the activity numbers and unique developer numbers for all protocols.

Protocol pushes vs. unique developers pushed year-to-year

	Besu		Corda		Fabric		MultiChain		Quorum		Sawtooth	
	Activity	Unique developers	Activity	Unique developers	Activity	Unique developers	Activity	Unique developers	Activity	Unique developers	Activity	Unique developers
2015							8	1				
2016			312	18	679	184	159	2	64	6	299	3
2017			10,416	44	3,806	194	515	3	314	8	1,276	23
2018	175	18	11,752	64	4,013	272	364	3	960	16	1,131	33
2019	1,758	31	7,902	98	3,940	215	294	3	3,628	20	807	25

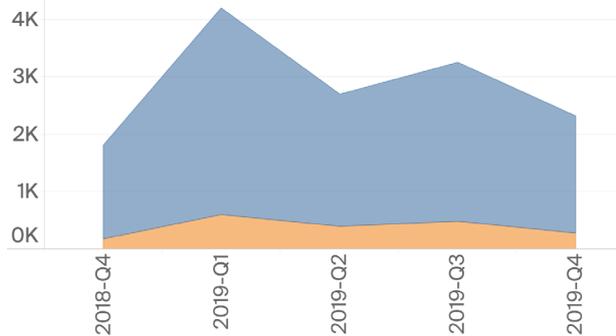
Event makeup by protocol

[View interactive version](#)

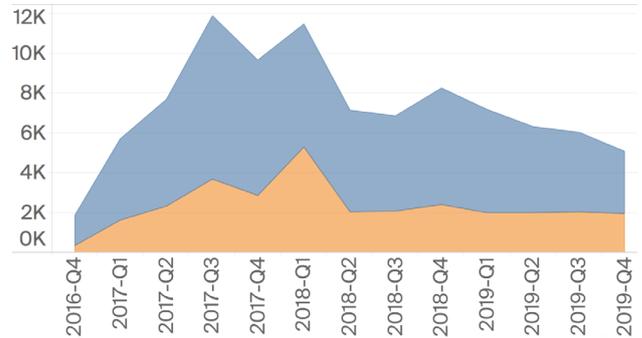
A look into which events each protocol's activity consists of and how they change over time.

Push events vs. all other events:

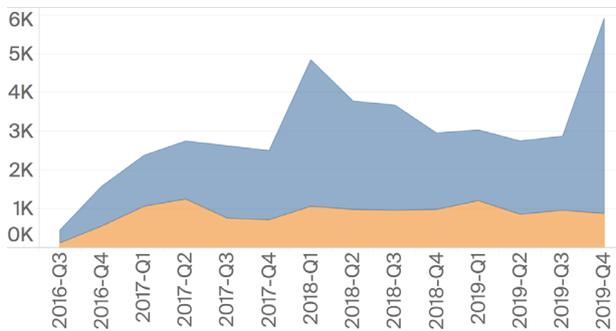
Hyperledger Besu



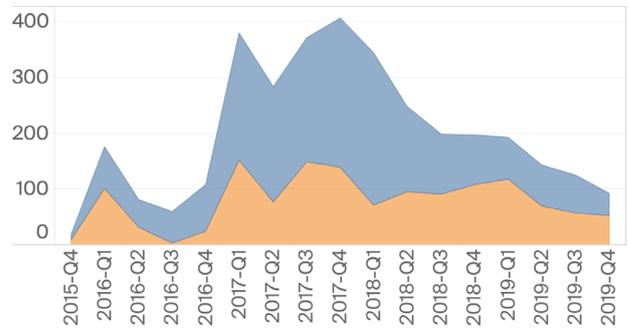
Corda



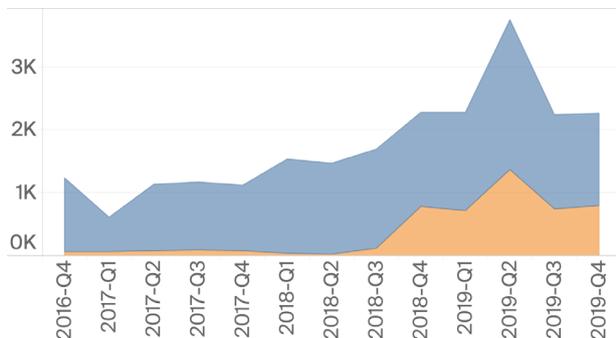
Hyperledger Fabric



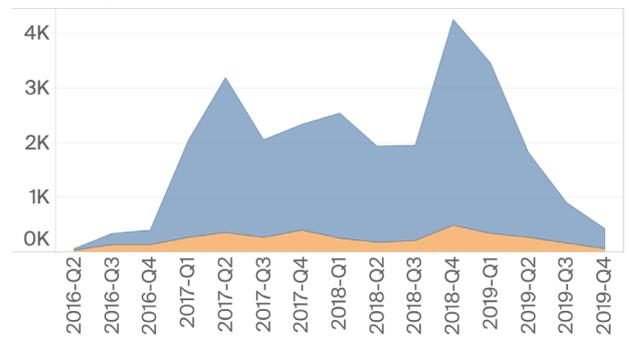
MultiChain



Quorum



Hyperledger Sawtooth



■ OtherEvent ■ PushEvent



Push events are caused when a push is triggered to a repository branch.

Other events are a grouping for all non-push events triggered for the analyzed protocols.

Namely:

CommitCommentEvent, CreateEvent, DeleteEvent, ForkEvent, GollumEvent, IssueCommentEvent, IssuesEvent, MemberEvent, PublicEvent, PullRequestEvent, PullRequestReviewCommentEvent, PushEvent, ReleaseEvent, WatchEvent

Hyperledger Besu has enjoyed community engagement right from the start and saw an engagement spike with the first protocol version was released, named Pantheon v1.0 at the time.

Hyperledger Fabric moved from Gerrit to GitHub in November 2019 and saw a spike in community engagement.

MultiChain had a spike of community interest in 2017 but has been fairly consistent in engagement and pushes most of its lifetime.

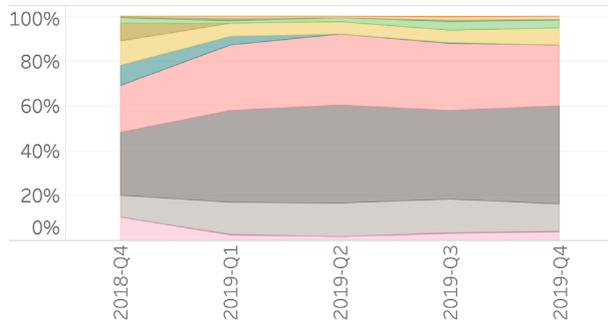
Hyperledger Sawtooth has enjoyed high community interest relative to its push output but has seen a decline in both in 2019.

All events in percentage form:

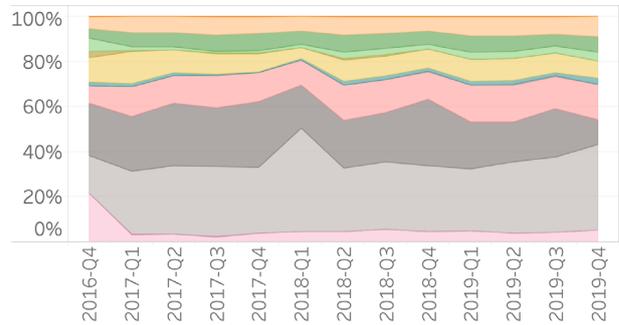
[View interactive version](#)

Hyperledger Besu, Hyperledger Fabric, and Hyperledger Sawtooth see higher community engagement relative to their push output.

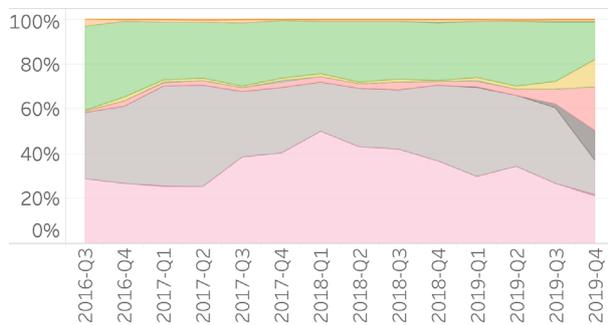
Hyperledger Besu



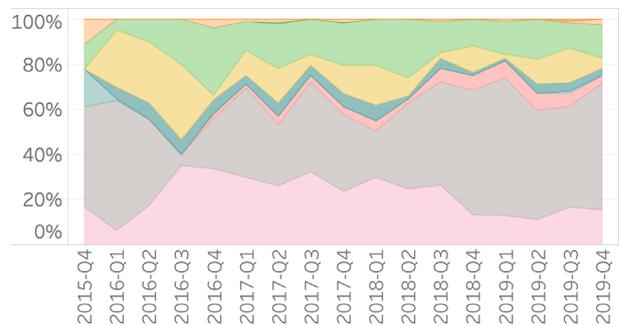
Corda



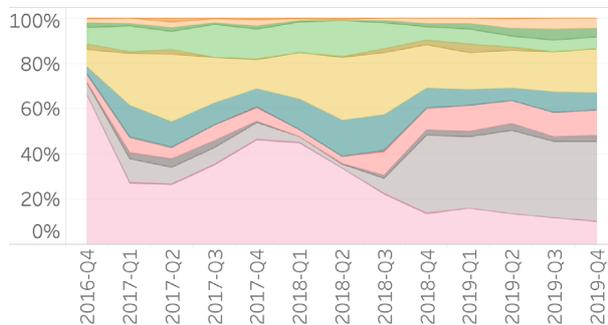
Hyperledger Fabric



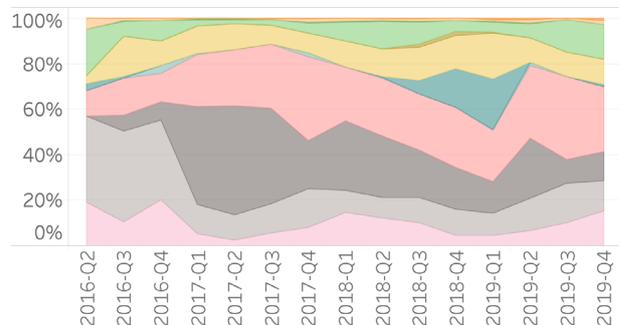
MultiChain



Quorum



Hyperledger Sawtooth



- CommitCommentEvent
- CreateEvent
- DeleteEvent
- ForkEvent
- GollumEvent
- IssueCommentEvent
- IssuesEvent
- MemberEvent
- PublicEvent
- PublicRequestEvent
- PullRequestReviewComment
- PushEvent
- ReleaseEvent
- WatchEvent



Hyperledger Besu's activity mainly consists of pull requests and reviews.

Corda had a spike of star events right at the start in 2016. Barring the push spike of January 2018, Corda has been relatively consistent with the activity distribution around the project; the main activity being in what makes the protocol—pushes and pull requests.

Hyperledger Fabric is consistent in the activity distribution over time, with the three main activities being pushes, forks, and stars.

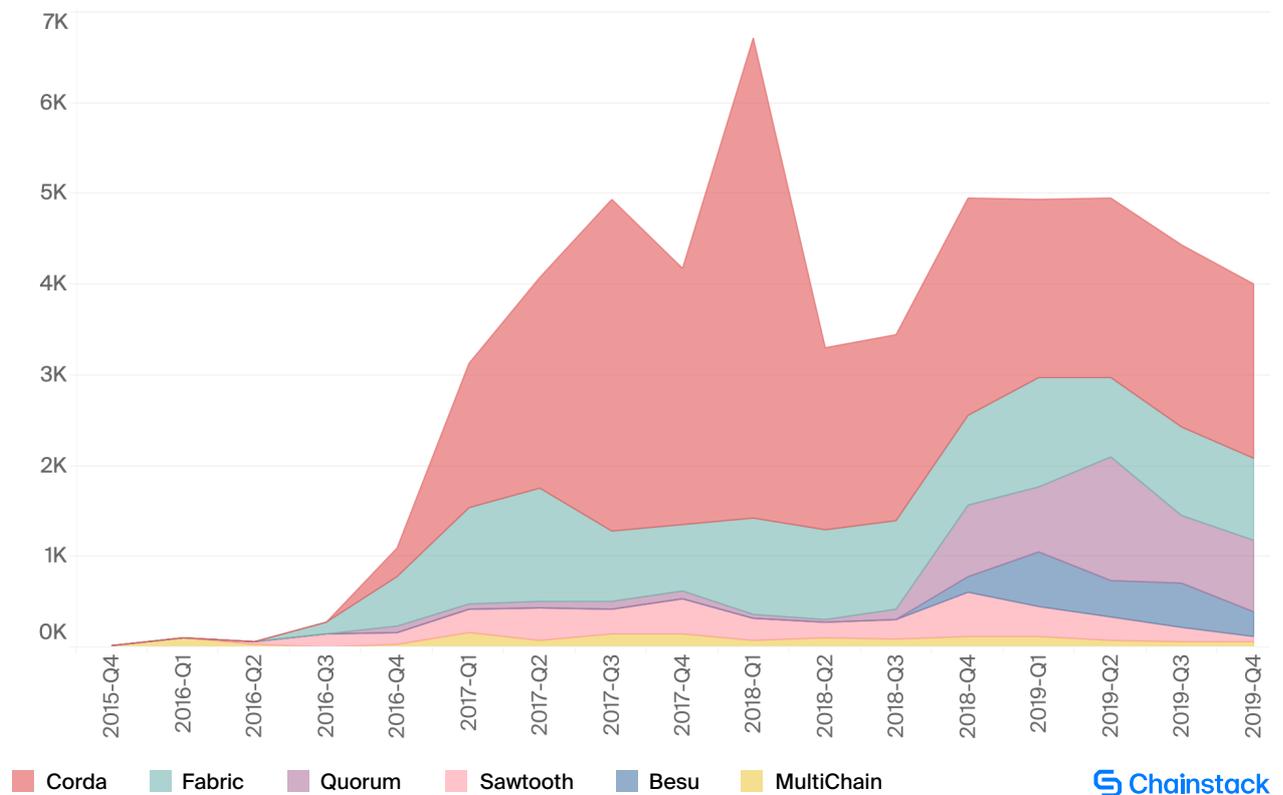
MultiChain is mostly comprised of pushes to the project's repositories.

Quorum had a spike of interest manifested in star events right at the start in November 2016, followed by a decline in proportion of pushes. The push activity picked up again late in 2018 and has been relatively consistent as a proportion of overall activity since then.

When calculated for all protocols, an outstanding event is PullRequestReviewCommentEvent¹¹, which represents 17% of all activity.

All protocol pushes:

[View interactive version](#)

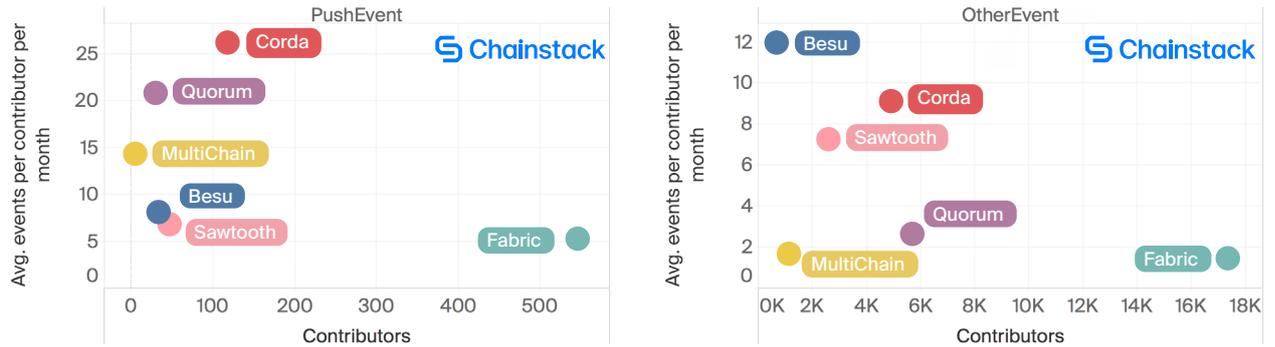


11. PullRequestReviewCommentEvent. Developer.GitHub.com. <https://developer.github.com/v3/activity/events/types/#pullrequestreviewcommentevent> (accessed January 17, 2020).

Unique developers pushed and engaged by protocol (2015 – 2019)

[View interactive version](#)

Push events vs. all other events in unique developer numbers.



Hyperledger Fabric is the outlier in both push and non-push average activity per developer. While Hyperledger Fabric has the highest number of developers, the protocol has the smallest average activity per developer.

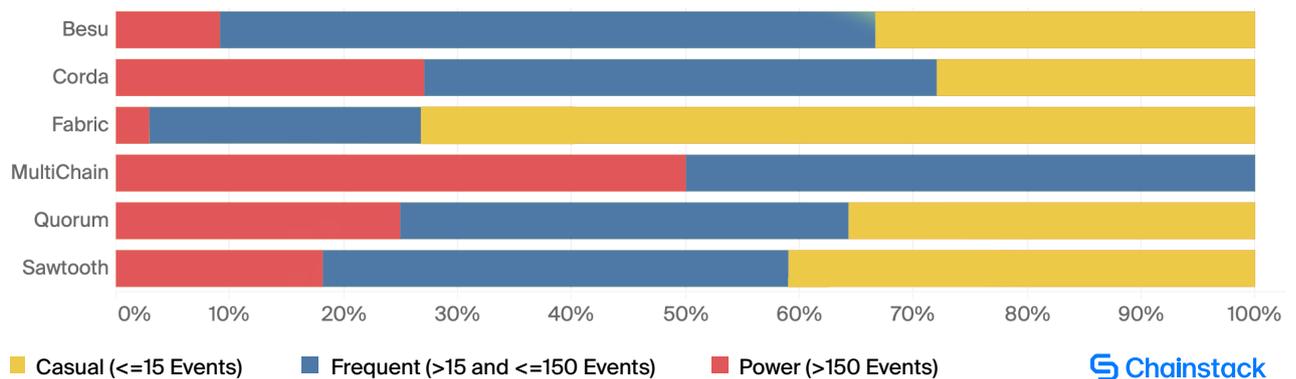
Corda developers are consistently active on average, having the highest average number of pushes per developer per month of all protocols analyzed. Quorum is a close second.

Casual, frequent, and power developers by protocol

Let's group all developers who pushed to project repositories by their average push numbers and assign them into buckets of Casual, Frequent, and Power developers.

All developers (during a protocol's lifetime):

[View interactive version](#)



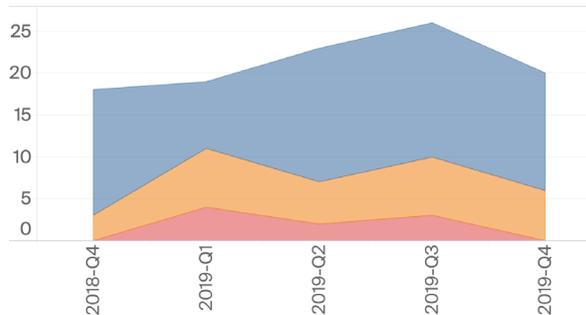
Developers quarterly:

[View interactive version](#)

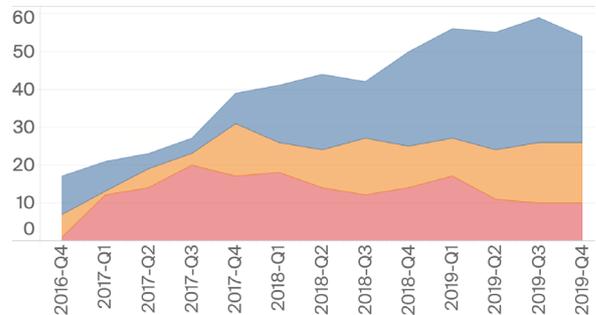
Let's see how the groups of casual, frequent, and power developers change for each protocol quarter-to-quarter: Casual: ≤ 15 pushes, Frequent: > 15 and ≤ 45 pushes, Power: > 45 pushes.

The distribution of the developer groups and their change over time is an indicator to see the proportion of the developers working consistently on a protocol.

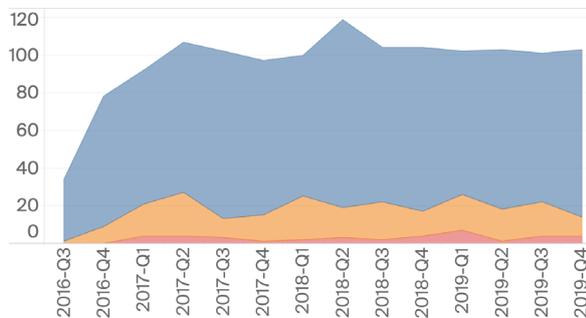
Hyperledger Besu



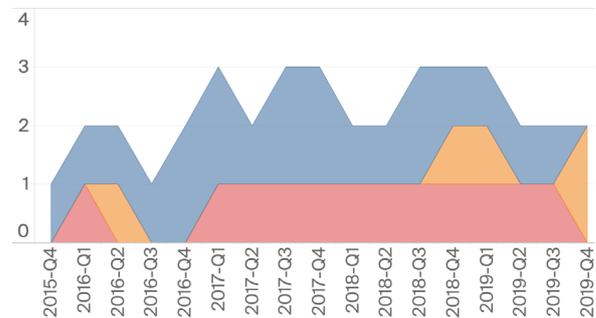
Corda



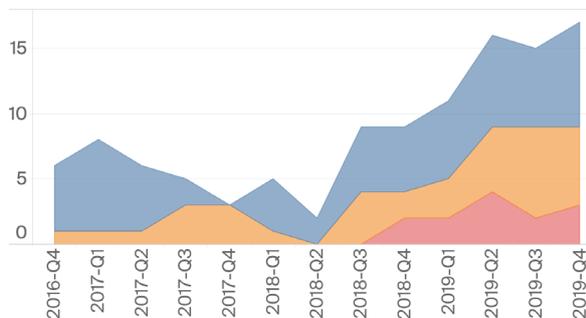
Hyperledger Fabric



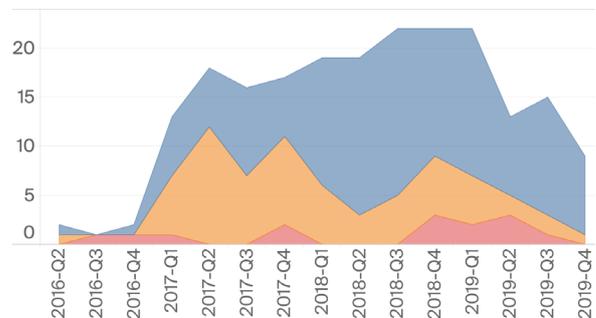
MultiChain



Quorum



Hyperledger Sawtooth



■ Casual (≤ 15 Events)
 ■ Frequent (> 15 and ≤ 45 Events)
 ■ Power (> 45 Events)



Once again, Hyperledger Fabric most consistently has the lowest average amount of pushes per developer, with the majority of its developer base made up of casual engagements.

Corda has a consistent group of power contributors pushing code full-time, which is expected with their average developer activity seen earlier.

Both Hyperledger Fabric and Corda have the highest amount of developers pushing of all the protocols analyzed.

Quorum has increased their power developer count around the first quarter of 2019.

CONCLUSION

Based on the six protocols analyzed for this report, we can see that the number of developers contributing to the largest portion of the enterprise blockchain market has multiplied by 12 in the past three years, demonstrating a strong commercial interest. It is also clear to see that activity (both in terms of contributions to the codebase and general activity of the surrounding communities) in this part of the enterprise blockchain landscape has reached a degree of stability, pointing to a departure from the earlier formative years prior to 2018. The shapes of the different protocols' community and composition of their teams have become clear, with some industry leaders (namely Fabric and Corda) making up a significant amount of all activity, while others still vie for scale and consistency in their contributors.

When performing this analysis, the importance of looking beyond the collective activity of each protocol became clear, since all activity is certainly not equal. There are important distinctions to be found in the nature of the activity occurring on each protocol's repository. Fabric, for example, has a much larger network of developers interacting with their repository to a much smaller degree, while Corda sees fewer, but highly active developers. Instead, in order to understand the health of a protocol we must focus on how many developers are consistently pushing code day-to-day and whether that number and their activity is steady, growing, or dropping. Other types of engagement are certainly important to view as a heartbeat of activity that can help to spur actual development; however, they are not the primary factor that keep a protocol alive. For example, see Sawtooth's non-push related activity spike in Q4 2018 – Q1 2019, which was followed by a sharp decline in developer numbers and contributions over the course of 2019.

What we have seen in this report is a clear pattern of development consistency from the teams that have the resource backing to continue building their solution after the initial attention they receive dies down. It is no surprise that by maintaining consistent contributors who can work as a wholistic software team to build features, fix bugs and write documentation, protocols can persist and attract further attention from new contributors and the community.

Enterprise blockchain development is still very much a nascent and evolving world in the bigger picture of software development and is a great case study to analyze how developers contributing to technology applications in new industries make their contributions. We encourage others to take advantage of this publicly available data set, and those like it, as a metric to measure the traction of permissioned blockchain protocols and similar technologies.

What's next?

This analysis does not consider the multitude of other permissioned protocols that have been created over this period, who have been able to attract developers to work on them to varying degrees. This could be a consideration for a future report to attempt to enumerate the scale and growth of the whole industry, including teams working on more niche applications of enterprise blockchains. Furthermore, it would be interesting to understand whether we are generally seeing more contributors joining or leaving the enterprise blockchain space and to what degree developers shift around the community, contributing to different projects.

Another potential area for expansion on this data is to explore regional data and trends. There is already other data pointing to the fact that this new era of technology has seen a significant shift away from traditional software powerhouse regions such as the United States. It would be valuable to understand how this growth has manifested and identify the regions that stand out as hubs for enterprise blockchain developer communities.

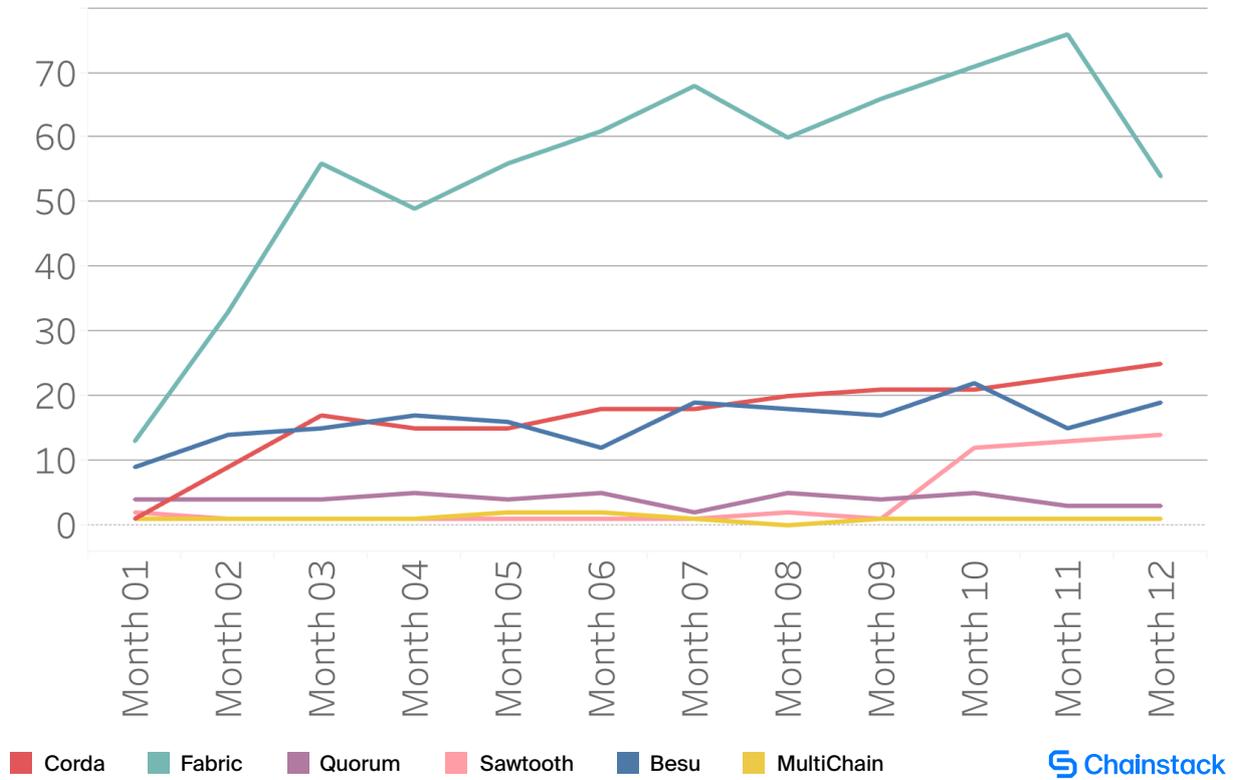
For any questions or feedback, contact us at contact@chainstack.com.

Appendix

1. Major protocol releases during lifetime

	Besu	Corda	Fabric	MultiChain	Qurorum	Sawtooth
2016					1.0, November	
2017		1.0, October 2.0, November	1.0, July	1.0, August	2.0, November	
2018						1.0, January
2019	1.0, February	4.0, February		2.0, March		

2. The first 12 month: Unique developers pushes following the launch of each protocols



About Chainstack

Chainstack provides managed blockchain services, making it simple to launch and scale decentralized networks and applications—complete with an intuitive user interface, seamless orchestration, and predictable pricing.

We offer enterprise-grade tools and services that empower developers, solution providers, and consortia to safely experiment and run in production.

By building on Chainstack, you reduce the time, cost, and risk involved with leveraging decentralized technologies. With a secure API, membership management, and flexible deployment options, you can immediately accelerate and future-proof your development of transformative solutions.

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