#### The Past, Present, And Future of Extensions Management Charles Edge

#### Part I

#### SECRET CHEST 17

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## The Return Of Extensions Manager

https://github.com/krypted/extensionsmanager

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## Importing Code Into Swift

- Swift Package: Uncompiled folders and files with a specific format and a manifest.
- Library: Code and compiled code that can be imported into a project.
- xcframeworks: Opinionated, compiled code that has private and public structures.
- App Extensions: Discrete, signed, and compiled/factored pieces of code.
- Apps: Completed/compiled products available for distribution.
- SDK: Collection of artifacts (libraries, frameworks, & documentation) for types of applications.
- Kit: Apple's manifestation of an SDK.
- Extension: Keyword that extends a type with components, methods, types, etc.

#### https://www.secret-chest.com/post/ design-patterns-and-technicaloptions-when-re-using-swift-code



# Some extensions are from Apple, to be consumed

### For those developers write, users just see the Apps and App Extensions in final products



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charlesedge@CE-MacBook-Pro ~ % pluginkit -mAvvv -p com.apple.authentication-services-credential-provider-ui \ grep Path | grep -o '/.\*' /Applications/SecretChest.app/Contents/PlugIns/CredentialProvider-macOS.appex



![](_page_15_Picture_0.jpeg)

#### Passkeys Access for Web Browsers

Applications that have requested access to see which websites and apps you have saved passkeys for will appear here.

# But I just needed to make some of my QA tasks simpler

## To future proof systems, understand how they came to be

### The Apple II was the crowning achievement of the hobbyist movement

![](_page_19_Figure_1.jpeg)

# People explored with type-in programs

# Then came the Macintosh Image Courtesy of: https://commons.wikimedia.org/wiki/File:Macintosh\_SE\_b.jpg

## GUIs made computers more about utility

## The Macintosh 512K in 1985 Had A 20MB Hard Drive

#### Enter the kernel

![](_page_25_Picture_0.jpeg)

<u>Name</u>	Size
Apple Menu Items	
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## INITS

- Hackers experimented with the System suitcase and Finder file in System
- There was an INIT loader (like /etc/rc) that searched for resources at boot
- Developers figured out how to use ResEdit, to edit the resource fork of the System suitcase to INIT their own code
- Could INIT 32 files by dropping them in the System folder
- Thus we got Desk Accessories

## **Desk Accessories to Extensions**

- Desk Accessories were written to be drivers, but could call SystemTasks
- By System 6, suitcases stored fonts and Desk Accessories
- DA/Mover could move Desk Accessories
- Developers (and Apple) could create Control Panels as well
- Some Control Panels were hybrid extensions

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	Finder Help	40K	file
	D Foreign File Access	40K	system
	High Sierra File Access	24K	system
	ISO 9660 File Access	24K	system
	Network Extension	96K	system
	Dpen Tpt ATalk 68K Libr	288K	Shared
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System 7 The LC III Era

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n extension	-	Thu, Aug 13, 1992, 12:00 PM	
n extension	-	Thu, Aug 13, 1992, 12:00 PM	
n extension	-	Mon, Aug 17, 1992, 12:00 PM	
	-	Thu, Aug 27, 1992, 12:00 PM	
n extension	-	Mon, Jun 19, 1995, 12:00 PM	
n extension		Mon, Jun 19, 1995, 12:00 PM	
n extension	-	Mon, Jun 19, 1995, 12:00 PM	
n extension	-	Thu, Aug 27, 1992, 12:00 PM	
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![](_page_30_Picture_2.jpeg)

## Less of the Wild West

- Early extensions had a resource type of INIT as well
- The boot loader showed extension icons at boot time
- Extensions could try to run in the same part of the system conflicts
- Jeff Robin (who later wrote SoundJam) then wrote Conflict Catcher
- Macintosh System 7.5 added a graphical interface called Extensions Manager (a name that should sound familiar)

![](_page_31_Picture_6.jpeg)

#### Extensions Manager Circa 1991

![](_page_32_Picture_1.jpeg)

## Maturing Classic Extension Types

- Application Program (APPL): Programs that lived in the Extensions folder
- Chooser Extensions: Network handlers, printers, scanners, etc
- Communications Toolbox (cbnd/fbnd/tbnd): Custom socket handlers
- Document: Document handlers (e.g. Sherlock)
- Library (libr/shlb): Shared libraries and open transport
- System Extension: Described on the next slide

## **Classic System Extensions**

- Background Application (appe): Think of these as services or launchd items now
- Component (thng): Shared code dynamically loaded when needed.
- Driver (comd for 68000 systems and ndrv for PowerPC): Drivers
- INIT (INIT): Modifies system resources at startup and can talk directly to the kernel (similar to what later kernel extensions were).
- Scripting (scri): Never used this, just read it exists in documentation.

## The list grew to include hundreds from Apple and third parties
#### But conflicts...



### At Ease (1992-1998)

#### for using At Ease 3.0 with System 7.5

At Ease 3.0 is compatible with System 7.5. However, some control panels and other features of System 7.5 may work differently while At Ease is running. This section provides information on these differences. Please refer to Macintosh Guide, available in the Guide (2) menu, for more information on

#### AppleScript

Scripts written using AppleScript can be launched by At Ease. However, scripts that require the Finder will not run properly.

#### **Extensions Manager**

You cannot change the settings in this control panel while At Ease 3.0 is running.

#### **Find File**

When At Ease 3.0 is open, the Find File command does not let you open or

#### Then Came OS X

## Two Mach-based projects became one

- Developers knew the limitations the original Mac team had baked in  $\bullet$
- Apple developed a kernel called Nukernel based on Mach
- Copland was a "failed" project that introduced protected memory that would eventually lead to multithreading
- Apps could invoke a new thread as a separate process in protected memory that could communicate with the kernel, akin to kernel extensions
- Apple released Mac OS 8 instead and bought NeXT

### Copland

### The NeXT Legacy

- UNIX was initially free but AT&T then Novell got cranky about licensing after BSD extended Unix and redistributed their work with the BSD license
- The Mach micro-kernel was written at Carnegie Mellon University by Richard Rashid and Avie Tevanian
- Existing BSD 4.3 code provided compatibility with other Unix variants
- The gist: Mach + BSD + Nukernel (also Mach-based) evolved to XNU, the hybrid kernel in modern Apple operating systems

- With Mach came Unix Pipes; data could move between programs
- Tasks, message queues, memory management, etc gave Mach object oriented multiprocessing capabilities.
- Less monolithic but with interprocess communications (IPC), which evolved to xpc (see https://knight.sc/reverse engineering/2020/03/20/audit-tokensexplained.html for XPC security)
- Services could be piped system wide
- NeXTSTEP got Objective-C as a programming language and what the developers called kits to provide an extensible application layer

#### Pipes

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Creative Cloud Files	AirDrop & Handoff.appex	Mar 24, 2023 at 8:26 PM	1.1 MB	Applicaxtension
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loud	AppExtensionManagement.appex	Mar 24, 2023 at 8:26 PM	172 KB	Applicaxtension
	AppleIDSettings.appex	Mar 24, 2023 at 8:26 PM	2.4 MB	Applicaxtension
	8 Bluetooth.appex	Mar 24, 2023 at 8:26 PM	1.9 MB	Applicaxtension
Documents	CDs & DVDs Settings Extension.appex	Mar 24, 2023 at 8:26 PM	470 KB	Applicaxtension
Desktop	ClassKitSettings.appex	Mar 24, 2023 at 8:26 PM	1.5 MB	Applicaxtension
	🕓 ClassroomSettings.appex	Mar 24, 2023 at 8:26 PM	2.4 MB	Applicaxtension
Shared	ControlCenterSettings.appex	Mar 24, 2023 at 8:26 PM	1.4 MB	Applicaxtension
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OneDrive	FollowUps.appex	Mar 24, 2023 at 8:26 PM	339 KB	Applicaxtension
Network	GameCenterMacOSSettingsExtension.appex	Mar 24, 2023 at 8:26 PM	657 KB	Applicaxtension
	GameControllerMacSettings.appex	Mar 24, 2023 at 8:26 PM	2.7 MB	Applicaxtension
igs	HeadphoneSettingsExtension.appex	Mar 24, 2023 at 8:26 PM	1.5 MB	Applicaxtension
Red	Internet Accounts.appex	Mar 24, 2023 at 8:26 PM	1.3 MB	Applicaxtension
Cray	KeyboardSettings.appex	Mar 24, 2023 at 8:26 PM	3.3 MB	Applicaxtension
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# More capabilities are better to help recruit developers

## But kernel extensions were fairly complicated

### Kernel Extensions

- Kernel tasks weren't officially supported
- Kernel extensions were added to expose various kernel data structures
- Users relied on kernel extensions so kernel advancements slowed
- Apple supported Kernel Programming Interfaces in 10.4 (Tiger) as part of the Kernel Authorization subsystem (kauth) <u>https://developer.apple.com/library/</u> <u>archive/technotes/tn2127/\_index.html</u>
- 10.4 brought kernel "concurrency" (no more kernel locking, so better for multi-CPU computers)
- These were mostly device, file, and network I/O tasks

## Conflict Catcher for Mac OS X was never released

- Less problems
- Command line tools like kextutil, kextload/ kextunload, kextstat, kextlibs
- Peter Borg's Lingon (launchd)
- More .dylibs (third parties needed their own shared objects)

#### Instead

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Com.apple.pcastuploader	2 Write a command on one line list as you would in e.g. Terminal or choose an application	
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com.apple.periodic-monthly		
com.apple.periodic-weekly	When	
Com.apple.platform.ptmd	Keep it running all the time no matter what happens	
com.apple.portmap	Due it when it is leaded by the sustain (at startup or leader)	
com.apple.preferences.timezone.admintool	Kun it when it is loaded by the system (at startup or login)	
com.apple.preferences.timezone.auto	Run it every time a volume is mounted	
com.apple.printtool	At a specific date: Every day	
com.apple.proxyhelper	E duran musi (d mit	-
com.apple.racoon	Run it every seconds	
com.apple.RemoteDesktop.PrivilegeProxy		
com.apple.ReportCrash.Root	Run it if this file is modified:	
com.apple.RFBEventHelper		
Com.apple.RFBRegistRemoteManagement		
com.apple.RFBRegisterMDNS_ScreenSharing	Run it if anything is placed into this folder:	
Com.apple.sandboxd		
com.apple.SCHelper	Remember to make sure that it clears this folder after it has been nor	
Com.apple.scsid		
com.apple.securityd		
Comapple.securityproxy_mail		



## With Unix underneath, Mac OS X became a hacker OS

## Developer Relations didn't have much recourse yet...

### Then Came iOS in 2007

### **Remember The Simple Finder?**



### Modernized







Mail



Maps



TV



Stocks



System Settings



App Store

FaceTime

5

Music

Pages

Safari



Messages



Podcasts





Siri



Mission Control



















#### Q Search



Contacts



Find My



Voice Memos



Books



Other

. . . . . . .



Calendar



Photo Booth



GarageBand



Dictionary



Xcode-old



Reminders



Photos



Numbers



Calculator



Tor Browser



Home



iMovie



Notes

Preview



## iOS didn't support kernel extensions

# The Application Sandbox came to the Mac in 10.7 (2011)



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App > 🐼 ExtensionManager > No Selection								
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	٥	Boolean	NO					
	٢	Boolean	YES					

### But its origins lie in the "TrustedBSD MAC Framework: Extensible Kernel Access Control" (2000)

https://ieeexplore.ieee.org/document/1194871

#### As bandwidth increased, most apps talked to rest endpoints, not through sockets

### Cryptographic Signing became more pervasive (thank you CryptoKit)

MDM required a certificate

### Soon, access to certain APIs, libraries, kits, etc had to be signed

# Powerful APIs needed to be protected

### iOS 2 gave us entitlements in 2008, which came to the Mac in 2011

#### Code signing, notarization, sandbox profiles, and attestation frameworks matured

## Now, Apple could revoke certificates for bad behavior

## The marketing term for some of this became Gatekeeper

# The importance of rootless (expanded to SIP) - 2015

### What good is SIP if a kernel extension can trespass anywhere?

## Example: Managed Open In and supervision

### User Accepted Kernel Extension Loading in 10.13

There's always backlash


Hey, what gives you the right

### Apple forged on, with Privacy Preferences Policy Control

## But the path we're on followed the same route it did in System 8

### Which brings us to Part II: The Present

#### In the meantime...

## Apple has provided us with a manicured sandbox



# There are the privacy && security issues with what extensions can access

## So it's on developers to surface the level of telemetry we want to give

### A few extra lines of code...

111

extension Interface\_ReadableMainActorValue<(any Interface\_LocalSecretChestInstance)?> {

#### 111

public func fetchPasswordForCredentialProviderExtension (credentialIdentity: ASPasswordCredentialIdentity, extensionContext: ASCredentialProviderExtensionContext) -> AnyProcedure<Void> {

```
111
```

```
Name("\(#function)") {
self
    .getCurrentValue
    .flatMap { secretChestInstance in
        secretChestInstance
            .loggedInSecretChest
            .waitUntilNotNil()
            .flatMap { loggedInInstance in
                loggedInInstance
                    .fetchInternetPassword(
                    .flatMap { password in
                        loggedInInstance
```

.unwrap(orThrow: "The extension has no instance to use for fetching the password.")

for: .init(credentialIdentity)

.disableNearbyInteraction .map { \_ in extensionContext.complete(with: password) }



#### Close

MainActorValueModule\_main\_actor\_value.MainActorValue<Sv D, interface\_nearby\_secret\_chest\_interaction.Interface\_Near MainActorValueModule\_main\_actor\_value\_source.MainActor\ production\_secret\_chest\_push\_notification\_sender.Production userDevicesManager: production\_user\_devices\_manager.Pro localInstallationParticipant: installation\_participant.Installation instanceType: secret\_chest\_instance\_type.SecretChestInstan local\_secure\_enclave.LocalSecureEnclave(\_encrypt: (Function local\_shard\_storage.LocalShardStorage(\_storeShard: (Function) (Function)), installationMapStorage: local\_installation\_map\_st MainActorValueModule\_main\_actor\_value\_source.MainActor\ ntity, installation\_maps.InternetPasswordInstallationMap>>, a local\_autofill\_suggestions\_setter.LocalAutofillSuggestionsSet <ASCredentialIdentityStore: 0x6000034561d0>)))), localInsta local\_installation\_map\_storage.LocalInstallationMapStorage(letters) MainActorValueModule\_main\_actor\_value\_source.MainActor\ ntity, installation\_maps.InternetPasswordInstallationMap>>, a local\_autofill\_suggestions\_setter.LocalAutofillSuggestionsSet <ASCredentialIdentityStore: 0x6000034561d0>))), localShare \_fetchShard: (Function), \_deleteShard: (Function), \_wipeShar MainActorValueModule main actor value source MainActor

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	Close
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uceOutput(us	ing:retryOnEachPublishFrom:timeout:) 🥑
> 🥑 Optio	onal <productionlocalsecretchestinstance></productionlocalsecretchestinstance>
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	API	Status
M	GET /auth/users/device/list	↑ Success
M	GET /auth/users/device/list	↑ Success
M	GET /auth/users/device/list	↑ Success
M	GET /auth/users/device/list	↑ Success
M	GET /auth/users/device/list	<b>↑ Success</b>
« Previous 1 <u>2</u>	<u>3 4 5 10 Next</u> »	

#### • • •

0 0

Q Search						
Name	Vendor	Туре	Status	Path	Versicn	SDK
MarsEdit	MarsEdit	App Extension	Not installed	/Applications/MarsEdit.app/Contents/Plugins/MarsEdit	4.6.3	com.apple.share-services
Microsoft Edge Widgets	Microsof	App Extension	Installed	/Applications/Microsoft Edge.app/Contents/PlugIns/Mic	99.0.11	com.apple.widgetkit-extension
MindNode Intents Ext	MindNode	App Extension	Installed	/Applications/MindNode.app/Contents/PlugIns/MindNo	2023.1.1	com.apple.intents-service
MindNode QuickLook	MindNode	App Extension	Installed	/Applications/MindNode.app/Contents/PlugIns/MindNo	20231.1	com.apple.guicklook.preview
MindNode Thumbnail	MindNode	App Extension	Installed	/Applications/MindNode.app/Contents/PlugIns/MindNo	20231.1	com.apple.guicklook.thumbnail
MindNode Widget	MindNode	App Extension	Installed	/Applications/MindNode.app/Contents/PlugIns/MindNo	2023.1.1	com.apple.widgetkit-extension
NordPass® Password	NordPass	App Extension	Installed	/Applications/NordPass.app/Contents/PlugIns/safariExt	1	com.apple.Safari.extension
NordPass® Password	AgileBits	Google Chrome	Installed	http://www.onofice.co.co.co.pp/contents/indgina/sarainz.co.	5.2.12	oo mappeloara non consion
Okta Browser Plugin	Okta Ext	App Extension	Installed	/Applications/Okta Extension App.app/Contents/PlugIns	6.10.0	com apple Safari web-extension
OneDrive File Provider	OneDrive	App Extension	Installed	/Applications/OneDrive app/Contents/PlugIns/OneDrive	23.086	com apple fileprovider-popui
OneDrive Finder Integ	OneDrive	App Extension	Not Installed	/Applications/OneDrive.app/Contents/PlugIns/EnderSy	23.086	com apple FinderSync
OneNote	Microsof	App Extension	Installed	Applications/Microsoft OneNote app/Contents/Plugins/	16 72	com apple share-services
Petal Cite Web Import	Detal Cit	App Extension	Installed	/Applications/Microsoft Orientote.app/contents/Flugins/	2.2	com apple Safari web-extension
Picture_In_Dicture	picturein	Firefox Extension	Installed	Applications/Fetal one web importenapp/contents/Plu	100	com.appie.oaian.web-extension
Picture-In-Picture	picturein	Firefox Extens	Not installed	/Applications/Firefox.app/Contents/Resources/browser/	11.0.0	
Playmaker – Balanced	playmak	Firefox Extens	Not installed		1.1.2	
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PointerswidgetExtens	CardPoin	App Extension	Installed	/Applications/CardPointers.app/Contents/Plugins/Point	4.4.1	com.apple.intents-service
Send to MarsEdit	MarsEdit	App Extension	Not Installed	/Applications/MarsEdit.app/Contents/PlugIns/Send to M	4.6.3	com.apple.Safari.extension
Shortcuts	Particulars	App Extension	Installed	/Applications/Particulars.app/Contents/PlugIns/Shortcu	51	com.apple.intents-service
Solflare Wallet	Citationsy	Google Chrome	Installed		1.43.2	
Suspicious Package	Suspicio	App Extension	Installed	/Applications/Suspicious Package.app/Contents/PlugIn	4.0	com.apple.quicklook.preview
System theme — auto	default-t	Firefox Extens	Installed		1.3	
Text Toolset	Text Tool	App Extension	Installed	/Applications/Text Toolset.app/Contents/PlugIns/TextTo	1.2	com.apple.dt.Xcode.extension.source-editor
Twitter	Twitter	App Extension	Installed	/Applications/Twitter.app/Contents/PlugIns/ShareExten	9.30	com.apple.share-services
TwitterNotificationSer	Twitter	App Extension	Installed	/Applications/Twitter.app/Contents/PlugIns/TwitterNotif	9.30	com.apple.usernotifications.service
Visionary – Balanced	visionary	Firefox Extens	Not Installed		1.1.2	
Visionary – Bold	visionary	Firefox Extens	Not Installed		1.1	
Visionary – Soft	visionary	Firefox Extens	Not Installed		1.1	
Web Compatibility Int	webcom	Firefox Extens	Installed	/Applications/Firefox.app/Contents/Resources/browser/	106.0.0	
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Wikipedia (en)	wikipedi	Firefox Extens	Installed		1.1	
MSG_APP_NAME		Google Chrome	Installed		1.0.0.6	
MSG_appName		Google Chrome	Installed		10.29.0	
MSG_application_ti		MicrosoftEdg	Installed		1.0	
MSG_extName		Google Chrome	Installed		1.61.4	
MSG_extName		Google Chrome	Installed		2.10.0	
_MSG_nameedge		MicrosoftEdg	Installed		2.6.3.0	
eBav	ebav@se	Firefox Extens.	Installed		1.3	
lock	, <u></u>	Google Chrome	Installed			
nomadssoe	NoMAD	App Extension	Installed	/Users/charlesedge/Library/Developer/Xcode/DerivedD	2.0	com.apple.AppSSO.idp-extension
wizdom.ai	Homino	Google Chrome	Installed	jobolojana nosedgejelona yjoetelopelji koodejoen tedo	23.3.22	
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		Network Extension	ns	System Extensions Google Chrome Extensions	Firefox Exte	ansions
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#### https://github.com/krypted/extensionsmanager

Extensions N	lanager
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### Thank You!