Smart Banknotes and Cryptobanknotes: Hybrid Banknotes for Central Bank Digital Currencies and Cryptocurrency Payments

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Abstract:

We are heading for a cashless world. At some point, we will say goodbye to all those pieces of paper and polymer and switch to an electronic alternative. The only problem with these statements is that people have been saying them since the late 1960s. Banknotes have a robust technology and will be around for quite some years to come.

What is needed is a transitional device that will ease the transition from nineteenth-century cash to twenty-first-century digital currency. The answer is a hybrid banknote.

Basically, a hybrid banknote is a physical banknote on a paper or polymer substrate that can transfer value over an electronic network. It is denominated and has all the physical properties of a traditional banknote, allowing it to pass hand to hand. However, when the need arises, the user can access an electronic network and transfer the denominated value off the hybrid banknote.

In this paper, we look at the past and present of hybrid banknotes, identifying their two basic forms—smart banknotes and cryptobanknotes—and how they differ. We also offer three hybrid banknote models that can be used to address pressing needs in payments technology.

INTRODUCTION

As Central Bank Digital Currencies (CBDCs) become reality and the use of cryptocurrencies for payments become ever more mainstream, concerns have arisen about the widespread adoption of these new digital monies. Particularly worrisome are how to make them available to everyone, everywhere, at all times. Potential users include those without bank accounts, without technical aptitudes, and even those without electricity. Rightly, much attention has been focused on how to utilize digital currencies offline on a regular basis or during emergencies.

To date, the only payment technology that can be used offline by everyone, everywhere, and at all times is cash. Banknotes are a robust payment technology that has planetary acceptance and is used by all classes and all ages. They are a familiar technology and, in some cases, a comforting one, given their tactility and ability to be accumulated as a store of value.

However, the pure physicality of banknotes presents problems in the digital age. Foreign remittances are slow and not secure, access to and storage of banknotes can be costly and problematic, and the existence of cash alongside CBDCs can impede central bank monetary policy, in particular, by creating a zero lower bound.

It seems only logical, therefore, that an ideal payment instrument would combine the advantages of banknotes and digital currencies. A hybrid banknote would use a universally accepted and robust payment technology, cash, to deliver the cutting-edge benefits of digital money. A hybrid banknote could routinely function as a banknote does currently but have the ability to access an electronic network to transfer value.

It is the purpose of this paper to present the fundamental traits of hybrid banknotes, their history, and to propose three potential models for hybrid banknotes for use in the present and future. These hybrid banknotes can not only solve immediate problems but also act as a transitional device from a world or cash to one of digital payments.

OVERVIEW OF HYBRID BANKNOTES

A hybrid banknote is a traditional banknote that has the added ability to communicate with an electronic network.

> It is like a traditional banknote in that it bears intaglio and offset printing on a paper or polymer substrate.
>
> It is denominated and has the physical properties of a traditional banknote in size, feel, appearance, security features, and etc.
>
> It is able to operate totally offline without internet or electricity as does a traditional banknote.

It is able, when necessary, to transfer its denominated value electronically over a network.

It is not a rigid, plastic card such as may be used in present credit or debit transactions or other hardware-based payment systems like Mondex or WhisperCash.[1]

The idea of adding electronic capabilities to a traditional banknote to create a hybrid arose in the 1990s. As early as 1996, a patent was sought for a banknote with an embedded chip that would act as an anticounterfeiting device.[2] The idea caught on.

Soon, Hitachi, Philips, and others were working on chips for banknotes. By 2001, the European Central Bank and the Bank of Japan were planning chips for their high-denomination notes.[3] Hitachi's Mu-Chip was the leading contender. But, chip cost and size stopped progress. In 2008, Hitachi developed RFID powder, super-small chips, for anticounterfeiting applications.[4] This led to calls for "IC [Integrated Circuit] Banknotes" and "Physical-Digital Cash."[5] All these efforts were aimed at creating notes that were hard to counterfeit.

By the early 2010s, the idea of a hybrid banknote was expanded to not just preventing counterfeiting but also to conveying value electronically via a banknote, a merging of physical and digital money. Two basic models for such hybrid banknotes developed: smart banknotes and cryptobanknotes. Briefly, a smart banknote has the ability to communicate with an electronic network via chip technology. It is basically a traditional banknote with an embedded chip. Meanwhile, a cryptobanknote conveys the value of a digital money but cannot interact directly with an electronic network. It is modeled on a paper wallet as used with cryptocurrency, sometimes bearing the private and public keys needed to access a cryptocurrency address. Let us now see how these two models of hybrid banknotes developed.

THE HISTORY OF HYBRID BANKNOTES

Smart Banknotes

The first concepts of a hybrid banknote that transferred value over an electronic network involved smart banknotes (having chips). By 2010, and the rise of cryptocurrencies, thinking about electronic features on banknotes had expanded to include the thoughts of a hybrid banknote, acting as a transition between traditional banknotes and cryptocurrencies and facilitating financial inclusion. Such a perspective was expanded in work performed for the Bill & Melinda Gates Foundation by Ignacio Mas and Consult Hyperion, represented by Paul Makin and Andrew Whitcombe. Makin and Whitcombe dubbed the resulting hybrid banknote a “smart banknote.”[6]

Futurist Ignacio Mas was one of the first theorists of smart banknotes. In a 2010 paper, he started with the premise that the continued existence of traditional banknotes was

inevitable, pointing to cash's benefits of universal acceptance, store of value, immediate transactions, and fixed denominations (allowing for budgeting).[7] Also, the physicality of notes, he argued, aided in the everyday use, handling, and budgeting of money.[8]

The purpose of a smart banknote was to minimize the problems and costs associated with traditional banknotes. These included the inability to make remote payments, the cost of access (via ATMs), and the problem of individual and institutional safe-keeping. He envisioned a smart banknote that could send and receive a set amount of value, the amount denominated on the note, over an electronic network.

He originally envisioned these notes as traditional, denominated banknotes with RFID chips embedded in them. The chips allowed the smart banknotes to communicate with electronic networks via a smart phone or POS device and to "activate" or "deactivate" the note, meaning to validate or invalidate the banknote's face value. It was envisioned that smart banknotes could repeatedly move between these states, having the denominated value of the note transferred to and from the smart banknote as needed.

And, the note would physically show without connection to an electronic network whether it was "activated" or "deactivated," whether it had value or not.[9] This state would be apparent on the face of the note in some way: perhaps the ink changed color, from brilliant to grayed out (using E ink), from "activated" to "deactivated."[10] Central banks might even save money by transporting only deactivated notes to issuers, which would then activate the notes before issuance.[11]

The RFID chip in the note, according to Mas, would "hold an encrypted unique serial number" that could only be read when connected to a payment network. This would ensure authenticity and allow for the tracking of the note.[12]

The Consult Hyperion model that appeared at roughly the same time as that of Mas, being based on the same research effort at the Gates Foundation, also included an RFID chip in a banknote with a polymer substrate.[13] This smart banknote would also have an antenna, sensors, a power supply, and a display.[14] The display would use electronic ink or E Ink to display the value of the smart banknote.

The smart banknote envisioned acted more as a debit card. And, while the note would presumably be denominated with a maximum value, value could be subtracted from or added to the smart banknote via electronic transactions. The current value would be displayed on the note via the E Ink.[15]

Consult Hyperion argued that the use of an encrypted chip in the banknote would eliminate the need of other costly, more traditional security features such as intaglio printing and holograms.[16] However, Consult Hyperion recognized that it would be difficult for a user to judge the authenticity of a smart banknote if no electronic network was available to read the chip.[17] It was also concerned about how to prevent the "virtual pick-pocketing" of the RFID chip.[18]

At the time, Consult Hyperion also concluded that its banknote could take on any shape and put forward a card-type smart banknote.[19] However, it saw that this design would make it less socially acceptable to those used to traditional banknotes, and it would not be compatible with the existing cash-handling infrastructure, resulting in resistance to its adoption by the cash-handling industry.[20] In 2010, Consult Hyperion estimated that the technology needed to mass produce smart banknotes would be available by 2020 or 2025.[21]

After 2010, ideas for placing chips in banknotes and creating some kind of smart banknote continued to emerge. By 2012, Saudi Arabia was joining the race for a RFID banknote but mainly for note tracking.[22] Then, in 2014, EDAQS unveiled the DICE system (Dynamic Intelligent Currency Encryption), a hardware/software system using RFID notes and AI to verify, track, and remotely cancel banknotes. DICE has continued to develop this technology, moving away from older chip technology.[23] Presently, the new firm, Noteworthy, appears on track to create a smart banknote, utilizing chip technology.[24] And, while, smart banknotes were originally envisioned to exist on a centralized ledger, using digital fiat currency, later smart banknotes became based on cryptocurrencies and blockchain technology.

Cryptobanknotes

In the early 2010s, while the first smart banknote concept was being developed involving chips, others were starting from a cryptocurrency perspective and creating what would become known as cryptobanknotes. (As seen below, this term was coined by Andrei Lipkin in 2017.)

These hybrid banknotes were built upon the conception of a paper wallet for Bitcoin. A paper wallet is a paper or polymer item that contains the private and public keys needed to access a single cryptocurrency address or account and the funds therein. It conveys no value without access to an electronic network. However, the idea of a paper wallet was modified by creating a device that was denominated, allowing it to convey value without connection to the internet and to be passed hand to hand. And, unlike smart banknotes, there was no RFID chip involved. Further, while smart banknotes can operate via a central ledger or a blockchain, cryptobanknotes must rest upon a blockchain foundation.

In 2011, bitbills were designed as plastic cards denominated in Bitcoin. They bore public keys and private keys in the form of QR codes covered by tamper-evident stickers.[25] The bitbill, it is assumed, would allow the user to transfer the denominated value in Bitcoin to an account. Use of the card and the removal of its value would be apparent because the sticker over the private key had been removed.

This meant that once the card had been connected to an electronic network that it was basically useless in further hand to hand transactions and had to be considered burned or deactivated. It was largely a one-use device. However, as long as the bitbill had not been connected to a network and its tamper-evident sticker was intact, it could circulate

as a denominated note at face value. It is unknown whether any of these cards ever entered circulation.

Bearing a greater resemblance to a banknote were notes issued by Bitcoin Suisse AG in 2013. Again, denominated in Bitcoin, these Bitcoin Suisse Crypto Certificates held a public key as a QR code (and in alphanumeric format) and a private key in alphanumeric format sandwiched between sheets of polymer paper, requiring destruction of the note to access it.[26] These notes had serial numbers as well as passive and active security features.

These smart cryptobanknotes were shipped deactivated or unloaded.[27] The purchaser of the note had to contact Bitcoin Suisse AG with the serial number and public key to load it with the denominated value.

Based upon paper wallets, these cryptobanknotes acted the same as previous bitbills. Bitcoin Suisse Crypto Certificates would allow the user to transfer the denominated value in Bitcoin to an account.[28] The transfer of Bitcoin would be evident by the revealing of the private key printed on the note.

So, like bitbills, these smart banknotes could be passed hand to hand until they were connected to an electronic network. After that, they had to be considered burned or deactivated.

In 2016, BitNotes appeared on the scene. Like bitbills and Bitcoin Suisse Crypto Certificates, these cryptobanknotes were based on Bitcoin, bore denominations, and used QR Codes to interface with an electronic network. However, BitNotes were designed to be printed at home using blanks provided by BitNote. The point of this design was to increase security and anonymity by removing the manufacturer from having knowledge of and providing the private key.[29]

To redeem the note, the foil over the private key originally printed on the note by the manufacture would be removed. And, using BitNote software, this private key along with the second private key generated by the user and the public key would be used to access the loaded Bitcoin. As with all the paper-wallet models discussed so far (bitbills and Bitcoin Suisse Crypto Certificates), BitNotes could only be passed hand to hand until they were connected to an electronic network. After that, they had to be considered burned or deactivated.

In 2017, Andrei Lipkin, a banknote designer, began creating models for hybrid banknotes and coined the term, “cryptobanknotes.” Lipkin’s first hybrid banknotes also employed QR codes and private keys protected by a tamper-evident device as well as other layers of security and authentication. He did not recommend the use of RFID chips as they could be hacked. These cryptobanknotes would be produced by existing security printers, using existing equipment and techniques.[30]

The cryptobanknotes would be denominated and be linked to a unique e-wallet equal in value. Lipkin, as with the BitNotes prototype, believed specialized software would be needed to make the notes operate. This software would act to authenticate the cryptobanknote and "simultaneously facilitate the execution of an e-payment of a banknote to any user and cancel the address of an e-wallet" corresponding to the note.[31] Once this happened, the note was no longer valid. Until then, the cryptobanknote could be passed hand to hand and used as a traditional banknote.

Two years later after the start of Lipkin's designs for cryptobanknotes, in 2019, Bitcoin Suisse released a new series of Bitcoin Suisse Crypto Certificates. These cryptobanknotes are currently available in various denominations and cryptocurrencies and bear a private key under a scratch-off sticker.[32] These certificates act in the same way as the earlier series of cryptobanknotes. However, the 2019 series has advanced banknote security features such as optically variable ink, security ribbons, and UV ink.[33]

HYBRID BANKNOTES FULFILL PRESSING NEEDS

So, why have so many people spent so much time over the past decade developing hybrid banknotes like smart banknotes and cryptobanknotes? The histories presented above provide some of the reasons: the electronic transfer of value, financial inclusion, popularization of digital money, and etc. Over time, these reasons have lost none of their potency. Indeed, the expansion of cryptocurrencies and the rise of central bank digital currencies have increased the importance of the old concerns and added new ones. And, all the while, cash has continued to be preeminent.

Banknotes have proved so enduring because they serve some essential functions.[34] However, the continued widespread use of traditional banknotes can hinder the adoption of digital currency and the exploitation of its advantages.

A hybrid banknote will allow for the best of both worlds, fulfilling the role of cash while allowing for digital usages. It will also act as a transitional device between traditional payment systems and electronic and digitally based payment systems, especially CBDCs.[35] Hybrid banknotes would gradually replace current banknotes and exist alongside current smart-phone technology until no longer needed. Here's how a hybrid banknote would aid in the transition to digital currencies:

Financial Inclusion: There are many people who do not have the bank accounts that would be needed to access an electronic network and use digital money on a regular basis.[36] They depend on cash for their daily transactions but could periodically use a hybrid banknote's electronic capabilities perhaps at a retailer or public kiosk.

No Internet Access: There are places and times when there is no internet access (or even electricity), rendering electronic money and payment methods useless. Designed to work totally offline, a hybrid banknote would fill the gap.

The Cash Industry: There are many industries and people employed in the manufacture, transportation, safekeeping, and cycling of cash. Making this sector obsolete would have a great economic impact and cause significant pushback against CBDCs and cryptocurrencies. Hybrid banknote production and issuance would maintain this industry as it adapts to cashless payments.

Popular Payment Practices: People are used to cash, and many people prefer using cash over existing electronic payment methods. This may be a generational phenomenon. Hybrid banknotes allow the public to continue dealing in cash but gives them the option to make electronic transactions.

Increased Cash Usage: Despite the predictions of the imminent death of cash, its usage is actually increasing.[37] The possession of physical banknotes is seen as a measure of security during times of economic uncertainty.[38] Hybrid banknotes allow people to continue to hold a physical object as a store of value.

Digital Money Adoption: A banknote that allows for electronic transactions will foster the adoption of digital money. Hybrid banknotes conflate the concepts of physical and electronic money, which will lead to greater familiarity and comfort with digital payments on the part of the general public. This will promote the adoption of CBDCs and cryptocurrencies.

Central Bank Policy Implementation: Hybrid banknotes will facilitate the application of new central bank policies such as breaking the zero lower bound in interest rates or other innovative policy initiatives that would require smart contracts.[39] Currently, the existence of cash prevents a complete movement below a zero interest rate. However, a banknote that interacts with an electronic network and represents a digital currency will lift this restriction and open new possibilities.

Transactional Anonymity: Acting as traditional banknotes, hybrid banknotes provide for anonymous transactions as in any cash transaction. However, whenever a hybrid banknote is used on an electronic network that anonymity can be lost. The degree of anonymity of a hybrid banknote when used online ultimately depends on the design of the ledger and protocols with which it operates. Indeed, there are ways currently being developed to maintain anonymity in transactions involving blind signatures, timed erase, and Zcash.[40]

THREE HYBRID BANKNOTE OPTIONS FOR TODAY

Building upon the past and incorporating current technology and developments in the cash and payment worlds, we present the most promising hybrid banknote models for CBDC and cryptocurrency use today.

First is a smart banknote, a traditional banknote that has the added ability to communicate with an electronic network via chip technology, which can operate on a central ledger or

a blockchain. The second and third models are variations of a cryptobanknote, which uses QR codes and is reminiscent of a paper wallet and is based on blockchain technology. Two types of cryptobanknotes are possible: cryptonotes and cryptobills.

Smart Banknotes

A smart banknote is like a traditional banknote in that it bears intaglio and offset printing on a paper or polymer substrate. Like a traditional banknote, a smart banknote conveys its value without a network or electricity. It can work completely offline. Its visible denomination presents its discrete value, prima facie. A smart banknote conveys value without the need to connect to an electronic network. However, a smart banknote is capable of conveying its value over an electronic network, acting as an electronic payment vehicle.

This hybrid banknote talks to an electronic network via one or more RFID chips. Using a smart phone, a point of sale device, of other reader, the value of the smart banknote can be moved back and forth on an electronic network. Value can be transferred off of a smart banknote onto a network, or value can be transferred from a network on to an "empty" or valueless smart banknote. The status of the smart banknote, whether it contains its face value or not, whether it is "empty" or not, is indicated by a tactile and visible icon formed by electronic ink.

A smart banknote would appear much like existing Dollar, Euro, or Pound banknotes. The same substrate, intaglio and offset printing, denominators, security features, and overall design could be maintained from existing notes. And, depending on the chip technology employed, the chips may be largely invisible. The icon, indicating the note's status, could be an existing design feature or new feature worked into an existing design.

Imagine a $10 US smart banknote. It will appear as a regular $10 bill but may have a tiny chip or two visible in the substrate. The status icon could be the current Symbol of Liberty in the design: The Statue of Liberty Torch.

$10 Federal Reserve Note

This smart $10 bill would circulate hand-to-hand like a current $10, being used in face-to-face transactions or fed into vending machine bill acceptors. No access to an electronic network is necessary. Everyone would know that this $10 bill contains its value because the torch symbol is colored and raised above the surface of the note. With this tactile feature, even the visually impaired can gauge the status of the note.

$10 Federal Reserve Note, Symbol of Liberty Highlighted

Perhaps the smart banknote user then needs to complete an electronic transaction. They want to transfer the $10 to their bank account, transfer it to a distant relative, or make a transaction at a point that does not accept cash. The user touches the note to their phone or point of sale device and transfers the value over the network.

The value icon or The Statue of Liberty Torch symbol then disappears, indicating visually and tactilely that the smart banknote no longer has value; it is “empty.”

The user can then turn in the smart $10 bill to a bank or merchant that will recharge the note and reintroduce it into circulation. Or, the user can hold on to the smart banknote and recharge it themselves by transferring $10 back on to the bill. At this point, The Statue of Liberty Torch symbol would appear, indicating that the smart banknote bears its face value. And, the smart $10 can continue circulating hand-to-hand.

Cryptobanknotes

A cryptobanknote is also a hybrid banknote. It is a traditional banknote that conveys the value of a digital money but cannot interact directly with an electronic network. But, it is modeled on a paper wallet as used with cryptocurrency, usually bearing the private and public keys needed to access a cryptocurrency address.

Like a traditional banknote, a cryptobanknote conveys its value without a network or electricity. It can work completely offline. Its visible denomination presents its discrete value, prima facie. A cryptobanknote conveys value without the need to connect to an electronic network. However, when needed, the value of a cryptobanknote can be transferred over an electronic network, using the keys located on the note.

Two types of cryptobanknotes are possible: cryptonotes and cryptobills.

<u>Cryptonotes</u>

A cryptonote is a hybrid banknote that bears the public and private keys to access a cryptocurrency account. Cryptonotes can pass hand-to-hand until a user wants to transfer the value of the note to an electronic account. This action will “burn” or invalidate the note, making it incapable of further use. Hence, a cryptonote can be considered single use as regards the electronic transfer of its value.

It would require a design somewhat different from existing Dollar, Euro, or Pound banknotes. It would use a banknote substrate, use intaglio and offset printing, and bear

denominators and security features like existing notes. However, the note would require a QR code and a location for a removable foil or other concealing, tamper-evident device.

A £10 note, for example, would bear all the attributes it now has, but the silver foil patch (bearing the crown, top-left) would be removable. Underneath of it would be the private key in QR form. The hologram (bearing "Ten," bottom-left) would be replaced with a visible QR code that would be the public key.

£10 Note

Like a current £10 banknote, the £10 cryptonote would repeatedly pass hand-to-hand and be used in face-to-face transactions or fed into vending machine bill acceptors. No access to an electronic network is necessary. Everyone would know that this £10 contains its value because the foil patch is intact, evidence that no one has accessed the private key necessary to transfer its value electronically.

Perhaps, the cryptonote user then needs to complete an electronic transaction. They want to transfer the £10 to their bank account, transfer it to a distant relative, or make a transaction at a point that does not accept cash. The user scratches off the foil patch to reveal the private key. Then, using their phone or point of sale device, the user scans the QR codes for the public and private keys, accessing the corresponding wallet. The £10 can then be transferred.

Now, with the foil patch removed and the value removed from the note, the cryptonote can no longer be used. And, because of the physical damage to the note, it cannot be reused. The lost foil patch also makes it evident to everyone, including the visually impaired, that the note no longer has value.

Cryptobills

A cryptobill is a hybrid banknote that bears only the public key of the cryptocurrency holdings of the issuer. The private keys to individual accounts are held by the note issuer. Cryptobills can pass hand-to-hand until a user wants to transfer the value of the note to an electronic account. The note must then be taken to the issuer or its representative to have the value represented by the note transferred. This action does not involve the actual note but only the cryptocurrency accounts holding the backing value for all cryptobills. As a result, the note can be reissued repeatedly and circulate until worn out.

A cryptobill takes as its model past banknotes used in the United States such as Silver Certificates and Gold Certificates. Such bills were certificates of deposit with the banknote representing a certain amount of the backing silver or gold held in the US Treasury. A holder of a Silver Certificate and Gold Certificate could go to the Treasury and turn in the note for the backing silver or gold. After accounting for the payout of this specie in its books, the Treasury would reissue the note for continued circulation until the note was worn out or all the backing silver or gold was depleted. A cryptobill acts in the same way. Only, here, the backing is a cryptocurrency.

It would require a design very similar to that of an existing Dollar, Euro, or Pound banknote. It would use a banknote substrate, use intaglio and offset printing, and bear denominators and security features like existing notes. However, the note would require a QR code, bearing a public key. No chips or removable foil patches.

Like a current banknote, the cryptobill would repeatedly pass hand-to-hand and be used in face-to-face transactions or fed into vending machine bill acceptors. No access to an electronic network is necessary. As with current banknotes, there is no need to determine whether the note actually holds value, because it is irrelevant. A cryptobill, like a current Dollar, Euro, or Pound, is simply a token for its underlying currency. As a result, users are only concerned with the authenticity of the note as they are with current banknotes.

Cryptobanknote Model by Andrei Lipkin

CONCLUSION

Hybrid banknotes may seem new and radical, but they are not the first instruments to act as hybrid instruments. During the 1970s, hybrid US Treasury securities existed. These securities were meant to bridge the transition from physical (definitive) securities to electronic ones handled in the new book-entry system. This began with Treasury Bills and was slowly expanded to include Notes and Bonds. These physical securities were entered in the book-entry system but were still issued in paper form bearing their CUSIP numbers. This was a hybrid, transitional security able to work in both worlds.[41]

Given that 50 years ago the US Treasury was issuing hybrid securities (part definitive, part electronic), it does not take a great stretch of the imagination to believe that a hybrid banknote could be produced today, acting as a transition between definitive and electronic cash.

Transcending the division between the world of banknotes and electronic money through a hybrid banknote will bring many advantages to central banks and cryptocurrency advocates. Such banknotes will use a universally accepted and robust payment technology, cash, to deliver the cutting-edge benefits of digital money, passing hand to hand until used to access an electronic network to transfer value.

Hybrid banknotes can provide anonymous, offline transactions, using a familiar technology. At the same time, they can promote the adoption of digital money and facilitate central bank monetary policies possible only with CBDCs. All this can be done while maintaining the health of the cash industry and meeting the popular demand for cash.

Also, the use of one form of hybrid banknote does not preclude the use of another. Smart banknotes, cryptonotes, and cryptobills can all be used together, serving specific purposes within the same currency. Some issuers may want to use full-feature notes like smart banknotes and cryptonotes for high denominations and use simpler cryptobills for low denominations. And, there may be times, such as during disaster relief, when a single-use note (such as a cryptonote) or a note that can be activated onsite (such as a smart banknote) are preferable. Hybrid banknotes provide many options.

Since their inception in 2010, hybrid banknotes have taken many forms but shared many characteristics. These commonalities stem from the notes having the same overall mission, to create a device that brings together the world of cash and traditional banknotes and the world of cryptocurrencies and electronic networks. These devices were designed to solve a myriad of payment problems that are still with us today and will be into the future.

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