

Inventio Software Ltd
Specialist Instrumentation Design and Programming

The You-Me Drive

Creating a trusted network in a decentralised world

Kickstarter project #1299456832

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About Us

Howerd Oakford specialises in real-time, embedded, internet-enabled programming where program size, speed, security or reliability are critical.

Inventio Software Ltd - registered as a computer consultancy in the UK since 1985, and as a limited liability company 7th July 2000, is the platform for Howerd Oakford's work as a computer consultant in the UK and Europe. It is run by husband and wife team, Howerd and Rita Oakford.

Rita Oakford specialises in making sure that Inventio Software runs smoothly.

Inventio is Latin for "discovery". Software is what makes a computer do what you want.

Please visit www.inventio.co.uk for more information.



Howerd Oakford



Rita Oakford

The Elevator Pitch

The You-Me Drive (YMD) is a combination of USB Flash Drive, Wi-Fi module and secure software, which aims to replicate the trust network currently provided by centralised institutions such as banks.

Groups of up to 256 You-Me Drives communicate with each other over an existing Wi-Fi network to backup secure data, and also have the ability to unlock forgotten passwords and replace lost You-Me Drives, by means of a consensus of You-Me Drive Group members.

“The You-Me Drive is a personal identity device that aims to connect important data to real, trusted people”



The first You-Me Drive prototype

So Why Do I Want One?

Because everybody needs a USB Drive that you can throw away but cannot lose, securely locked with a password that no one can crack but anyone can ask for...

“It’s so difficult to throw away that you have to pay to delete files”

A bit of a riddle? Not really – You-Me Drives live in Groups – you just ask friends and family in your Group to give you an unlock code to replace a lost You-Me Drive, or reset its password. But they have to say “yes”...

The problem with computers is that they are machines that just happen to look intelligent, but we all know that they just do what they are told, even if we don’t want them to. And, they break down, get hacked, lost or stolen. This is acceptable until you start to store important data on them.

I want to create a simple, reliable USB Drive to store important information that you cannot lose – the You-Me Drive.

To do this I want to take computers out of the equation, and bring **people** back into the equation.

Isn't this already out there on the internet?

No, not as far as I know. Google Drive, iCloud and Dropbox store your data – the You-Me Drive does not compete with them – you will still need lots of backup for photos and videos. The You-Me Drive can only store 64 Megabytes, about thirty photos, so you shouldn't waste space – just store your Google Drive, iCloud or Dropbox **passwords** there. Especially because you might have to **pay to delete them!**

Isn't that what password managers already do? The You-Me Drive does not compete with them – you will still need a password manager to keep track of your life online. Just store your master password on your You-Me Drive. Then you can shred the Post-it note on the fridge, rub out the pencilled note on the back page of your diary and ask your best friend to forget what it was...

Backup and password manager companies employ people to look after their customers – checking identity, resetting passwords and so on. This is fine until the company closes down, gets hacked, or you stop paying the subscription. With the You-Me Drive **you get to choose** who your customer support people are – your own friends and family. You can pay them back by being their customer support when they ask you.

Just how secure is the You-Me Drive?

Phase 1 You-Me Drives are only as secure as the computer and operating system that you plug them into – that is, not at all secure.

As a consumer, you are caught in the crossfire between the operating system writers, e.g. Microsoft, and the computer virus writers e.g. people who resent Microsoft's share of the market. Your computer is a single point of failure – if it gets hacked, that's it.

Phase 2 of the You-Me Drive project removes the risks and viruses of your operating system by providing its own, temporary replacement "operating system". The aim is to make the You-Me Drive as secure (and simple) as the best smart cards – that is, very secure.

The encryption scheme will be simple and strong, and will be used in the simulation software and Phase 1 and 2 hardware devices.

Funding and Rewards

We are requesting funding to achieve :

Phase 1

Feasibility study using existing hardware, (such as the ZSUN Wireless Wi-Fi USB Smart Card Reader pictured [above](#)), and a user interface programmed on a Windows PC, beta test of the YMD system.

Open discussion of security policies, and usage possibilities.

Defining the requirements document for Phase 2.

£80k, rewards of evaluation software and You-Me Drive prototypes (fully operational, but with security limited to the security of the PC).

Phase 2

Design and development of :

Secure You-Me Drive hardware

Secure You-Me Drive Wi-Fi firmware

YMD-Boot firmware

Graphical user interface software.

Marketing and sales of You-Me Drives and YMD Group IDs.

£500k, rewards of YMD Boot software (Operating System replacement) and secure You-Me Drive production units.

Rewards

I won't duplicate them here in detail because it's too much work to keep synchronised – please see the Kickstarter Project page – thanks!

The You-Me Drive

Every You-Me Drive (YMD) belongs to at least one You-Me Drive Group (YMDG) of up to 255 other You-Me Drives, and is normally linked to the identity of one person.



Figure 1 A Group of four You-Me Drives

The You-Me Drive requires power to operate, by being plugged into a laptop, PC or USB power adapter.

Once powered up and configured, each you-Me Drive will connect to an available Wi-Fi network and communicate with other You-Me Drives in its own group, either via the internet or by direct peer-to-peer (P2P) connection.

Every file stored on a You-Me Drive (YMD) is automatically saved via the Wi-Fi connection in encrypted form onto every other YMD in its YMD Group.

A file stored on a You-Me Drive can be protected by specifying how many, and optionally which, of the other YMDs in its YMD Group are required to be able read, edit or delete the file.

The default is that only the YMD's owner can edit or delete a file, but anyone can read it.

Replacing the Centralised Institution

A You-Me Drive Group (YMDG) of up to 256 You-Me Drives can be used replace the trust network of a centralised system.

Centralised institutions such as banks, solicitors and mortgage companies provide the following services :

1. Backup and secure storage of legally relevant documents and accounts
2. Prevention of data destruction
3. Performing regular or one-time transactions
4. Customer authentication through human to human interaction

In each case we need to provide an equivalent decentralised service – here's a comparison of how a centralised bank and the decentralised YMD do this :

Backup and secure storage of legally significant documents and accounts

Centralised : data stored encrypted on a server which is protected by physical security such as locked doors, night watchmen, burglar alarm systems and CCTV recording.

YMD : data is stored encrypted on every available YMD in a YMD Group. Physical protection of each YMD is not required because :

1. the encryption is strong enough to resist cracking for long enough to allow a stolen YMD to be deactivated (please see the [Deactivation and Blocking section](#) for details)
2. a lost YMD (or forgotten PIN) can be replaced, by the authorisation of the required number of YMD Group members

Prevention of data destruction

A file stored on a You-Me Drive can be protected by specifying how many, and optionally which, of the other YMDs in its YMD Group are required to be able read, edit or delete the file.

If a file is specified as requiring 257 YMD Group members for editing or deletion, but zero members for reading the file, it can never be deleted – this would be suitable for Public Keys that should never be lost.

For storing legally relevant documents such as a Will, Deeds of Covenant or contract the data would be specified as requiring all of the concerned parties to edit or delete the file, and any member of the YMD Group to be able to read it.

For storing the bank account passwords for a forgetful family member, the file would be specified as readable by members of the family sub-group (a sub-group of the YMD Group), and only able to be edited or deleted by members of the family sub-group except the forgetful family member.

Each file can be given properties that are appropriate for the function of the file.

Of course it is possible to delete a file by physically destroying every one of the YMD Group Drives, so some physical protection is required: the location of YMD Group members should be restricted information to make this difficult to achieve. Human level communication between YMD owners can be through the YMD text system or conventional email, phone or text messages, without disclosing their physical location.

Performing regular or one-time transactions

Centralised : Direct Debit or Standing Orders can be applied to an account, and this data is stored on a physically secure server.

YMD : all YMDs that are powered up and connected to the network check that a transaction stored by a given YMD (on all YMDs in its Group) is successfully completed when required. Since the transaction is stored as a file with specific properties, only the appropriately authorised YMD owners can stop, start or change these transactions.

Customer authentication through human to human interaction

Use Case 1 Opening an account

Centralised : When you open a bank account you must provide utility bills, ID cards or passports etc. to an employee of the bank, at a local branch, you must convince the bank employee that you are who you say you are, and that you live at the address that you gave them, then are you allowed to open a bank account, share secret information with the bank, and start to use their services.

YMD : when a new member wants to join a YMD Group they must convince (say) four existing members of the YMG Group to send them authorisation codes. This can either be by conventional phone, email, text or spoken messages, or by YMD-Text messages. This is done in a similar way to the centralised bank approach.

Use Case 2 Getting a new smart card or PIN

Centralised : If you lose your smart card or forget your PIN, you phone an employee of the bank, explain the situation, and the bank sends you a new card, and invalidates the old one.

YMD : If you lose your YMD, you obtain a new blank one from your supplier, and convince (say) four members of your group that you are who you say you are, and would like them to authorise a new You-Me Drive for you, and invalidate the old one. Using the YMD-Text system, together with phone calls emails and messages, you send the four Group members your request and the Unique ID of your new YMD, and they respond with an "OK" when they are convinced that your request is genuine. Once the YMD Group has synchronised, the new YMD will function in exactly the same way as the old, lost one did.

Revenue Streams

The You-Me Drive project provides four sources of revenue:

1. Sale of the You-Me Drive software
2. Sale of You-Me Drive hardware with unique ID numbers
3. [Configuration of You-Me Drives](#) into a YMD Group
4. [Authorisation of decryption, deletion](#) or editing of YMD files

Simulation software, similar in appearance and function to the Phase 2 secure software will be sold for £10, and will operate without a physical You-Me Drive. This will allow real-world testing of the communications protocols before the Phase 2 hardware is available.

The lowest level, level 3 You-Me Drive unique ID will cost around £10, making a total of £30. The benefit to the purchaser is that sensitive or important information is backed up on all YMDs in their YMD Group and that lost or forgotten YMDs and PINs can be replaced in a simple, but decentralised way.

The next highest level, level 2 You-Me Drive unique IDs will be able to configure up to 256 level 3 YMDs, and so will attract a premium price. The owner of a level 2 YMD can configure 256 YMDs, charging £10 each

for the service. This is a possible maximum total of £2560, although there will be some work in configuring the YMDs and supporting the end user.

Similarly the owner of a level 1 You-Me Drive will be able to configure up to 256 level 2 You-Me Drives, and depending on the success of the YMD project, this gives a possible total of £655k. This figure is purely theoretical, as it would require nearly 17 million YMDs to be sold – it is expected that market forces would dictate the actual price, depending on realistic sales predictions.

Four years after launch, level 3 You-Me Drives may be allowed to configure level 0 You-Me Drives. This will close the loop, converting a pyramid structure into a circular, “flat” network where all YMDs are equal.

[Configuration of You-Me Drives into a YMD Group](#)

Pre-configured You-Me Drives will be offered for sale to individuals or small groups for their own use. A typical example would be an extended family of twelve users, all of whom can connect to each other securely, with the advantages of replacement of lost YMDs and PINs. “Blank” You-Me Drives (i.e. not configured to belong to a YMD Group) will be offered to suppliers, who purchase in bulk and configure the You-Me Drives for individuals or small groups.

The cost of You-Me Drive consists of a fixed hardware cost (approximately £20 for the first beta test units) plus a registration fee for a hierarchical unique ID number which depends on the hierarchical level of the ID number.

[Deletion of secure data stored in a YMD Group](#)

Both before and after the early adoption phase, the owner of a You-Me Drive will be able to charge other members of their group for authorising the deletion or editing of a file stored in the YMD Group. This income is smaller, but will increase as the data on the YMDs fills up the available space, eventually requiring some form of archiving.

Legally relevant files, such as wills, password files, contracts and crypto-currency wallets should be protected by requiring authorisation to edit or delete them, but less important files can be created without this feature.

The details of file delete protection will be finalised in the Proof of Concept development phase.

The You-Me Drive hierarchical unique ID numbers “Pay To Delete” concept

Deletion of secure data stored in a YMD Group. An emergent property of the ability to specify the properties of a file stored in the YMD Group is that while it is always possible to create a new file at no cost (up to the limit of the storage on the YMDs) some files can only be deleted when authorised by one or more members of the same YMD Group, or a higher level YMD Group. Since answering such a request takes time, it could be reasonably considered as a form of work, and therefore should be charged for.

This is the “Pay To Delete” (PTD) concept, and indicates that the YMD Group stores files in a way that is fundamentally different to that used by conventional file operating systems.

The “Free Access Secure Storage” concept

Another emergent property of the ability to specify the properties of a file stored in the YMD Group is that files can be specified that are stored securely, but given the right authorisation, may be freely accessed by an interested third party.

Each YMD can become a parent to a new YMD Group that is one hierarchical level lower than it. Similarly each “child” YMD can create their own YMD Group of children, in a pyramid structure.

The specification of file properties can be extended to include You-Me Drives from the next level up in a hierarchy.

The “Free Access” comes about because the required number of YMDs from a higher level YMD Group can authorise access to a lower level YMD.

If a YMD owner is suspected of using the YMD to store content that is deemed illegal or immoral, an interested third party can request access to the suspect content. Precisely who can authorise such a “big brother” action can be decided by members of the higher level YMD Group.

This should make the You-Me Drive effectively useless for such unwanted activities.

This is the “Free Access Secure Storage” concept, and solves the practical problem of how to protect both the privacy of the user and the security of the wider population.

The “Village Elder” concept

Each You-Me Drive has a unique hierarchical ID number, and is designed to securely store sensitive data such as user ID's, passwords, certificates and online contracts.

A “consensus” is defined in the properties of each file as a certain number of YMD Group members, or percentage of the total number of active YMD Group members, who give a positive reply to a consensus request.

This allows a group of people to interact in a defined way with the securely stored data, so that members of the YMD Group can :

1. protect legitimate data
2. expose malpractice
3. restore data from a lost or broken You-Me Drive
4. reset a user's PIN.
5. Invalidate a specific You-Me Drive's unique ID (e.g. if it is lost)

Access to a given You-Me Drive, other than by its owner, is controlled by members of the YMD Group that it belongs to and members of the YMD Group in the next hierarchical level up, creating a “village group of elders” structure, which allows a responsible overview of the content stored on a specific You-Me Drive.

Information about the person making the request and the reasons for the request will normally be distributed by conventional means – email, phone, letter or by face to face contact.

The physical You-Me Drive, with its user PIN, represents the authority to access the You-Me Drive owner's data take part in or create a consensus vote within its level or lower level YMD Group.

Appendix A Hierarchical unique ID number

Each You-Me Drive has its own unique 64 bit ID number.

The 64 bit ID number is divided into the following 1 byte fields :

1. System version number, currently 0
2. SuperGroup ID number (0 means non-member)
3. Level 3 ID number (0 means non-member)
4. Level 2 ID number (0 means non-member)
5. Level 1 ID number (0 means non-member)
6. Level 0 ID number (0 means non-member)
7. Non-voting sub-group ID number (0 means voting YMD)
8. Physical instance number

The eight 1 byte values can be thought of as a 48 bit unique ID number wrapped in the system version and physical instance numbers.

The 48 bit unique ID number also defines the hierarchical level of the You-Me Drive, with its corresponding authority within the YMD Groups' hierarchical levels.

The non-voting sub-group ID number allows a You-Me Drive to create up to 256 "ID cards" – associated with the YMD, but having no voting rights in enabling other YMDs in the Group.

Appendix B Specifications

Please note : all of this information is subject to change, pending “contact with the enemy”. The enemy in this case is human error. (https://en.wikiquote.org/wiki/Helmuth_von_Moltke_the_Elder)

Flash Disk

Low cost 32 GByte FLASH chip : 16 Gbytes are used for the FASS Free Access Secure Storage, shared equally between each of the 256 You-Me Drives in the YMD Group (for backup), giving $16 \text{ G} / 256 = 64 \text{ M}$ Bytes of secure storage.

The remainder of the 32 Gbytes (somewhat less than 16 Gbytes, depending on the FLASH chip) is mapped as a conventional FAT32 USB drive.

WiFi module

Low power, low cost WiFi module, e.g. Atmel ATSAMW25H18-MR210PA or Atheros AR9331 module or similar. Maybe also a LoRa or BlueTooth LE module, for peer to peer and mesh networking.

Secure single chip microprocessor with wireless capability.

Secure Software on WiFi module processor

Each You-Me Drive contains a WiFi module which has a single chip (e.g. ARM) microprocessor with on-chip FLASH containing the FASS software.

1. No Operating System, so no computer viruses.
2. Direct connection to the Internet via the WiFi module, all data encrypted.
3. Single chip solution means no plain text off chip, with tamper switch on case.
4. USB slave interface to PC or laptop.

Secure Software on PC/Laptop

Each You-Me Drive also contains a standard 32 GByte FLASH chip which stores :

1. the data for the You-Me Drive's user
2. the backup data for other You-Me Drive users in the YMD Group
3. the list of You-Me Drives within the YMD Group
4. the colorForth YMD-Boot program for the PC/Laptop

Appendix C The You-Me Drive Boot program (YMD-Boot)

Each Phase 2 You-Me Drive contains the YMD-Boot program, which runs automatically when a laptop or PC is powered up with a You-Me Drive plugged into it. The laptop or PC must be able to be configured for booting from a USB drive.

The YMD-Boot program allows the user to configure the You-Me Drive, for example to :

1. select the SSID and password for the Wi-Fi connection
2. check the authorisation for, and to read, edit and delete files
3. to set up and run time-based transactions
4. to authorise the access to other You-Me Drives in its group, if requested

The colorForth YMD-Boot system is an ultra-simple Operating System replacement, comprising editor, compiler and PC/Laptop BIOS drivers, and is therefore completely independent of the hard drives, Operating Systems and possible viruses on the PC/Laptop.

The colorForth YMD-Boot system is held in the You-Me Drive's secure storage, and can be easily upgraded online, but **only with the explicit agreement of a consensus** of YMD Group members.

Metadata

The You-Me Drive secure storage system does not have a Disk Operating System, and does not use conventional files. All data is stored as MetaKibbles - a compact format that separates data from meta data.

Part of the 32 GByte storage can be mapped to appear as a FAT32 file system when plugged into a PC/Laptop running Windows, Linux or MacOS for ease of data transfer.

The stored metadata (MetaKibbles) can be configured, for example to allow :

1. You-Me Drive user only to write, any member to read (a webpage or blog)
2. You-Me Drive user and any YMD Group member to read and append (email or newsgroup)
3. You-Me Drive user and any member to read and write (Wiki)
4. You-Me Drive user only to write, any member to execute (online contract)

The phrase "YMD Group member" also implicitly implies members of any YMD Group of a higher hierarchical level than the You-Me Drive's own hierarchical level.

Appendix D Trust

[Ed Gerck](#) in his paper [Trust as Qualified Reliance on Information](#) defines trust as follows :

"Trust is that which is essential to a communication channel but cannot be transferred from a source to a destination using that channel."

This means that you cannot use the same method to convince someone to trust you as you do to perform transactions with them. For example a password reminder for an online account is often sent as a text message to the mobile phone linked with that account.

Trust is essential to doing business. If you deposit money in a bank you trust that you will be able to get it out again in the future, and that nobody else can do this without your permission.

Banks have developed technology to prevent theft, while allowing access to authorised individuals – for example the “chip and PIN” smart card. Theft of the smart card is not sufficient to get money from an ATM – you have to know the PIN too.

In a centralised system like a bank, if you forget your PIN you can ask for a new one by convincing the bank that you are the rightful owner of the account. This can be done by presenting utility bills, ID cards or passports etc. to an employee of the bank, at a local branch.

Alternatively this can be done online by giving information that only you should know – the make of your first car, mother’s maiden name and so on, based on the information that you gave them when you opened the account, by presenting utility bills, ID cards or passports etc. to an employee of the bank, at a local branch, exactly as in the first case.

In either case a trust relationship was created by a human to human interaction, accompanied by the required paperwork such as photo-ID cards or passports. You must convince the bank that you are who you say you are, and that you live at the address that you gave them, only then are you allowed to open a bank account, share secret information with the bank, and start to use their services.

The conventional centralised banking system charges you (in the interest they don’t give you) for operating a network of banks, where you can interact with real people, and build up a trust relationship.

In the decentralised crypto currency world this is not possible – there is no central bank, no employees and no obvious way to create trust. If you forget your Ethereum or Bitcoin password the contents of your wallet are lost for good.

The You-Me Drive uses conventional technology to connect human beings to each other, allowing them to build up trust relationships, and support functionality similar to centralised institutions.

“The You-Me Drive is the smart card of the crypto world.”

Appendix E Usage

A You-Me Drive starts in its "factory reset" state, the entire 32 GByte storage is cleared. The Wi-Fi module's firmware is installed at the factory, and is **not** field upgradable (this is an important part of the security strategy).

A You-Me Drive can be restored to the "factory reset" state using the colorForth YMD-Boot program on a PC/Laptop, after which it no longer belongs to any YMD Group.

Note that destroying (physically or by performing a "factory reset") does not delete the data that was held by the You-Me Drive's YMD Group.

Deleting the data can only be done (if the file's property specifies this feature) by a consensus, and there is the possibility of charging for this deletion service.

This is because the 16 GByte secure storage space is shared amongst all YMD Group members, and should be used sparingly to hold user ID's, passwords, and certificates that can be used to secure bulk data on other storage devices, or remotely on the Internet.

The colorForth YMD-Boot program must be run on the PC/Laptop, and is obtained from a previously configured You-Me Drive. A small number of "You-Me SuperDrives" will produced by another method.

The "factory reset" You-Me Drive is inserted in a USB socket on the PC/Laptop running YMD-Boot, it can be configured as an "applicant" member of the YMD Group of the You-Me Drive that was used to boot the PC/Laptop.

When an "applicant" You-Me Drive is used to boot a YMD-Boot program on a PC/Laptop it will automatically send a request to join the YMD Group to all YMD Group members.

When a consensus of YMD Group members has approved the "applicant" You-Me Drive, it becomes a full member of the YMD Group, with rights equivalent to all other members.

YMD-Boot options not requiring authorisation by other YMD Group members:

1. clone a You-Me Drive (hardware replacement or backup)
2. change the You-Me Drive's PIN (a four digit number required to use the You-Me Drive), the current PIN must be entered
3. "factory reset" the You-Me Drive

YMD-Boot options requiring authorisation by other YMD Group members:

1. create a new YMD Group, each group has a human-readable name and a unique ID number, and must belong to a higher hierarchical level YMD Group
2. add/remove a You-Me Drive to/from the YMD Group
3. join or leave a YMD Group in the next hierarchical level
4. update the YMD-Boot colorForth program
5. allow Free Access to a given You-Me Drive

Security

Any secure system is only as secure as its weakest link, usually the human beings operating the system. Basic procedures must be followed if security is desired :

1. keep the You-Me Drive and its PIN safe and locked away from potential hackers.
2. only use a PC/Laptop that has not had its BIOS hacked.
3. do not allow others to see or copy plain text data, e.g. on the PC/Laptop screen.
4. do not join a YMD Group that has a possible consensus of members whom you do not trust.

Deactivation and Blocking

Deactivating a YMD puts it into a state where it requires re-activation before it will provide any information. Reactivation will be automatically provided by the YMD Group unless the deactivated YMD has been blocked (because it has been lost, stolen or replaced).

This provides a similar functionality to a centralised system that blocks a smart card.

A lost YMD can be deactivated by requesting deactivation authorisation from a specified number of members of the YMD Group that it belongs too.

Tamper protection deactivates a YMD if an attempt is made to open its case.

If a YMD is not able to connect to its YMD Group for a certain period of time it will deactivate itself.

Appendix F Rationale

Connecting the virtual world to real people.

The stronger you make your bank vault, the more of a problem you have if you lose the key or forget the password. Real bank vaults have backup systems in place that have evolved over many centuries, to ensure that the vault can be opened, provided the correct, authorised people form a consensus.

In the decentralised world if you lose your password, you have lost your password – there is no “forgot my password” button. This is a symptom of the mechanical, material level that the blockchain works on.

In the virtual crypto world there are only numbers, connected by mathematical calculations and software. There is a need to re-connect with people, to provide accountability, responsibility and common sense. The You-Me Drive provides this connection.

The You-Me Drive and YMD Group system provides secure storage, but with easy access to this data provided a consensus of its YMD Group members allow it.

This makes the You-Me Drive of almost no value to anyone who wants to hide anything, but very useful for people who have nothing to hide. This solves the problem of how to protect your data from the bad guys, while at the same time protecting society from the bad guys too.