# High Throughput, Byzantine Fault-Tolerant Web Services Using Layer 2 Blockchain

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Abstract—Blockchain technology has gained significant attention in recent years due to its potentials. However, it is still trying to find its way into a wider range of applications. One of the most promising benefit of blockchain is its ability to offer fault-tolerance, where this aspect seems to be underexplored, especially in web services. Previous works like Decentralized and Byzantine Fault-tolerant Web Services (DeWS), have shown that web services can be made fault-tolerant using blockchain. But the scalability issues of the blockchain and the high latency of the consensus algorithms caused the system to have a limited scalability and throughput. This research explores scaling solutions for Decentralized and Byzantine Fault-tolerant Web Services (DeWS), a framework that enhances traditional web services with transparency, auditability, and Byzantine fault tolerance through blockchain technology. While DeWS successfully replaces the conventional request-compute-response paradigm with a more robust request-compute-consensus-logresponse model, its performance is constrained by the inherent latency of Byzantine consensus protocols. Our investigation identifies Rollkit, a Cosmos SDK-compatible sovereign rollup framework, as a promising layer-2 solution for DeWS performance optimization. Initial testing demonstrates significant throughput improvements, achieving approximately double the transaction capacity compared to a standard 4-node system under 100-200 concurrent requests. This research proposes a two-layer architecture that maintains DeWS's security guarantees while addressing its performance limitations, enabling wider adoption for mission-critical and safety-critical applications where both fault tolerance and responsiveness are essential. Our implementation with Tendermint/CometBFT demonstrates that decentralized web services can achieve reasonable performance while preserving the integrity assurances required for multi-stakeholder environments.

Index Terms—blockchain, web services, Byzantine fault tolerance, scalability, rollup

## I. Introduction

This document is a model and instructions for LATEX. Please observe the conference page limits.

# II. EASE OF USE

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The IEEEtran class file is used to format your paper and style the text. All margins, column widths, line spaces, and text fonts are prescribed; please do not alter them. You may note peculiarities. For example, the head margin measures proportionately more than is customary. This measurement and

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#### A. Abbreviations and Acronyms

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, ac, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

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- Use either SI (MKS) or CGS as primary units. (SI units are encouraged.) English units may be used as secondary units (in parentheses). An exception would be the use of English units as identifiers in trade, such as "3.5-inch disk drive".
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Number equations consecutively. To make your equations more compact, you may use the solidus ( / ), the exp function, or appropriate exponents. Italicize Roman symbols for quantities and variables, but not Greek symbols. Use a long dash rather than a hyphen for a minus sign. Punctuate equations with commas or periods when they are part of a sentence, as in:

$$a + b = \gamma \tag{1}$$

Be sure that the symbols in your equation have been defined before or immediately following the equation. Use "(1)", not "Eq. (1)" or "equation (1)", except at the beginning of a sentence: "Equation (1) is . . ."

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Please use "soft" (e.g., \eqref{Eq}) cross references instead of "hard" references (e.g., (1)). That will make it possible to combine sections, add equations, or change the order of figures or citations without having to go through the file line by line.

Please don't use the {eqnarray} equation environment. Use {align} or {IEEEeqnarray} instead. The {eqnarray} environment leaves unsightly spaces around relation symbols.

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## E. Some Common Mistakes

- The word "data" is plural, not singular.
- The subscript for the permeability of vacuum  $\mu_0$ , and other common scientific constants, is zero with subscript formatting, not a lowercase letter "o".
- In American English, commas, semicolons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited,

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- A graph within a graph is an "inset", not an "insert". The
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- The prefix "non" is not a word; it should be joined to the word it modifies, usually without a hyphen.
- There is no period after the "et" in the Latin abbreviation "et al.".
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An excellent style manual for science writers is [?].

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Component heads identify the different components of your paper and are not topically subordinate to each other. Examples include Acknowledgments and References and, for these, the correct style to use is "Heading 5". Use "figure caption" for your Figure captions, and "table head" for your table title. Run-in heads, such as "Abstract", will require you to apply a style (in this case, italic) in addition to the style provided by the drop down menu to differentiate the head from the text.

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TABLE I TABLE TYPE STYLES

Table	Table Table Column Head		
Head	Table column subhead	Subhead	Subhead
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<sup>a</sup>Sample of a Table footnote.

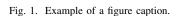


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### ACKNOWLEDGMENT

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#### REFERENCES

Please cite all your references [1], [2]. References are stored in a bibtex file "references.bib". You can use Mendeley or Jabref for your reference manager.

# REFERENCES

[1] S. Bhawal, H. Patel, K. Hatua, K. Vasudevan, and S. Bhattacharya, "Solid state transformer based on naturally cell balanced series resonant converter with cascaded h-bridge cells switched at grid frequency," *IEEE Transactions on Power Electronics*, pp. 1–14, 2023. [2] R. Chen, C. Li, C. Li, H. Fang, R. Lu, W. Yao, W. Li, and X. He, "Phase-shift angle segmentation modulation for soft-switching medium voltage dab converter with series-connected sic mosfets," *IEEE Transactions on Transportation Electrification*, pp. 1–1, 2023.