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Abstract

The UNIT fractal monetary ecosystem introduces a practical approach to creating essentially "apolitical money" that can be freely used as a storage of value or currency for payments via any open payment and clearing system, while providing long-term purchasing power stability. The UNIT ecosystem is proposed as a solution to the basic lack of trust problem stemming from the politicization of the use of a single global currency and constraints on its use for valuation and settlement of trade and capital flows.

We introduce the fractal monetary framework, which allows global financial system to function without directly using any national currencies for international trade and reserves. The UNIT is designed to serve as a convenient and stable global currency alternative within the existing financial infrastructure. It is also expected to be more resilient than any national currency to political exigences of the day.

Fractal design ensures that the composition of each UNIT token's basket of underlying assets (or "reserve basket") is invariant across the nodes of the network as it scales. The intrinsic value of each UNIT token always remains proportional to the total value of the UNIT reserve basket measured in gold and is expected to remain less volatile than the value of any of the components of the basket.

The UNIT token is not a cryptocurrency since the intrinsic value of each UNIT token is linked to a basket of underlying assets, which includes 40% gold. At the same time, the UNIT token is not a stablecoin, since its value is not directly derived from the basket of underlying assets and by design, there no mechanism for reverse conversion of the UNIT into the basket of underlying assets. After an initial period, the market value of UNIT tokens is expected to become primarily a function of supply and demand, not of the value of the underlying basket.

New UNIT tokens can be emitted (or "minted," the terms used interchangeably in this document) at UNIT nodes in exchange for depositing assets corresponding to the current value of the UNIT reserve basket, measured in gold. Minting is decentralized and is performed according to the UNIT governance rule-book, in the absence of constant coordination among issuers of the underlying currencies.

The integrity of the UNIT ecosystem is preserved by blockchain-based node synchronization and elimination of the need to re-balance gold holdings between UNIT nodes, thus minimizing costs and risks. UNIT tokens are not subject to any capital controls or price manipulation. They can be freely bought and sold or used as currency for payments via any open payment and clearing system.

In addition to the intended use of the UNIT as a currency for traditional and alternative payment systems, resilience of the UNIT ecosystem is further enhanced by a secure proprietary UNIT payment protocol designed to transact with UNIT tokens, which will be open for access in line with the UNIT rule-book.

Further development of the UNIT ecosystem foresees launch of new elements with additional functionality, including mercantile and capital stock exchanges, where commodities and financial instruments will be priced and settled in UNIT tokens. It is expected that issuance of financial instruments denominated in the UNIT will follow in due course and will enable the use of the UNIT for storage of value, investment, and reserves.

Introduction

In this document, we introduce the UNIT fractal monetary ecosystem that offers unique benefits to all participants. The UNIT ecosystem aims to provide a convenient global currency alternative, which will be resilient to political interference and will continue to function in the absence of full consensus and constant coordination among the ecosystem participants.

UNIT enhances sovereignty of individual states who no longer need to rely on other countries' domestic currencies for trade and foreign exchange reserves and can pursue independent domestic monetary policies, focused on growth and price stability, while retaining complete exchange rate and interest rate control.

Governance of UNIT ecosystem structured as a Decentralized Autonomous Organization (or "DAO") can be substantially enhanced by cooperation with an international intergovernmental organization (or "IIO") endowed with International Legal Personality, as governed by the current intergovernmental agreement and the 1980 Budapest Convention. Such an IIO may act as the custodian for the decentralized autonomous organization that underpins the UNIT ecosystem.

Research conducted over several years arrived at the conclusion that while the global economy functioned and expanded over several decades by relying on a single global currency for its trade, borrowing and investment needs, fundamental flaws of the post-Bretton-Woods system have never been adequately addressed.

The recent politically-driven explosion in local currency usage for bilateral trade, while aiming to reduce reliance on a single global currency, highlights a host of old problems. As most of the currencies used in these transactions are subject to capital controls, these currencies typically have limited circulation outside of their home countries and suffer from lack of liquidity, convertibility, and legal clarity on how and where they can be productively invested abroad.

The geopolitical paradigm shift underway presently highlights inherent vulnerabilities and conflicts of interest of the current system and leads to a search for an alternative global currency that could be introduced into existing financial infrastructure with minimal disruption (a "drop-in alternative").

We are of the opinion that none of the countries whose currencies could potentially take on this role are able or willing to allow their currency to become a viable alternative global currency for a number of well-founded reasons. At the same time, given the present divergence of political and economic interests, consistent and sustainable global policy coordination among trading countries remains difficult to achieve.

Consequently, the primary purpose of the UNIT as a new alternative global currency is to make global trade and capital flows more resilient to external interference (i.e., to serve as "apolitical money"). Such interference can be applied via various channels, such as payment and settlement systems, custody network, supra-national loans, or even denomination of the major commodity contracts. The approaching introduction of Central Bank Digital Currencies ("CDBC") makes the search for such a resilient solution even more urgent. The secondary purpose of the UNIT is to create a viable alternative for storage of value that would provide long-term purchasing power stability.

The underlying financial framework and basic technical design that we outline in this document do not require cooperation of individual countries. The UNIT can be used as a drop-in global currency alternative within existing infrastructure and by extension allows for such essentials as convenient and widely-adopted electronic payment and information dissemination systems, trade finance, credit origination, and fractional reserve banking, while addressing the fundamental problem of trust within the global financial system and protecting financial sovereignty of the ecosystem participants from political interference.

Fractal Monetary Design

We propose a solution to an alternative global currency problem by applying the fractal paradigm as broadly defined by Mandelbrot [1], where each node of the fractal network is a scaled-down replica of the whole.

Such a fractal network follows predefined evolution principles and simple governance rules. New nodes can be created and added by consensus among the existing nodes in the fractal network, and each new node contains a scaled replica of the whole as well.

The integrity of such a fractal network is preserved by a blockchain-based [2] synchronization and re-balancing mechanism that uses a variant of the Byzantine Fault Tolerance based Proof-of-Stake Consensus protocol [3].

The unique feature of the proposed decentralized monetary system is the anchoring of values of each component of the reserve basket to gold. The composition and pricing of the underlying basket is defined and measured in terms of gold.

We define the fractal unit ("the UNIT token") as a fungible monetary transactional element of the UNIT ecosystem representing a share of the total UNIT reserve basket consisting of 40% gold and fiat currencies freely convertible into gold.

A self-similar basket is present at each node of the fractal network, while the value of assets at all nodes adds up to the total value of the UNIT reserve basket, all measured in gold.

New UNIT tokens can be minted at the UNIT node level without the need for a central emitting authority or coordination among the issuers of underlying currencies. Further, new UNIT nodes can be launched in new jurisdictions with relative ease.

Emission of new UNIT tokens is made by exchanging a scaled replica of the UNIT reserve basket for new UNIT tokens and sharing the updated number of emitted UNIT tokens with the rest of the fractal monetary ecosystem and general public. Owning a share of the UNIT reserve basket at the UNIT node level is identical to owning a share of a scaled basket at the UNIT ecosystem level.

In the UNIT basket composition, there are no permanently fixed ratios for the underlying components, with the exception of two conditions stipulated in the UNIT rule-book and tested at the moment of emission of additional UNIT tokens: the gold content (40%) requirement and the maximum value (30%) requirement for any other component of the basket, valued in gold.

New UNIT tokens can be minted as needed at any time, upon delivery of the underlying components at a UNIT node. Composition and pricing of each component of the basket measured in gold is transparent and public.

This approach minimizes costs related to holding and moving a significant physical gold inventory, as modeled by Black [4]. We extend Black's analysis further by removing the assumption that gold is valued in terms of something other than gold itself.

The fractal design provides the following immediate benefits for participants of the UNIT ecosystem:

1. Transformation of relatively illiquid components (local currencies) into a liquid and transparently-priced whole via emission of new UNIT tokens in exchange for the underlying components;
2. "Re-anchoring" of price discovery and price formation to gold, away from using any national currency as a reference point;
3. Minimization, or complete elimination, of the need to re-balance gold holdings, reducing operational risks and costs to participants. Gold remains within the jurisdiction of the emitting

UNIT node;

4. Mitigation of major practical and legal constraints for new UNIT node creation within sovereign borders. In particular, it removes the key hurdle for sovereign and national institutions to join the ecosystem, as there is no requirement for gold (which might be a part of foreign exchange reserves of a nation state) to be sent abroad. Instead, a new UNIT node can be created on sovereign territory, using existing infrastructure, and with the nation's gold reserves remaining within national borders, albeit in a different legal form. Over the last few decades, the world witnessed several episodes when gold stored in a foreign central bank was not returned to the nation which originally sent the gold abroad. If gold never leaves sovereign borders, these risks are mitigated;
5. Prevention of possible TARGET2-type imbalances [5] and reduction of the exposed surface of the fractal system through explicit removal of a redemption mechanism for minted UNIT tokens. There will be no possibility to exchange them back into the basket of gold and currencies with one notable exception. A "UNIT node buyout" remains possible and removes an important constraint that may have prevented sovereign actors from joining the ecosystem. Any UNIT node can exit the UNIT ecosystem with its contents subsequently distributed, if the UNIT tokens previously emitted at the node are returned to the UNIT ecosystem in whole, in exchange for the proportional share of the basket components. To preserve the integrity of the ecosystem, the returned UNIT tokens are canceled simultaneously;
6. Feasible workaround for the "Impossible Trinity" or the Mundell-Fleming Trilemma [6], as the UNIT ecosystem does not force any participating governments to abandon their monetary policies, no matter how restrictive. If a local currency is used to pay for imports, by definition it already is at least partially convertible. Any and all constraints and conditions placed on this currency will be captured by its price expressed in gold, as long as the price discovery mechanism is reliable. In the next section, we discuss this important point in more detail. For now, we note that this partial currency convertibility is not incompatible with capital account controls, as the local currency used to pay for imports is typically constrained from freely re-entering domestic money supply;
7. Preservation of national sovereignty and independent monetary policies of the countries whose central banks can employ policies most beneficial to domestic growth and price stability. The UNIT ecosystem reduces pressure for interest rate convergence among participating countries, or indeed for any additional restrictions on monetary policy. This is contrary to the situation that emerges when other countries' currencies are used for trade: the local central banks in those circumstances are under pressure to align their interest rate policies with the policies of the country's trading partners or competitors. This also stands in contrast to, for example, a scenario modeled by Benigno [7]. Such improvement is possible due to point (4) above: the fractal monetary ecosystem does not create a direct feedback mechanism to the national monetary policies of the countries issuing underlying local currencies, which are included in the UNIT reserve basket. As the exchange rates are not "fixed" to gold or any other currencies, currencies in the UNIT basket will not see an increase in the "Impossible Trinity" pressures.

Outline of the basic UNIT framework

UNIT is the currency within a decentralized monetary fractal ecosystem. This ecosystem is capable of seamlessly increasing its capacity and usability by adding nodes in various jurisdictions.

The core element of the ecosystem is a UNIT node defined as an online entity linked to a physical (offline) hub containing a proportionally-identical basket of assets including gold and local currencies that follows governance principles set in the UNIT rule-book.

New UNIT nodes can be added by consensus among the existing UNIT nodes, whereby each new UNIT node shall contain a proportional replica of the UNIT reserve basket sufficient to mint a minimal quantity of UNIT tokens set by the UNIT rule-book.

Additional elements may be added to the UNIT ecosystem as it matures. These may include, depending on user demand and priorities: precious metals, currency, and mercantile exchanges, as well as capital stock exchanges. These additional elements might in due course facilitate the direct use of UNIT tokens in price discovery and payment for global trade, as well as in capital market transactions.

The UNIT ecosystem enables unconstrained economic transactions between all participants in fungible UNIT tokens, whose value is measured in gold and which can be used for:

- Price discovery for trade, services and capital transactions;
- Payments via any open payment system or inter-bank transfers, just as in any other currency (we propose the code UNT), including blockchain-based payment systems or the dedicated UNIT payment system;
- UNIT node validation protocol which will refer to minted UNIT tokens as a part of the staking process;
- Fractal de-centralized ecosystem governance as UNIT nodes will vote on proposals suggested by IIO for optimization of resource allocation and development of the UNIT.

IIO may act as a nonprofit auditing body based on the principles of international law and is not governed by any national monetary regulatory authority. In order to achieve transparency and wide adoption, the UNIT ecosystem requires a regular audit of UNIT nodes where users may store physical gold that is used within the ecosystem. IIO will govern and oversee the audit process, set development direction, and propose changes to the UNIT rule-book that may be required as the ecosystem evolves.

Sustainability of the UNIT ecosystem requires the following key conditions:

1. Transparent price discovery mechanism of each component of the UNIT reserve basket in gold terms. It is preferable to have multiple inputs for each price, as pricing in different venues may be affected by the differences in local regulatory regime, logistics costs, and availability of supporting infrastructure;
2. Distributed secure gold storage, which may or may not be directly linked to the price discovery venues. As new UNIT tokens are minted, incremental gold that is deposited at the UNIT nodes will be distributed across the secure storage, in order to minimize operational risks;
3. UNIT nodes serving as custodians by accepting replicas of the UNIT reserve basket and minting new UNIT tokens in exchange. They ideally will be located in favorable jurisdictions and linked to a physical (offline) hub with adequate transport connections and supporting infrastructure. UNIT nodes publicly broadcast UNIT basket composition and number of minted UNIT tokens, protecting the integrity of the network and enabling transparent pricing of UNIT tokens.

The key integrity-enforcement mechanism of the UNIT ecosystem is the super-majority vote by the nodes, in proportion to the value of UNIT tokens previously minted by each node.

Any needed changes in rules and regulations compiled in the UNIT governance rule-book proposed by IIO, as well as the evolution of the UNIT reserve basket, can be introduced and enforced in the future by this consensus building mechanism.

UNIT Basket Composition

We note that if two willing parties are transacting across borders in a local currency, and if imported goods are exchanged for this "off-shore currency" (OFC, domestic currency used to pay for imports), there exists an effective value of the OFC that makes such a trade economically attractive for both parties. While the benefits for importers in this case are obvious, exporters are only compensated fairly if they can further use the OFC in trading with third parties at a market-clearing value of the OFC that is not directly related to the original transaction.

This market-clearing value can materially diverge from the official exchange rates set by local authorities, especially in the presence of capital controls or other restrictions on the capital account. We posit that an efficient method for finding a consistently reliable market clearing value of OFC is to create a mechanism for transparent and free price discovery of OFC value in gold terms. Such clearing levels measured in spot gold correspond to the values that makes it economically attractive for an exporter to receive OFC in exchange for its exports, and subsequently trade with third parties using the foreign OFC that was obtained. This clearing level will reflect any and all practical and legal uncertainties that may apply in each individual case and will be objectively captured by the amount of gold that can be purchased at any given time in exchange for OFC from parties not related to the original export-import transaction.

Consequently, each UNIT token is a share of the UNIT reserve basket of assets, which is created and evolves according to the following simple rules:

1. All items in the UNIT reserve basket must be freely tradable in gold terms for spot delivery at one of the UNIT nodes. If the condition of free price discovery in gold terms is not satisfied, the currency cannot be deemed suitable for the UNIT reserve basket;
2. The gold content of the UNIT reserve basket as a share of the total value in gold terms which is required for emission of a new UNIT token equals 40%;
3. The value of any non-gold component of the UNIT reserve basket delivered for minting of a new UNIT token must not exceed 30% of the total, measured in gold terms;
4. The exact composition of the UNIT reserve basket at any time is public knowledge and is broadcast by all UNIT nodes.

The purpose of these rules is to preserve stability and continuity of prices expressed in UNIT tokens, to remove uncertainty from new UNIT tokens' and UNIT node creation, and to allow for long-term flexibility that may be required due to changes in policies, liquidity, or geopolitical realities.

There is plenty of analysis and historical evidence convincingly demonstrating why a currency fully-backed or even dominated by gold would not serve well as money. Perhaps the best intuitive explanation of why gold should not dominate the fractal financial system is the one by Hayek [8], who noted that "I do believe that if today all the legal obstacles were removed which prevent...an issue of private money...people would from their own experience be led to rush for the only thing they know and understand, and start using gold. But this very fact would after a while make it very doubtful whether gold was for the purpose of money really a good standard. It would turn out to be a very good investment, for the reason that because of the increased demand for gold the value of gold would go up; but that very fact would make it very unsuitable as money...If they [people] were free to choose the money, in terms of which they kept their books, made their calculations, incurred debts or lent money, they would prefer a standard which remains stable in purchasing power...in terms which it is equally likely that the price of any commodity picked out at random will rise as that it will fall. Such a stable standard reduces the risk of unforeseen changes in the prices of particular commodities to a minimum, because with such a standard it is just as likely that any one commodity will rise in price or will fall in price."

To maximize the utility of the fractal UNIT as money, following Hayek's logic, the value of UNIT should not be dominated by gold, just anchored by it. Gold for the fractal UNIT provides the function of an "outside money" anchor, as the term is used by Pozsar [9] and was originally defined by Gurley and Shaw [10].

We describe the basket re-balancing mechanism in the next section which proposes a practical implementation of this principle.

The best argument for why 40% is the appropriate share of gold for the fractal monetary system perhaps comes from Mr. Wexler, vice president of the Whitney Central National Bank of New Orleans, who in the 1913 Hearings Before the Committee on Banking and Currency at the US Senate noted in the context of the gold backing Federal Reserve Notes [the US were still on the gold

standard at the time]: "I think 33 percent would be sufficient; yes. We have suggested that there should be 40 per cent...We have raised it [from 33% to 40%], because we believe that it would be better to make the notes so absolutely good and impregnable that we would rather err on the side of too much reserve than too little reserve" [11].

Hayek's condition of long-term purchasing power stability would remain satisfied even if one of the currencies in the basket were to increase in value and liquidity due to, for example, a wider international adoption for trade, as its dominance would be checked by the 30% value limit in the UNIT reserve basket.

Basket Re-Balancing

Other things being equal, emission of new UNIT tokens does not create a requirement to re-balance the UNIT reserve basket. This is due to the fact that if all four conditions for emission of new UNIT tokens mentioned previously are satisfied, new UNIT tokens are minted in exchange for an exact replica of the UNIT reserve basket at that time.

A need for UNIT reserve basket re-balancing may arise if, due to the relative moves in value of the underlying components in gold terms, minting new UNIT tokens by accepting a replica of the UNIT reserve basket would constitute a violation of conditions (2) or (3) as presented in the section above.

To minimize costs and maximize resilience, there is no requirement for gold bullion to be re-balanced among UNIT nodes at all. Instead, re-balancing is done by adjusting the local currency portion of the UNIT reserve basket (the non-gold part of the basket, the "NGP"), if needed.

As all components of the UNIT reserve basket are valued in gold terms, risk of arbitrage between outstanding and newly-minted tokens is mitigated by keeping the gold-equivalent value of newly-minted UNIT tokens identical to the value of outstanding UNIT tokens and re-distributing incremental changes to the NGP across UNIT nodes as needed, in order to re-equalize proportions in the changed basket among the nodes of the fractal monetary system.

Basket re-balancing scenarios fall into two broad categories: Condition (2) violations and Condition (3) violations.

In a Condition (2) violation scenario, the value of NGP in the deliverable basket deviates from 60% of the total in gold terms. Minting new UNIT tokens in this case would require the basket delivered in exchange for emission of new UNIT tokens to contain exactly 40% of gold, while the value of NGP required would be reduced or increased (while preserving relative weights of components of the UNIT reserve basket at that time) to equal exactly 60% of the total delivered basket, measured in gold terms.

In a Condition (3) violation scenario, value of one of the local currencies exceeds 30% of the UNIT reserve basket. Minting new UNIT tokens in this scenario will require a smaller proportional share of the currency in question in the NGP of the deliverable basket, compensated for by the increase in the values of other NGP components, measured in gold terms.

In both scenarios, therefore, the share of gold in the basket delivered in exchange for new UNIT tokens would equal 40% of the total value, and the share of NGP in the basket would remain fixed at 60%. In both scenarios, the need for re-balancing is conditional on minting new UNIT tokens only, and is implemented by re-distributing incremental changes to the NGP, in order to re-equalize the proportional composition of assets at each UNIT node.

Importantly, there is no ongoing requirement for any re-balancing among UNIT nodes beyond the new UNIT token emission: composition of the UNIT reserve basket remains unchanged after the emission, regardless of relative price moves of the UNIT reserve basket components, unless new UNIT tokens are minted subsequently. This approach facilitates price discovery at the UNIT level

directly, driven by supply and demand for UNIT tokens, rather than some reference values. This design also reduces costs, operational risks, as well as the attack surface of the fractal monetary system.

Inter-nodal arbitrage risk is eliminated by keeping the composition of underlying assets synchronized at each node after each new UNIT token is minted. The risk of arbitrage between UNIT tokens already in circulation versus newly-minted UNIT tokens is mitigated by the requirement to deliver the exact replica of the UNIT reserve basket in exchange for new UNIT tokens, or by the re-balancing protocol outlined above, in case re-balancing conditions are triggered at the time of the emission.

Due to the variation in liquidity, arbitrage of UNIT tokens versus the UNIT reserve basket components will remain possible. Arbitrage activity of this kind would be a welcome part of the ecosystem, as it would improve liquidity and price discovery for all participants.

Incentives

We expect various economic agents to join the UNIT ecosystem, driven by different incentives. The most urgent need may be for exporters who may have accumulated large positions in local currencies as a result of bilateral trade.

At the same time, importing countries may be looking for ways to potentially sterilize the currency used to pay for imports and minimize the risk of this currency re-entering the domestic money supply in a disruptive fashion. Using UNIT tokens allows both exporters and importers to balance their interests.

Further, governments on both sides of cross-border trade might consider collecting export and import taxes and levies in the currency that can be used to finance trade and reserves, generating a revenue stream denominated in UNIT tokens.

Critically, UNIT tokens represent an attractive alternative to using other countries' domestic currency for trade, investment, and reserves.

The UNIT ecosystem offers its members the following further advantages:

- Decentralization - trade and financial flows shared by a large number of participants;
- Inclusivity - UNIT ecosystem is open for all participants;
- Efficacy - transaction costs, infrastructure requirements, and the speed of clearing/settlement will be comparable to or better than bilateral trade in local or global currencies;
- Transparency - clear rules and procedures monitored and enforced by a reputable international organization;
- Fairness - impossibility of asymmetrical information or asymmetrical advantages within the ecosystem;
- Security - focus on cyber and physical safety of assets and information;
- Sustainability - UNIT ecosystem is designed for resilience when facing economic and political disruptions, as well as attacks by third parties.

A fully-developed UNIT ecosystem should be able to survive an abrupt loss of any of its nodes. While disruptions related to the currency components of the UNIT reserve basket are relatively easy to mitigate, a loss of a material part of the gold which anchors the underlying basket may jeopardize the integrity of the system.

Distributed storage across multiple secure locations may be a part of the solution, but it will likely need to be augmented by a portion of UNIT tokens held in reserve funded by interest income on local currencies forming the UNIT reserve basket.

In order to accelerate the buildup of such reserves at the ecosystem level, emission of new UNIT

tokens may incur a small additional fee to cover the infrastructure costs of the system. As liquidity and resilience of the system increases, these fees are likely to materially decline.

Conclusion

We propose a solution to the alternative global currency problem by introducing an independent decentralized fractal monetary framework which avoids using national currencies for international trade and reserves.

Each UNIT token represents a proportional share of the basket of underlying assets, containing gold and local currencies. New transactional units can be minted at the node level without the need for a central emitting authority or coordination among the issuers of underlying currencies by exchanging a replica of the basket for new UNIT tokens.

With further resilience enhancements, the UNIT ecosystem may reach the level of robustness sufficient to continue functioning in scenarios of extreme disruptions and conflicts.

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