

# Welcome Neoxplorers!

# Enterprise Distributed Application Development using the NEO Blockchain

Michael Herman

Independent Blockchain Developer

NEO C# Developers Center of Excellence

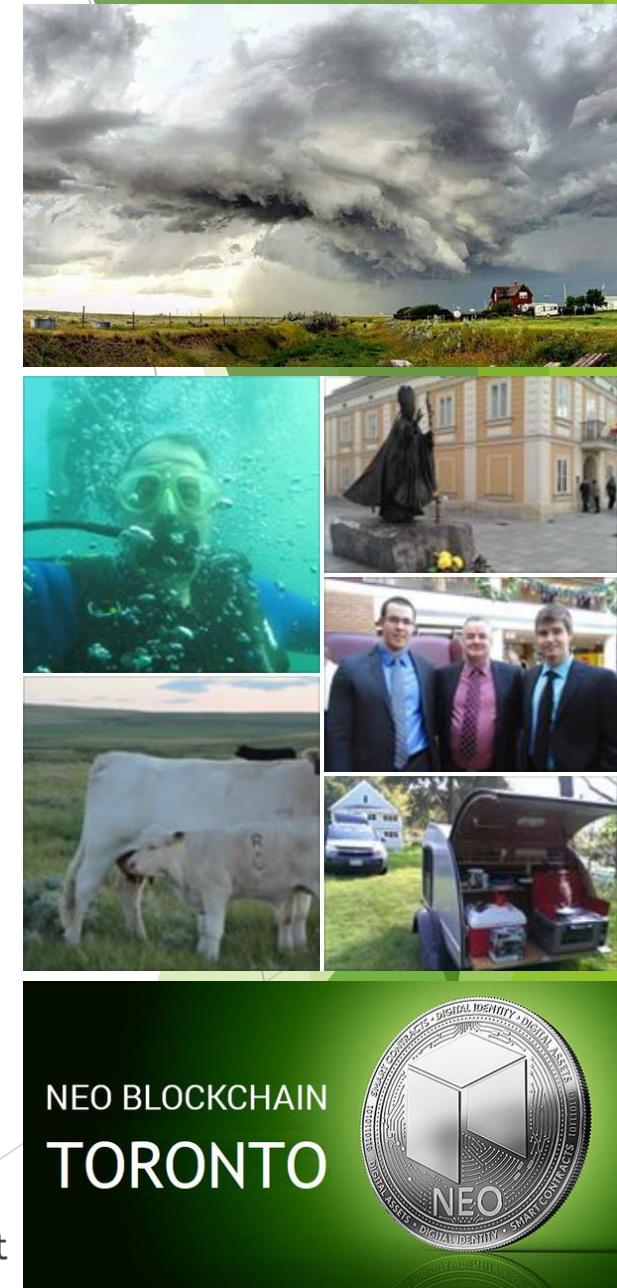
[neotoronto@outlook.com](mailto:neotoronto@outlook.com)

The poster features logos for T.C. Bilim, Sanayi ve Teknoloji Bakanlığı (Ministry of Science, Industry and Technology), TUBITAK BİLGEM, and the event's title "1. Ulusal BLOKZİNCİR ÇALIŞTAYI". It highlights "ANA SPONSOR" TÜRKİYE CUMHURİYET MERKEZ BANKASI (Turkish Central Bank). A section titled "Misafir Konuşmacılar" (Guest Speakers) lists three speakers with their profiles: Peter Gaži (Research Fellow, co-author of the Ouroboros Praos protocol), IOHK research iohk.io; Malcolm Lerider (Senior R&D Manager, NEO Smart Economy neo.org); and a third speaker whose profile is partially visible. The poster also includes a "Konular" (Topics) section listing various blockchain-related topics, an "Özet Çağrısı" (Summary Call) with application dates (11 Mart 2018 - 19 Mart 2018), and logos for BİLGEM UEKAE, Blokzincir Araştırma Laboratuvarı, NEO, and CARDANO. QR codes and a "Detaylı Bilgi ve Başvuru" (Detailed Information and Application) link are also present.

# 1. Introduction

# Who is Michael Herman?

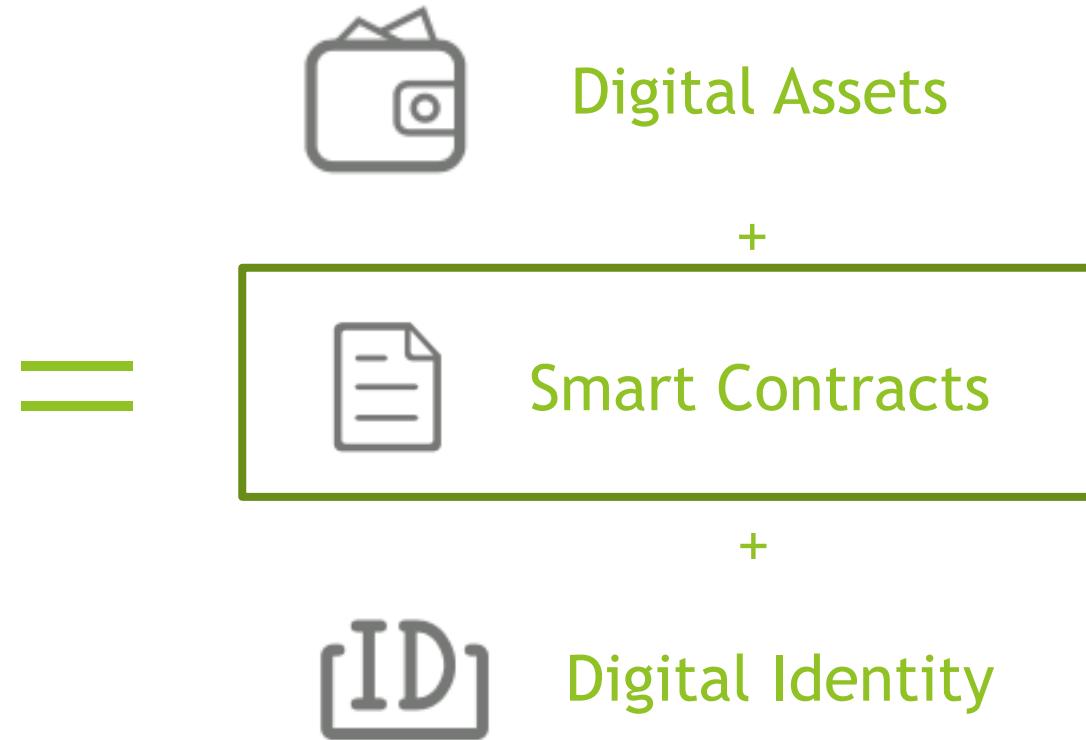
- ▶ Independent Blockchain Developer
  - ▶ I work 14 hours a day on the NEO Blockchain
  - ▶ Experienced Ethereum Developer
  - ▶ I work for myself (and on behalf of my clients)
- ▶ Decades of software development experience
  - ▶ Developer on every version of Microsoft Windows since the very first
  - ▶ Microsoft, IBM, medium-size companies, small businesses
- ▶ Curator of NEO C# Developers Center of Excellence community ([neo-csharp](#))
  - ▶ Contributes to several NEO community projects
    - ▶ NEO developer tool suite: [neo-debugger](#) and [neo-gui-developer](#) projects
    - ▶ NEO Persistable Class Framework (NPC) for efficient object-oriented smart contract development using C#.NEO: [mwberman2000/neo-persistentclasses](#) and [neo-npcc2s](#)
    - ▶ NEO Blockchain Quick Start Guide for .NET Developers: [mwberman2000/dotnetquickstart](#)
  - ▶ Founder of the first Canadian NEO Blockchain Meetup: NEO Blockchain Toronto



# Who are you?

- ▶ Software Developer/Achitect?
  - ▶ NEO smart contract developers?
  - ▶ Ethereum smart contract developers?
  - ▶ Other blockchain developers?
  - ▶ Microsoft .NET developers? .NET/C#/Visual Studio
- ▶ Crytopinvestor/trader?
- ▶ Legal profession?
- ▶ Financial services (conventional)?
- ▶ Government?
- ▶ Banking?
- ▶ Other sectors?
- ▶ Students?

# What is the NEO Smart Economy?



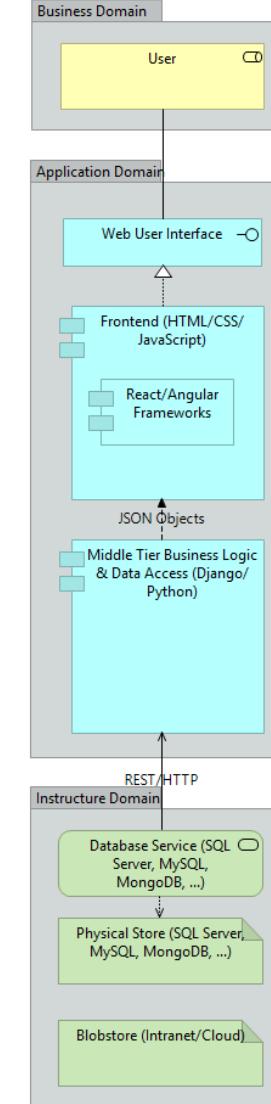
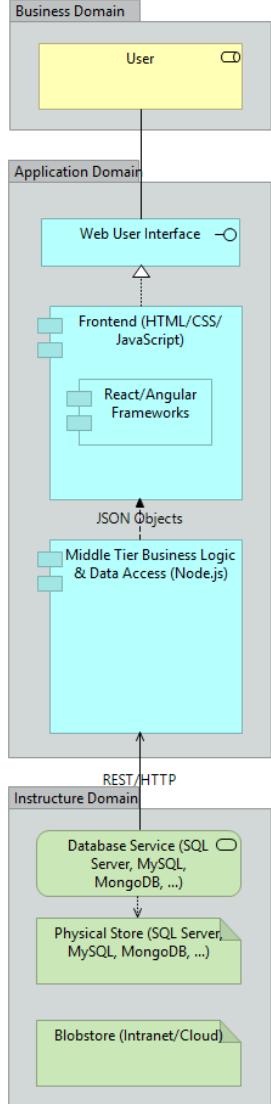
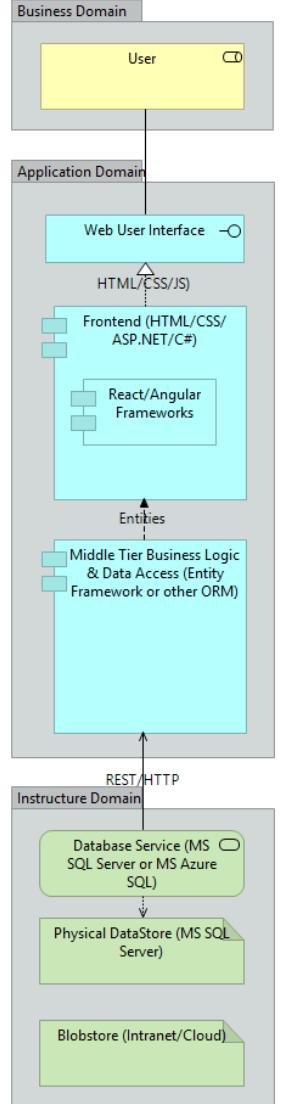
“Future world where the boundary between real assets in the physical world and digital assets in the digital world has been removed.”  
[Malcolm Lerider, March 2018)

# Traditional Multi-Tier Enterprise Applications

Microsoft ASP.NET/EF/SQL

Full Stack HTML/CSS/Node.js

Full Stack HTML/CSS/Python

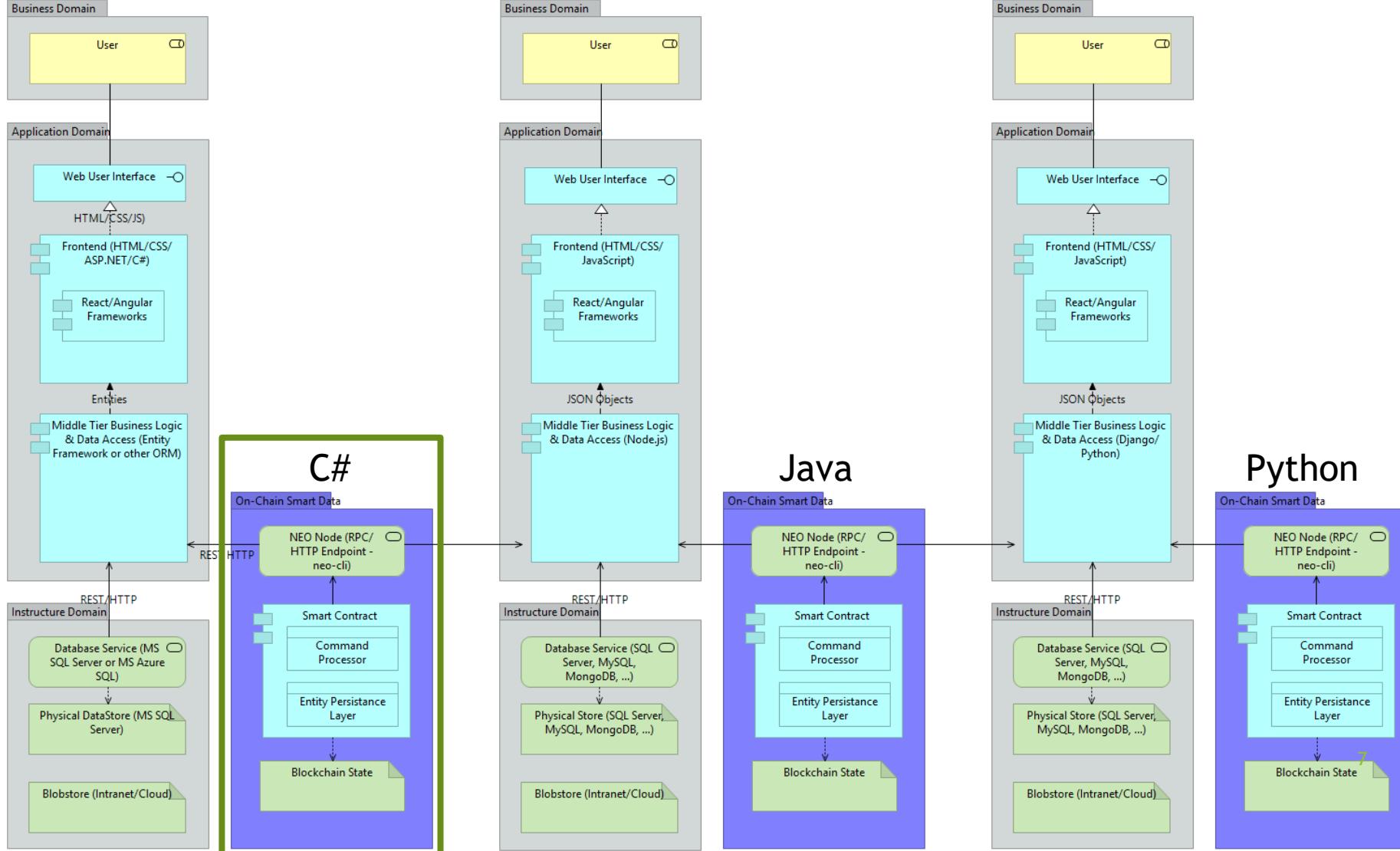


# Enterprise Distributed Application Architecture

Microsoft ASP.NET/EF/SQL

Full Stack HTML/CSS/Node.js

Full Stack HTML/CSS/Python



Smart Data =  
Data Entities  
wrapped in a  
Smart Contract

# When to use Blockchain Technology

“Blockchain: the force multiplier for the smart economy” [Microsoft]

## Questions to Ask

1. Is it a business process that crosses trust boundaries?
2. Do multiple parties manipulate the same data?
3. Are processes operating inefficiently or decisions delayed due to the number of intermediaries?
4. Does the business process involve low-value, manual verification steps?

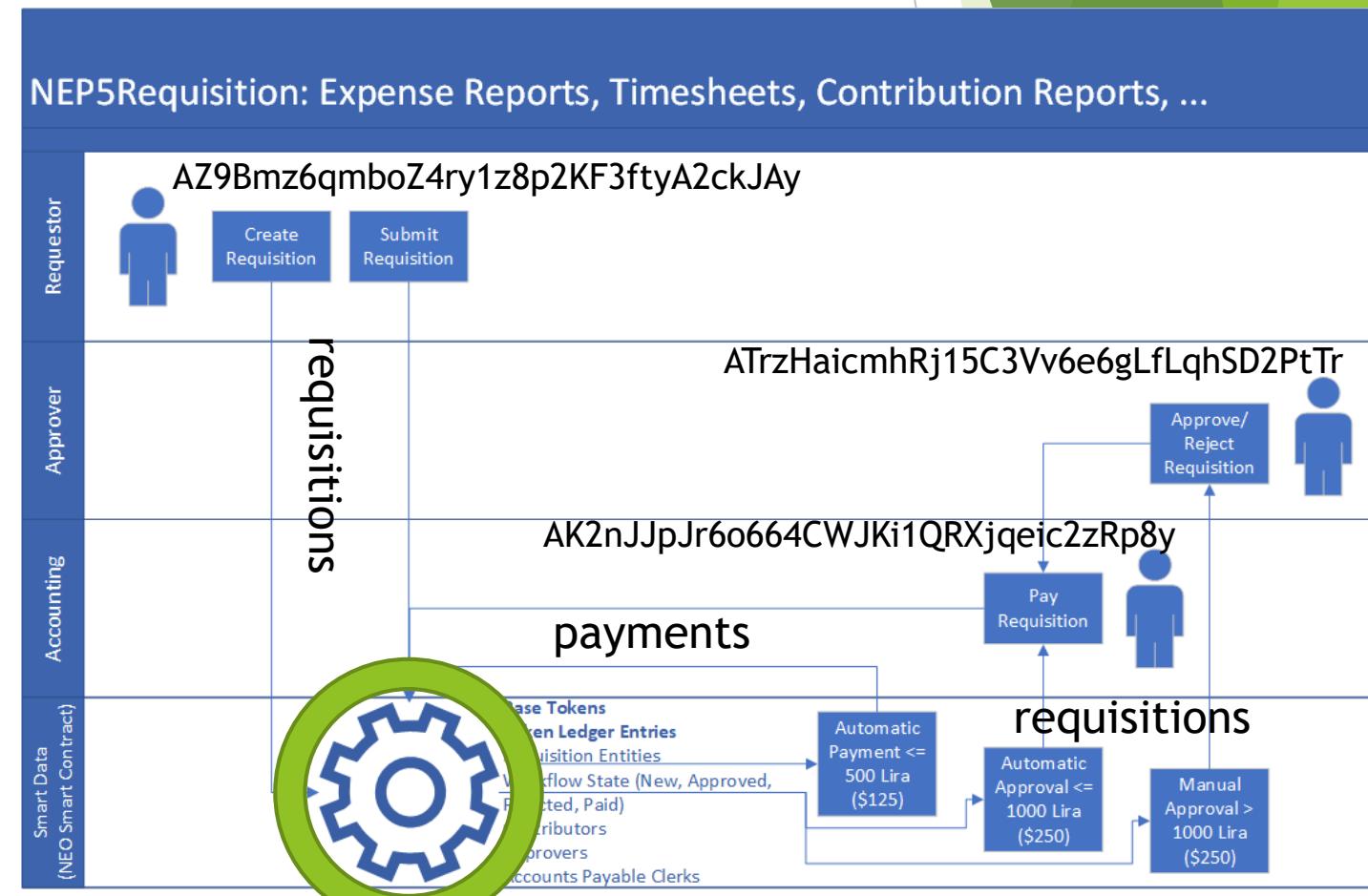
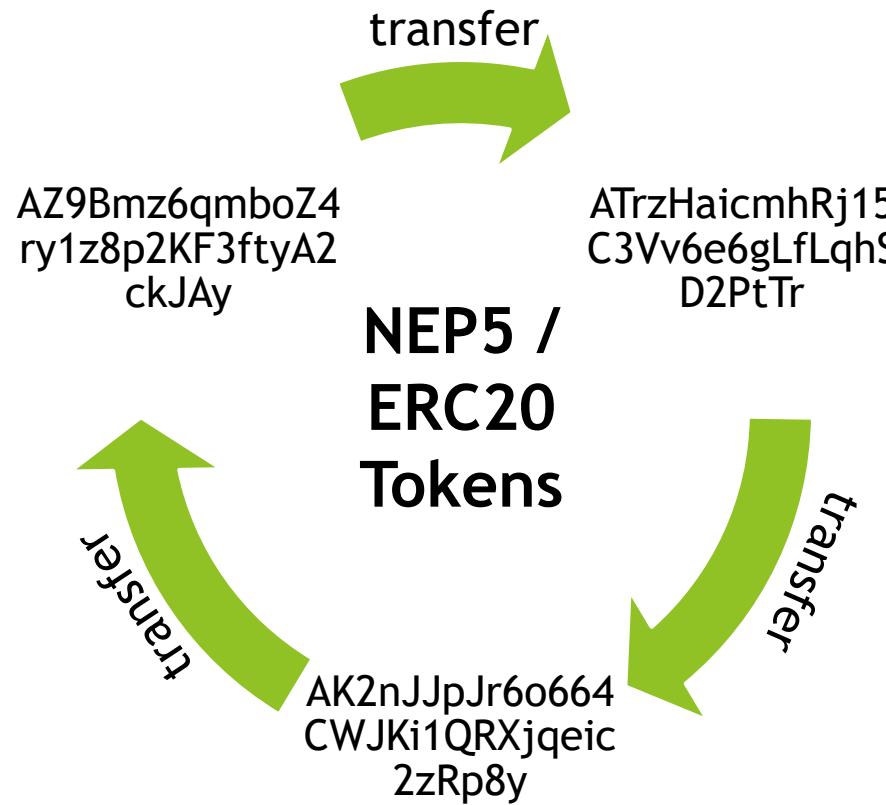
## Use a Blockchain when there is a Need for

- ▶ Real-time transparency by connecting business processes across organizations
- ▶ Real-time, transparent access to a verifiable source of the truth across organization boundaries
- ▶ Introduce trust and increase efficiency amongst participants - reducing the need for intermediaries
- ▶ Improved efficiencies and increased confidence through automation and smart contracts that execute consistently.

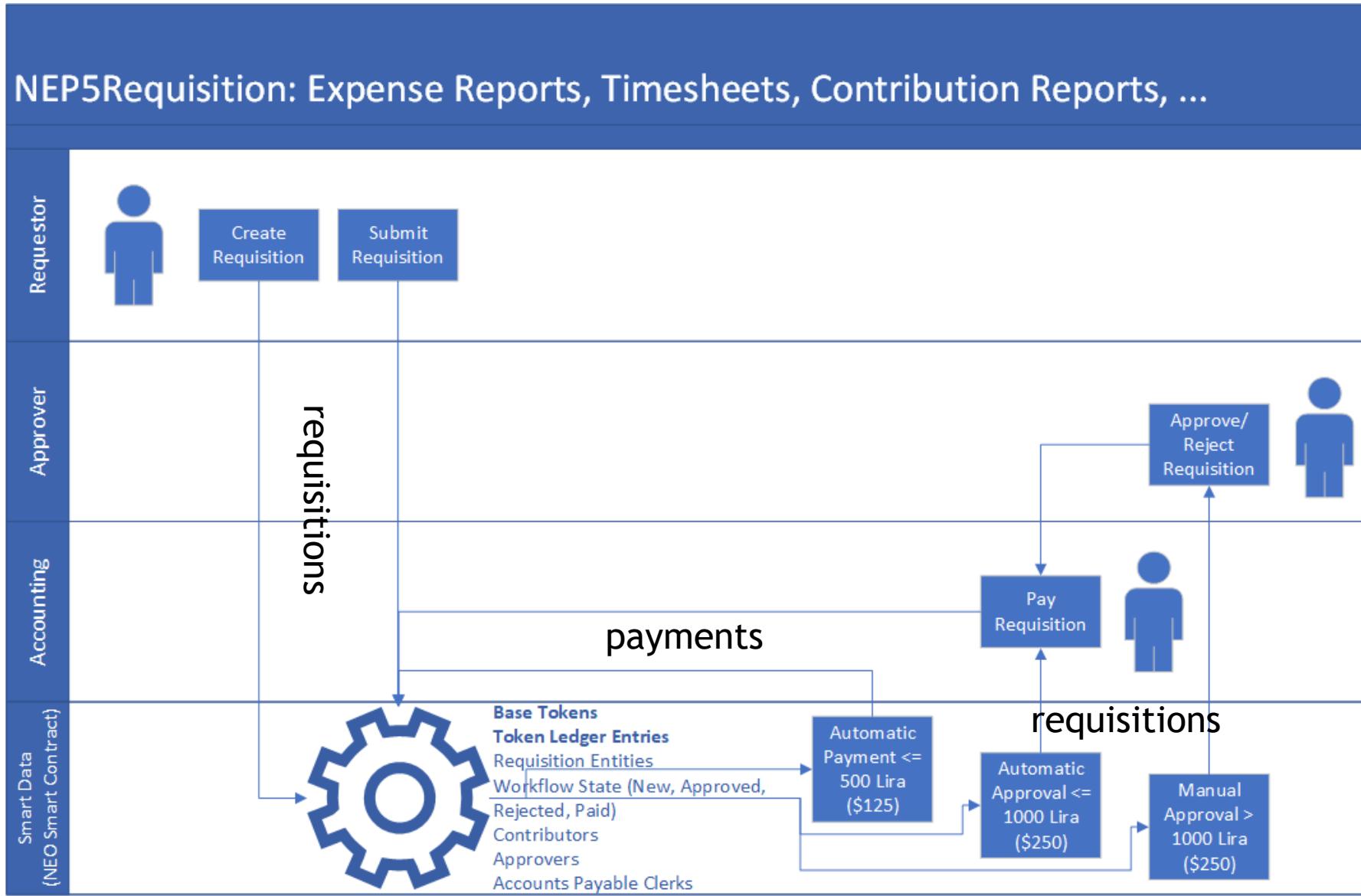
“Use blockchain technology when it matches the requirements of your application. Don’t automatically use blockchain technology simply because you’re re-platforming an existing application.” [Gartner 2018]

# Think Deeply about the NEO Smart Economy

“Future world where the boundary between real assets in the physical world and digital assets in the digital world has been removed.”



# NEP5Requisition Processing



# Purpose and Goals

- ▶ Purpose
  - ▶ Hands-on smart contract development workshop: .NET/C#/Visual Studio on the NEO Blockchain
- ▶ Goals, Non-goals and Assumptions
  - ▶ Target audience: Architects and Developers who are new to the NEO Blockchain platform
  - ▶ Background: Very little or no previous NEO or .NET/C#/Visual Studio Experience
  - ▶ Background: Understand basic 1<sup>st</sup> and 2<sup>nd</sup> generation blockchain technologies: hashing, blocks, mining, etc.
  - ▶ **Provide you with a basic level of awareness and understanding of NEO smart contract development**
  - ▶ **Help create a strong NEO Blockchain community in Turkey - helping each other**
- ▶ Principles
  - ▶ Provide reliable documentation: timely, accurate, visual, and complete
  - ▶ Save as much of a person's time as possible
  - ▶ Use open source software whenever possible
- ▶ Drivers
  - ▶ Need in the NEO .NET developer community to have concise and easy-to-follow documentation to enable people to get up to speed developing NEO smart contracts in as short a time as possible

# Agenda

1. Introduction
2. Preparation for the Hands-on Labs
3. Module 1 Hands-on Labs (x3)
4. Why NEO?

BREAK - 15 minutes

5. NEO Architecture
6. Module 2 Hands-on Labs (x3)
7. Why NEO?

BREAK - 15 minutes

8. NEO as a 3<sup>rd</sup> Generation Distributed App (dApp) Platform
9. Smart Contract Development using Entities
10. NEO Evidence
11. NEO Resources
12. Next Steps

## 2. Preparation for the Hands-on Labs

# Preparation: Twitter, Discord and Visual Studio

1. I will be sending links to additional downloads and information using [#BlockchainTURKIYE](#) on Twitter.

2. Join Discord NEO Developer Community on Discord by clicking one of the following links:

<https://discord.gg/gqCYeup> or <https://discord.gg/4>

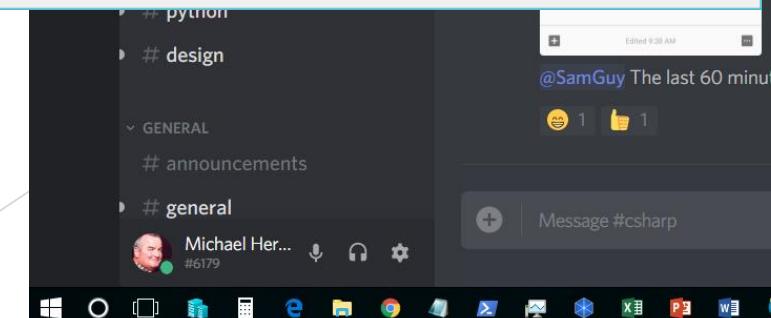
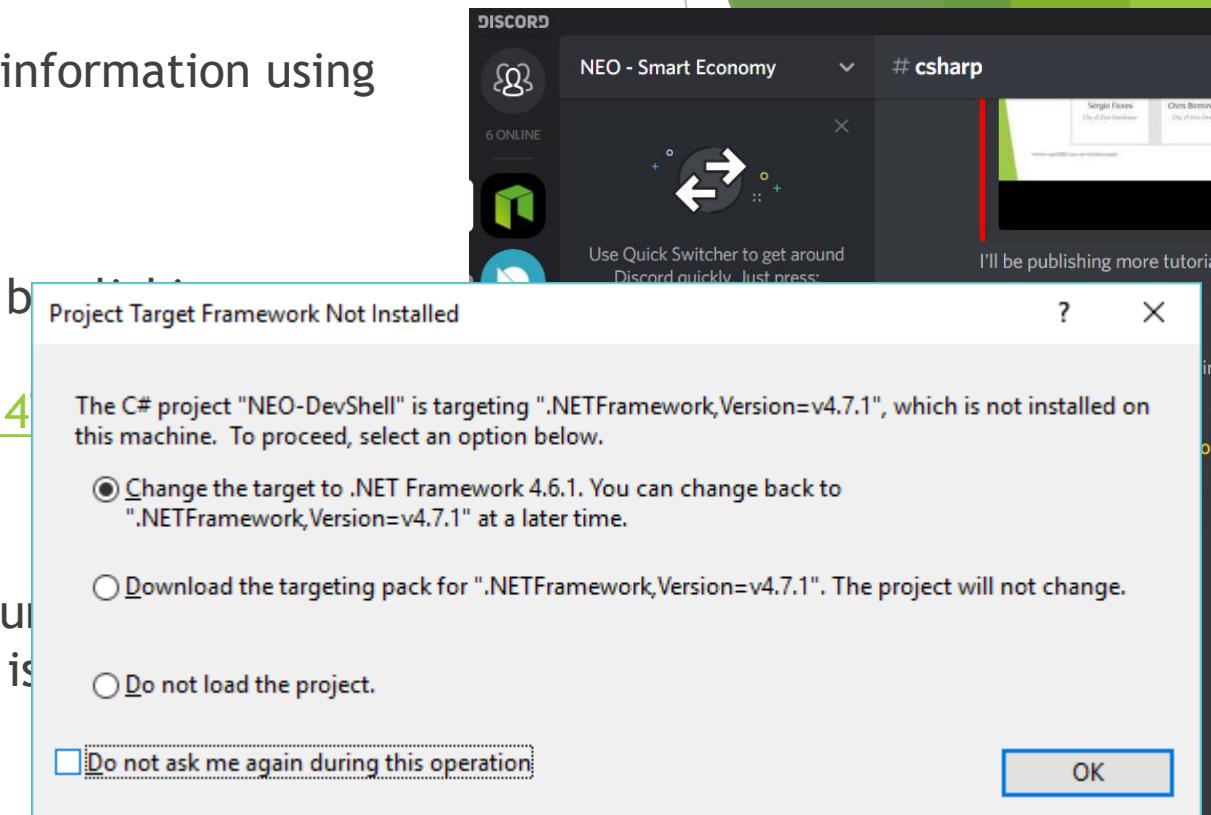
3. Download and install Microsoft Visual Studio Community Edition. This version is free to download and free to use. It is specifically designed for C# smart contract development.

<https://www.visualstudio.com/vs/community/>

4. Download and install the .NET 4.7.1 Dev Pack from here:

<https://www.microsoft.com/en-us/download/details.aspx?id=56119>

5. Install the NEO Smart Contact Visual Studio 2017 Extension  
See next slide



# NEO Smart Contract Visual Studio Extension

Extensions and Updates

Installed

All  
Controls  
Templates  
SDKs  
Tools  
**Search Results**

Sort by: Most Recent

**NeoContractPlugin**  
Allow users to create smart contract in Visual Studio.

**Disable** **Uninstall**

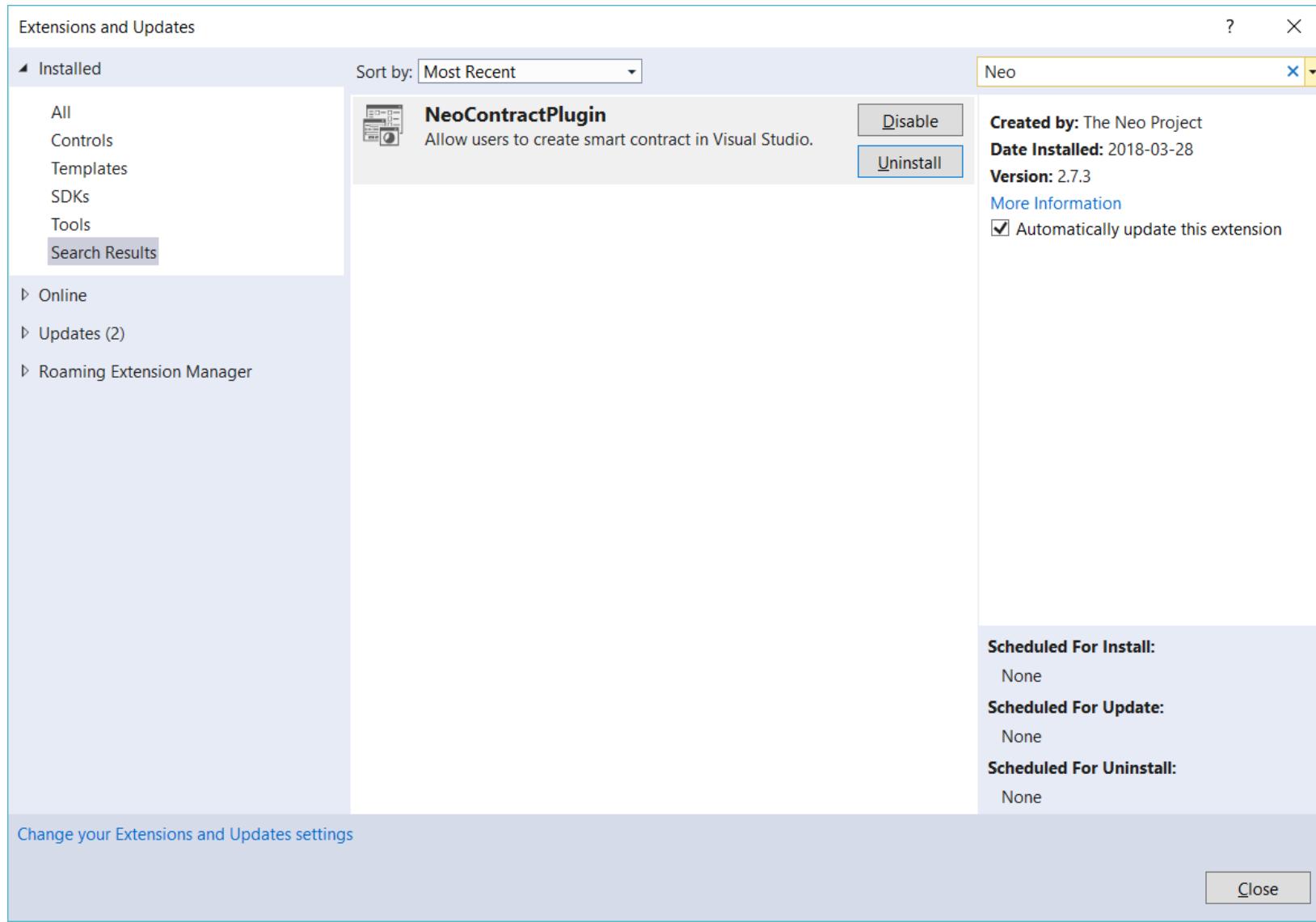
**Neo**

**Created by:** The Neo Project  
**Date Installed:** 2018-03-28  
**Version:** 2.7.3  
[More Information](#)  
 Automatically update this extension

**Scheduled For Install:** None  
**Scheduled For Update:** None  
**Scheduled For Uninstall:** None

Change your Extensions and Updates settings

Close



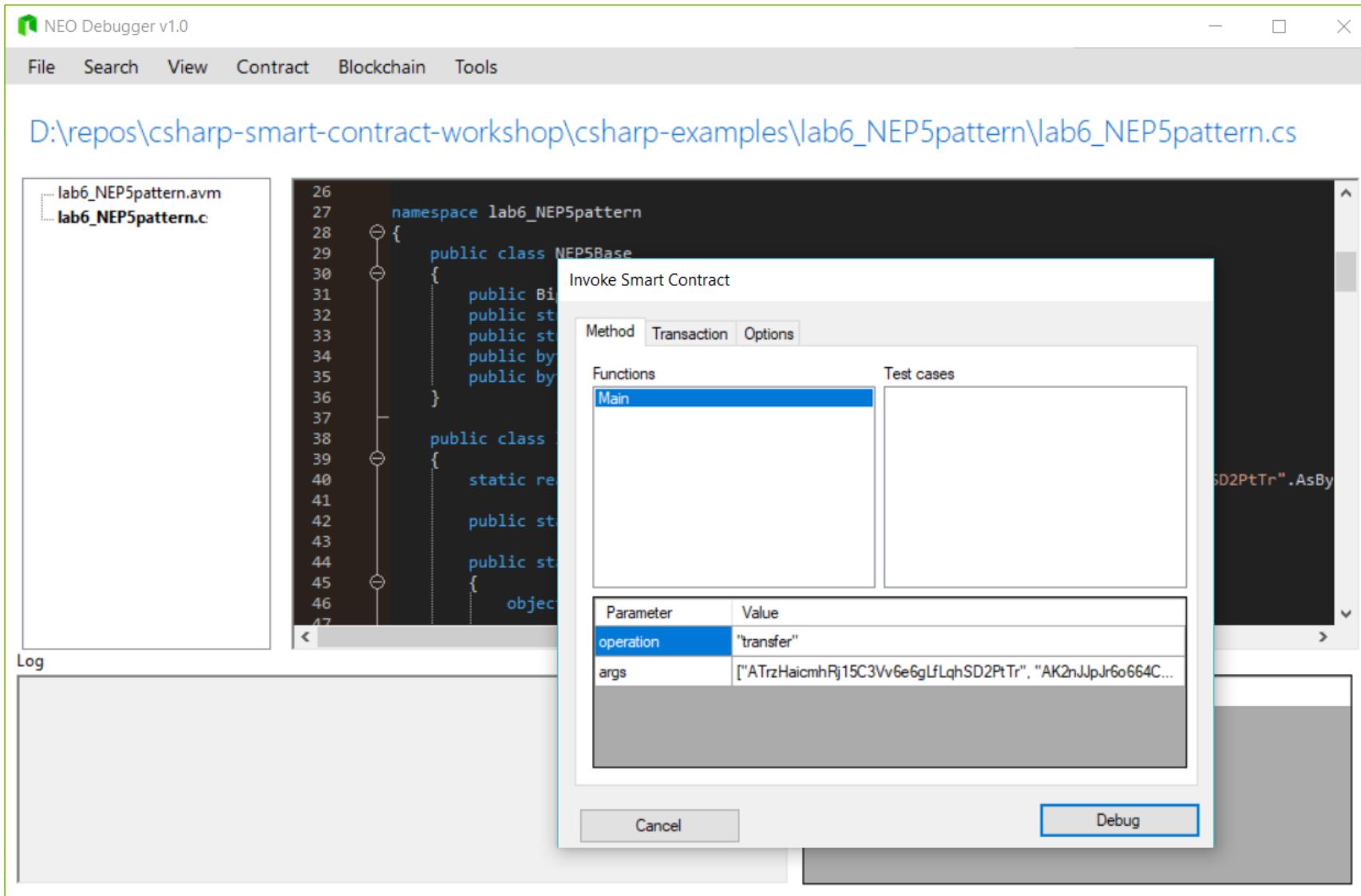
This screenshot shows the 'Extensions and Updates' window in Visual Studio. The 'Installed' tab is selected, displaying the 'NeoSmartContract' extension. The extension details show it was created by 'The Neo Project' on 2018-03-28, version 2.7.3. A checkbox for automatic updates is checked. The 'Scheduled For' sections indicate no scheduled installations, updates, or uninstalls. The window has a standard Windows-style header with a question mark icon, a close button, and a search bar containing 'Neo'. The sidebar on the left lists categories like All, Controls, Templates, SDKs, Tools, and Search Results.

# Preparation: NEO Debugger Tools

- ▶ Download the NEO Debugger Tools source code.  
<https://github.com/mwherman2000/neo-debugger-tools/archive/master.zip>  
The downloaded file will be called: neo-debugger-tools-master.zip
- ▶ Create a new folder on your hard drive - for example c:\repos
- ▶ Copy neo-debugger-tools-master.zip into c:\repos .
- ▶ Unzip neo-debugger-tools-master.zip and build the NEO Debugger Tools following the steps using diagram below.
- ▶ \*\*NOTE\*\* Please download a new copy of the neo-debugger-tools-master.zip file. It was updated last night.
- ▶ Update the Windows search PATH environment variable  

```
setx PATH "%PATH%;C:\Repos\neo-debugger-tools-master\NEO-Compiler\bin\Debug"
```

# NEO Debugger



## Commands

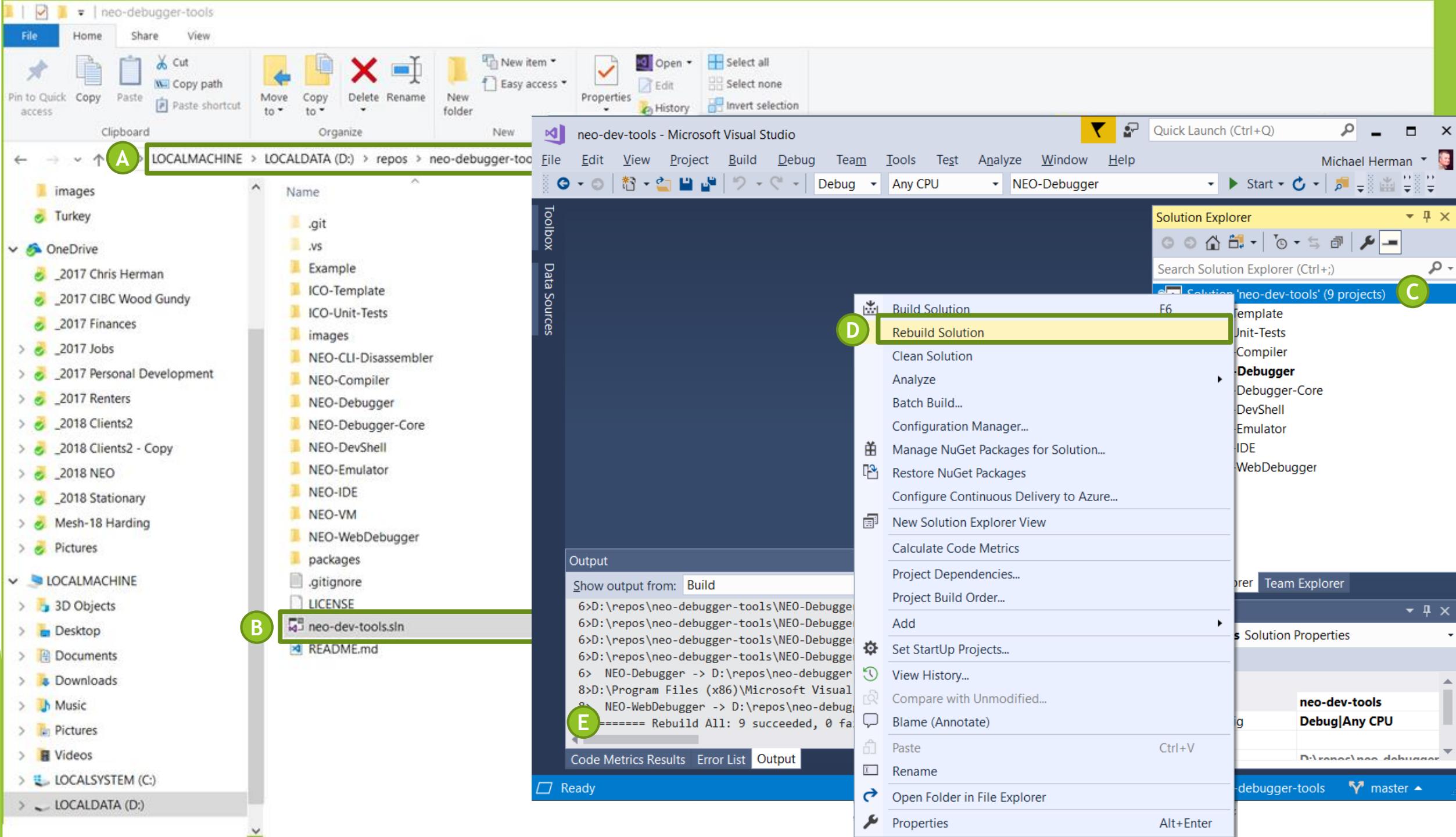
F10 - Single Step

F5 - Run

F6 - Storage Viewer

# 3. Module 1 Labs

Runtime.Log(), Runtime.Notify(), and NEO Storage



# Lab 1 - lab1\_log.cs

“Hello World” Hands-on Lab



File Edit View Project Debug Team Tools Test Analyze Window Help

New ▾

- Project... Ctrl+Shift+N
- Repository...
- File... Ctrl+N

Open ▾

Start Page

Close

Close Solution

Save Selected Items Ctrl+S

Save Selected Items As...

Save All Ctrl+Shift+S

Page Setup...

Print... Ctrl+P

Account Settings...

Recent Files ▾

Recent Projects and Solutions ▾

Exit Alt+F4

## New Project



Recent

Installed

Visual C#

Windows Universal  
Windows Classic Desktop

Web

.NET Core  
.NET Standard

Android

Cloud

Cross-Platform

iOS

Test

tvOS

WCF

Visual Basic

Visual C++

Visual F#

SQL Server

Azure Data Lake

Machine Learning

Not finding what you are looking for?

[Open Visual Studio Installer](#)

Sort by: Default



Class Library (.NET Framework)

Visual C#



ASP.NET Core Web Application

Visual C#



ASP.NET Web Application (.NET Framework)

Visual C#



Shared Project

Visual C#



Class Library (Legacy Portable)

Visual C#



WCF Service Application

Visual C#



Azure Functions

Visual C#



Azure WebJob (.NET Framework)

Visual C#



Azure Cloud Service

Visual C#



Blank App (Android)

Visual C#



NeoContract

Visual C#



Wear App (Android)

Visual C#

Search (Ctrl+E)



Type: Visual C#

Allow users to create a CSharp project for NeoContract.

Name:

lab1

Location:

c:\users\mwhe...repos

[Browse...](#)

Solution name:

lab1

 Create directory for solution Create new Git repository

OK

Cancel



Contract1.cs

```
C# lab1
lab1.Contract1
Main()

1 using Neo.SmartContract.Framework;
2 using Neo.SmartContract.Framework.Services.Neo;
3 using System;
4 using System.Numerics;

5
6 namespace lab1
7 {
8     public class Contract1 : SmartContract
9     {
10         public static void Main()
11         {
12             Storage.Put(Storage.CurrentCont
13         }
14     }
15 }
16
```

- Build Solution F6
- Rebuild Solution
- Clean Solution
- Analyze
- Batch Build...
- Configuration Manager...
- Manage NuGet Packages for Solution...
- Restore NuGet Packages
- New Solution Explorer View
- Calculate Code Metrics
- Add
- Set StartUp Projects...
- View History...
- Compare with Unmodified...
- Blame (Annotate)
- Paste Ctrl+V
- Rename
- Open Folder in File Explorer
- Properties Alt+Enter

Solution Explorer

Search Solution Explorer (Ctrl+Shift+F)

Solution 'lab1' (1 project)

lab1

- Properties
- References
- build.tasks
- Contract1.cs
- Neo.ConvertTask.dll
- packages.config

Explorer Team Explorer

Solution Properties

config	Debug Any CPU
option	



lab1 - Microsoft Visual Studio



Quick Launch (Ctrl+Q)



File Edit View Project Build Debug Team Tools Test Analyze Window Help



Contract1.cs

```
1 using Neo.SmartContract.Framework;
2 using Neo.SmartContract.Framework.Services.Neo;
3 using System;
4 using System.Numerics;
5
6 namespace lab1
7 {
8     public class Contract1 : SmartContract
9     {
10         public static void Main()
11         {
12             Storage.Put(Storage.CurrentContext, "Hello", "World");
13         }
14     }
15 }
16
```

100 %

Code Metrics Results Error List

This item does not support previewing

Debug

Any CPU

Start

Solution Explorer

Search Solution Explorer (Ctrl+Shift+F)

Solution 'lab1' (1 project)

lab1

- Properties
- References
- build.tasks
- Contract1.cs
- Neo.ConvertTask.dll
- packages.config

Solution Explorer

Team Explorer

Properties

lab1 Solution Properties



Misc

(Name)	lab1
Active config	Debug Any CPU
Description	

↑ 2

0

lab1

master



```
1  -> using Neo.SmartContract.Framework;
2    using Neo.SmartContract.Framework.Services.Neo;
3    using System;
4    using System.Numerics;
5
6  -> namespace lab1_log
7  {
8    ->   public class lab1_log : SmartContract
9    {
10      ->     public static void Main()
11      {
12        Runtime.Log("Hello world!");
13      }
14    }
15  }
```

# Lab 2 - lab2\_logandnotify.cs

Runtime.Log() and Runtime.Notify()

```
1  using Neo.SmartContract.Framework;
2  using Neo.SmartContract.Framework.Services.Neo;
3  using System;
4  using System.Numerics;
5
6  namespace lab2_logandnotify
7  {
8      public class lab2_logandnotify : SmartContract
9      {
10         public static void Main()
11         {
12             // `Log()` is best to add simple strings to the NEO event log for development purposes
13             Runtime.Log("log 1");
14             Runtime.Log("log 2");
15             Runtime.Notify("notify 3");
16
17             // `Notify()` is best for adding variables such as lists and objects to the NEO event log
18             int ten = 10;
19             Runtime.Notify("ten", ten);
20
21             object[] results = { "a", 1, 2, "3" };
22             Runtime.Notify("results", results);
23
24             User e1 = new User { FirstName = "Able", LastName = "Baker" };
25             Runtime.Notify("e1", e1);
26             User e2 = new User { FirstName = "Charlie", LastName = "Delta" };
27             User[] userEntities = { e1, e2 };
28             Runtime.Notify("userEntities", userEntities);
29         }

```

```
30
31     public class User
32     {
33         public string FirstName;
34         public string LastName;
35     }
36 }
```

# Lab 3 - lab3\_storage.cs

NEO Storage

# NEO Storage

- ▶ Each smart contact deployed to the NEO Blockchain has its own key-value data store
- ▶ Keys = byte[] array
- ▶ Values = string, byte[] array or BigInteger

Storage	X
Key	Content
84-99-21-A9-19-A3-1F-42-54-3A-8D-C3-64-3F-CB-9E-02-5F-20-FF-2F-23-4E-50-43-4E-45-50-35-4C-65-64-67-65-72-45-6E-74-72-79-2E-5F-53-54-41	3
84-99-21-A9-19-A3-1F-42-54-3A-8D-C3-64-3F-CB-9E-02-5F-20-FF-2F-23-4E-50-43-4E-45-50-35-4C-65-64-67-65-72-45-6E-74-72-79-2E-4C-61-73-...	0
84-99-21-A9-19-A3-1F-42-54-3A-8D-C3-64-3F-CB-9E-02-5F-20-FF-2F-23-4E-50-43-4E-45-50-35-4C-65-64-67-65-72-45-6E-74-72-79-2E-44-65-62-...	-100
84-99-21-A9-19-A3-1F-42-54-3A-8D-C3-64-3F-CB-9E-02-5F-20-FF-2F-23-4E-50-43-4E-45-50-35-4C-65-64-67-65-72-45-6E-74-72-79-2E-42-61-6C-...	999900
01-2F-23-4E-50-43-4E-45-50-35-4C-65-64-67-65-72-45-6E-74-72-79-2E-5F-53-54-41	3
01-2F-23-4E-50-43-4E-45-50-35-4C-65-64-67-65-72-45-6E-74-72-79-2E-4C-61-73-74-54-78-54-69-6D-65-73-74-61-6D-70	0
01-2F-23-4E-50-43-4E-45-50-35-4C-65-64-67-65-72-45-6E-74-72-79-2E-44-65-62-69-74-43-72-65-64-69-74-41-6D-6F-75-6E-74	100
01-2F-23-4E-50-43-4E-45-50-35-4C-65-64-67-65-72-45-6E-74-72-79-2E-42-61-6C-61-6E-63-65	100

# NEO Storage API

Storage [from metadata] ■ ✚ ✖

C# Neo.SmartContract.Framework Neo.SmartContract.Framework.Services.Neo.Storage

```
7  namespace Neo.SmartContract.Framework.Services.Neo
8  {
9      public static class Storage
10     {
11         public static StorageContext CurrentContext { get; }
12
13         ...
14         public static void Delete(StorageContext context, byte[] key);
15         ...
16         public static void Delete(StorageContext context, string key);
17         ...
18         public static byte[] Get(StorageContext context, byte[] key);
19         ...
20         public static byte[] Get(StorageContext context, string key);
21         ...
22         public static void Put(StorageContext context, byte[] key, byte[] value);
23         ...
24         public static void Put(StorageContext context, byte[] key, BigInteger value);
25         ...
26         public static void Put(StorageContext context, byte[] key, string value);
27         ...
28         public static void Put(StorageContext context, string key, byte[] value);
29         ...
30         public static void Put(StorageContext context, string key, BigInteger value);
31         ...
32         public static void Put(StorageContext context, string key, string value);
33     }
34 }
```

```
1  using Neo.SmartContract.Framework;
2  using Neo.SmartContract.Framework.Services.Neo;
3  using System;
4  using System.Numerics;
5
6  namespace lab3_storage
7  {
8      public class lab3_storage : SmartContract
9      {
10         public static void Main()
11         {
12             // Get a copy of the NEO Storage context
13             StorageContext ctx = Storage.CurrentContext;
14
15             string item_key = "test-storage-key";
16             Runtime.Notify("item_key", item_key);
17
18             // Try to get a value for this key from storage
19             BigInteger item_value = Storage.Get(ctx, item_key).AsBigInteger();
20             Runtime.Notify("item_value", item_value);
21             if (item_value == 0)
22             {
23                 Runtime.Notify("Storage key not set. Setting item_value to 1");
24                 item_value = 1;
25             }
26             else
27             {
28                 Runtime.Notify("Storage key already set. Incrementing item_value by 1");
29                 item_value += 1;
30             }
31
32             // Put the updated value for this key into NEO Storage
33             Storage.Put(ctx, item_key, item_value);
34             Runtime.Notify("New item_value", item_value);
35         }
36     }
37 }
```

```
10     public static void Main()
11     {
12         // Get a copy of the NEO Storage context
13         StorageContext ctx = Storage.CurrentContext;
14
15         string item_key = "test-storage-key";
16         Runtime.Notify("item_key", item_key);
17
18         // Try to get a value for this key from storage
19         BigInteger item_value = Storage.Get(ctx, item_key).AsBigInteger();
20         Runtime.Notify("item_value", item_value);
21         if (item_value == 0)
22         {
23             Runtime.Notify("Storage key not set. Setting item_value to 1");
24             item_value = 1;
25         }
26         else
27         {
28             Runtime.Notify("Storage key already set. Incrementing item_value by 1");
29             item_value += 1;
30         }
31
32         // Put the updated value for this key into NEO Storage
33         Storage.Put(ctx, item_key, item_value);
34         Runtime.Notify("New item_value", item_value);
35     }
36 }
```

# End of Module 1

- ▶ Lab 1 - lab1\_log.cs
- ▶ Lab 2 - lab2\_logandnotify.cs
- ▶ Lab 3 - lab3\_storage.cs

## 4. What is NEO?

# What is NEO?

- ▶ PROJECT: NEO (<https://neo.org/>) is a non-profit, community-based blockchain project that utilizes blockchain technology and digital identity to digitize assets, to automate the management of digital assets using smart contracts, and to realize a "smart economy" with a distributed network.
- ▶ SOFTWARE PLATFORM: 3<sup>rd</sup> generation distributed applications (dApp) platform
  - ▶ Multiple languages: C# (reference implementation), Python, Java, Golang, JavaScript
  - ▶ First dApp platform suitable for enterprise application development, deployment, and operations
- ▶ DUAL CRYPTOCURRENCY: NEO and GAS
- ▶ NEO SMART ECONOMY
  - ▶ Key differentiator
- ▶ GLOBAL COMMUNITY
  - ▶ Discord: <https://discord.gg/gqCYeup> / <https://discord.gg/4TQujHj>
  - ▶ NEO C# Developers Center of Excellence (neo-csharpcoe)  
<https://github.com/mwherman2000/neo-csharpcoe/blob/master/README.md>
  - ▶ NEL (NewEcoLab) “Chinese-speaking NEO Community”  
<https://github.com/neweconolab>
  - ▶ City of Zion “Home of the Open-source Global NEO Developer Community”  
<https://cityofzion.io/>

# Dual Cryptocurrency Model: NEO and NeoGas

- ▶ NEO Smart Economy, there is a separation of concerns:
  - ▶ NEO represents Voting Power
  - ▶ NeoGas represents Ability to Fund Work (Systems Fees)
- ▶ NEO (NEO)
  - ▶ Intended use: acquire, hold, and retain NEO to maximize your voting power in the network
  - ▶ Receive distributions of GAS
- ▶ NeoGas (GAS)
  - ▶ Sometimes referred to as a “Utility Token” or the “Fuel Token”
  - ▶ Used to fund the deployment of smart contracts (applications) on the NEO Blockchain
  - ▶ Used to fund transactions executed on the NEO Blockchain
  - ▶ System Fees are recycled and re-distributed in ratio/proportion to the number of NEO you hold

## NEO dApp List

These dAPPS come from the community. The information on this page is provided by the project owner. NEO Council and ndapp.org does not endorse these projects.

Add a NEO dApp



### NEX

by The NEX Team

NEX combines the NEO blockchain with an off-chain matching engine to enable much faster and more complex trades than existing decentralized exchanges

[Website](#) [Whitepaper](#) [Twitter](#) [LinkedIn](#) [Medium](#)



### Moonlight

by The Moonlight Team

Moonlight is a distributed workforce and analytical project management platform featuring a global public ledger of contributor work experience and a new match-making algorithm to effectively fulfill project needs.

[Website](#)



### Red Pulse

by Red Pulse

Red Pulse Tokens (RPX) are NEO tokens issued by Red Pulse, an event-driven research firm covering market events impacting Chinese companies, sectors and the overall economy.

[Website](#) [GitHub](#) [Reddit](#) [Contract](#)



### AdEx

by adexnetwork

AdEx is a decentralized ad exchange built on the blockchain and smart contracts. The core feature of AdEx will be the so-called AdEx User Profile - a personalized page that allows every end user to understand and control the ads delivered to them.

[Website](#) [GitHub](#) [Medium](#) [Facebook](#) [Telegram](#) [Twitter](#) [Reddit](#)



### NeoAuth

by @NeoAuth

NeoAuth enables authentication over the NEO blockchain, allowing you to log in with a NEO address instead of an email and password.

[Website](#) [Demo](#) [GitHub](#) [Whitepaper](#)



### Zeepin

by Zeepin

The Distributed Creative New Economy. Zeepin, a decentralized innovation community, is dedicated to promoting highly efficient circulation of innovation assets. Smart work. Creative life!

[Website](#) [Telegram](#) [Twitter](#) [Facebook](#) [GitHub](#) [Contract](#)



### Qlink

by Alkin Li

Qlink, developed by Qlink Foundation in Singapore, adopts the blockchain technology and creates a decentralized mobile network for P2Peer WiFi sharing, mobile data converted content distribution, enterprise telecom services and crowd-sourcing base stations (including

[GitHub](#) [Medium](#) [Page](#) [AMA summary](#) [Contract](#)



### Neo Smart IoT

by halib2328, jpharmer

Control IoT (Internet of Things) devices via Neo smart contracts (first device is an ESP8266).

[Website](#) [GitHub](#) [Contract](#)



### imusify

by DavidWalters125, geeklife, Nikolaj K, metachris

imusify is a free, blockchain based, incentivized and decentralized platform for music related digital content such as audio, video, apps, images, and blogging where anyone can join, contribute and get paid \$IMU.

[Website](#) [GitHub](#)



### Chain Line

by notatotuser

Peer-to-peer courier platform. Couriers transport items to fulfill demands and earn courier fees.

[Website](#) [GitHub](#)



### Phantasma

by Raltsui

Phantasma is a platform where the users control their own content, instead of relying in third parties servers. The platform support any kind of transactions between users, e.g. email, chat, files, money transfers. NEO was used for this project due to its fast transactions and C#

[Demo](#) [Website](#) [GitHub](#)



### NeoTrade

by birmas

NeoTrade is a NEP5 trading platform inspired by EtherDelta. NeoTrade is a NEO based smart contract that allows users to deposit NEO, GAS or any other NEP-5 asset directly to the smart contract and trade amongst themselves.

[Website](#) [GitHub](#)



### Turing Complete Smart Contract

by Nikolaj K

A smart contract which interprets encoded classical Turing machines.

[Youtube](#) [GitHub](#)



### Krypton

by MediaServe

KRYPTON is a Smart Contract and ecosystem to provide SIP registration on the NEO blockchain using a KRYPTON compatible SIP provider.

[Youtube](#) [Demo](#) [GitHub](#)



### Switcheo

by RavenKos, hennychea, jackyliu

Switcheo is a decentralised exchange built on NEO's blockchain. It supports trading of NEP-5 tokens and NEO system assets like GAS & NEO. It aims to be a truly decentralised exchange while still providing for a superb user experience.

[Youtube](#) [Website](#) [GitHub](#)



### TripShares

by etolya

Trip sharing with deposits. Travellers commit to a shared seat by depositing \$TRS NEP-5 tokens, which are used as insurance when the passenger cancels the trip after a set date.

[Website](#) [GitHub](#)



### BlockSaver

by imputmusic, morigan

Saving smart contract, with interests and fines. You can define how long to lock NEO and GAS assets, the smart contract defines an interest rate, and the system has a penalty for early withdrawal.

[GitHub](#)



### Lucky NEO

by mmoravec, horang, StefanBabitsch, WestleyLeung, tamersocial

Lucky NEO allows anyone to send their extra gas to a raffle contest. One winner will be chosen every two weeks and automatically paid out. Lucky NEO uses an admin account to automatically pay out the winner to the address that sent the funds; so you don't have to follow

[Post](#) [GitHub](#)



### Neo Fund

by nickang

Neo Fund is a decentralized crowdfunding platform, similar to Kickstarter. The basic function is to set a goal amount, and date limit. If the goal is reached, the contributors will be awarded the funds; and if not the contributors can redeem their funds again.

[GitHub](#)



### Neo Raffle

by ambethia

A smart contract that enables a raffle/lottery on the Neo block chain. Send GAS, win GAS! This project also demonstrates a solid way to use random numbers in a smart contract.

[Website](#) [GitHub](#)



### NepSwap

by block\_shaman

Protocol and smart contract for trading NEP-5 based assets. NepSwap is a protocol and smart contract for trading NEP-5 assets. This prototype idea is based on EtherDelta and Bancor. It doesn't have a personal token or ICO, this project is intended for community, and

[GitHub](#)



### Smart Promise

by SergeyAnkrumko, marlyona

Smart Promise is an electronic journal of smart promises developed through Blockchain. User of such an environment receives a reward for each of his fulfilled promises. The concept of the idea contains the possibility to get a strong motivation to action that user pointed in

[Youtube](#) [Website](#) [GitHub](#) [Whitepaper](#)



### Sunny dApp

by jannvanderberg

This dApp allows you to insure against bad weather conditions on a given day. If the relative sunshine duration on that day is lower than 50 percent, you get paid.

[Website](#) [GitHub](#)



### NEO Name Service

by NewEconLab(TEL)

Distributed domain name service ending with .neo based on NEO blockchain.

4/3/2018

[Website](#) [GitHub](#)



### THEKEY

by THEKEY team

THEKEY is a Decentralized Ecosystem of Identity Verification Tool Using National Big-data and Blockchain. THEKEY Project Team is now developing IDV (Identification verification) tool with blockchain based dynamic multi-dimension

[website](#) [GitHub](#) [telegram](#) [facebook](#) [twitter](#) [Contract](#)



### 蓝鲸淘

by 中科技

蓝鲸淘是链资产中心化管理平台，通过开源的区块链技术与智能合约的规则，为用户提供点对点、无中介的数字货币资产流转服务，降低数字货币资产流转过程中的信用成本。

[Website](#) [GitHub](#)



### TRINITY

by Trinity team

Trinity is applicable to blockchain transfer of NEP-5 standard tokens. As a Neo-version lightning network, Trinity achieves real-time payment, low transaction fee, scalability, and privacy protection of Neo mainnet assets through state channels

[website](#) [GitHub](#) [telegram](#) [twitter](#) [Contract](#)

# NEO Has All Ingredients



High TPS: 1,000 TPS



Finality: 1 Confirmation, dBFT



Interoperability: NeoX



Digital ID: NeoID / Ontology



Stable Coin: Alchemint

By 2020, NEO Will Handle

**100,000 TPS**  
Without Sharding!

NEO C# .NET Developers Center of Excellence



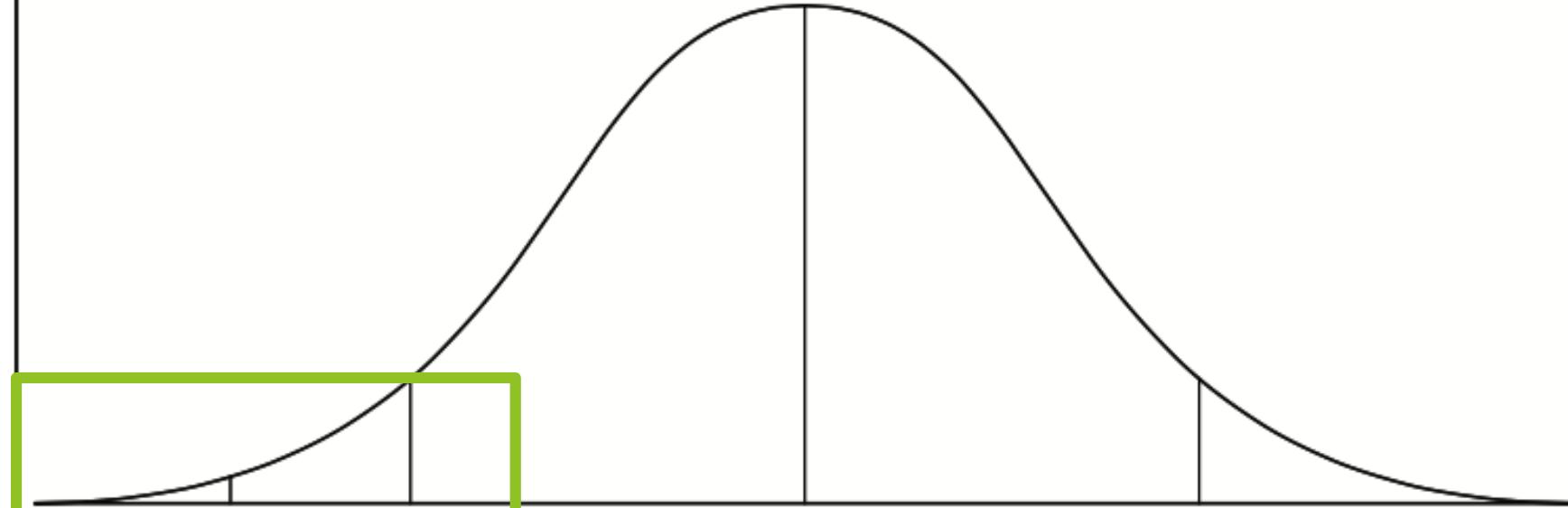
# NEO Decentralized Applications (Use Cases)

- ▶ Smart fund
- ▶ AI-assisted legal smart contracts
- ▶ Social networking
- ▶ Automated token liquidity providers
- ▶ Decentralized exchanges
- ▶ Secure communications protocol
- ▶ Supply chain (parts, food, wine, ...)
- ▶ Consortiums (business partnerships)
- ▶ Data exchange markets
- ▶ Intellectual property trading markets
- ▶ Prediction markets
- ▶ Advertising markets
- ▶ Hashpower (cryptohealth) markets
- ▶ NeoGas markets
- ▶ Business process re-engineering
- ▶ Requisition processing

# Blockchain: Early Adopters Marketplace

## The Technology Adoption Curve

*As captured by Everett Rogers in his book *Diffusion of Innovations*, people tend to adopt new technologies at varying rates. Their relative speed of adoption can be plotted as a normal distribution, with the primary differentiator being individuals' psychological disposition to new ideas.*



### Innovators

(2.5%) are risk takers who have the resources and desire to try new things, even if they fail

### Early Adopters

(13.5%) are selective about which technologies they start using. They are considered the “one to check in with” for new information and reduce others’ uncertainty about a new technology by adopting it.

### Early Majority

(34%) take their time before adopting a new idea. They are willing to embrace a new technology as long as they understand how it fits with their lives.

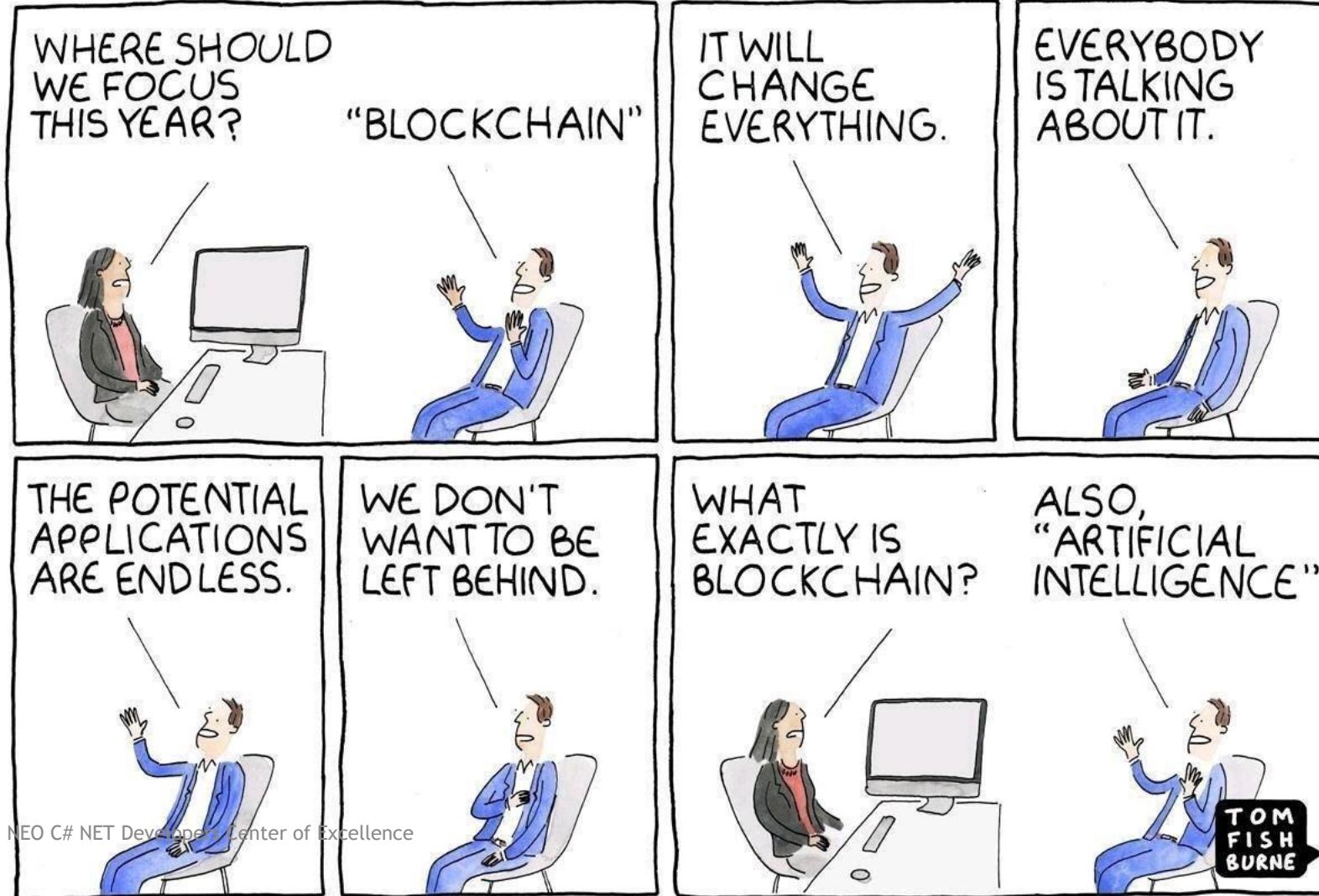
### Late Majority

(34%) adopt in reaction to peer pressure, emerging norms, or economic necessity. Most of the uncertainty around an idea must be resolved before they adopt.

### Laggards

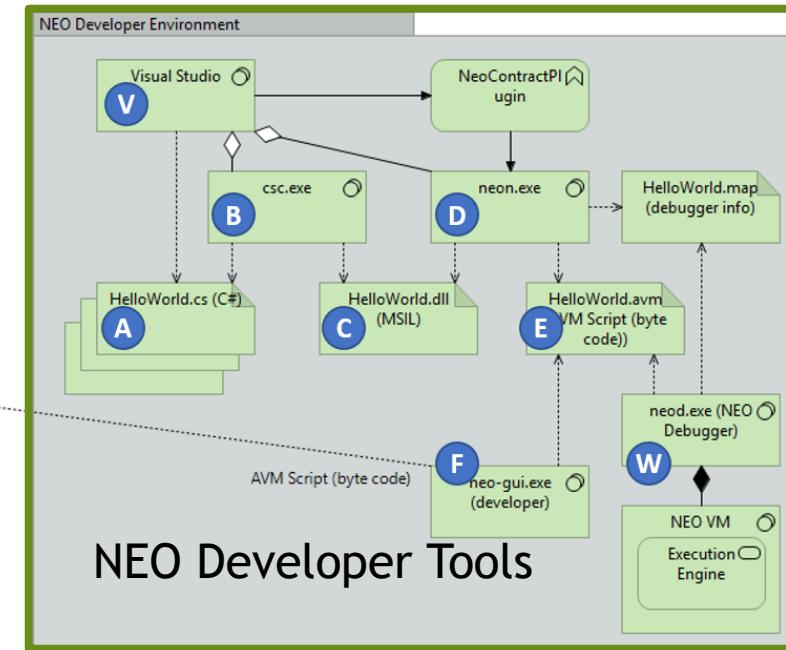
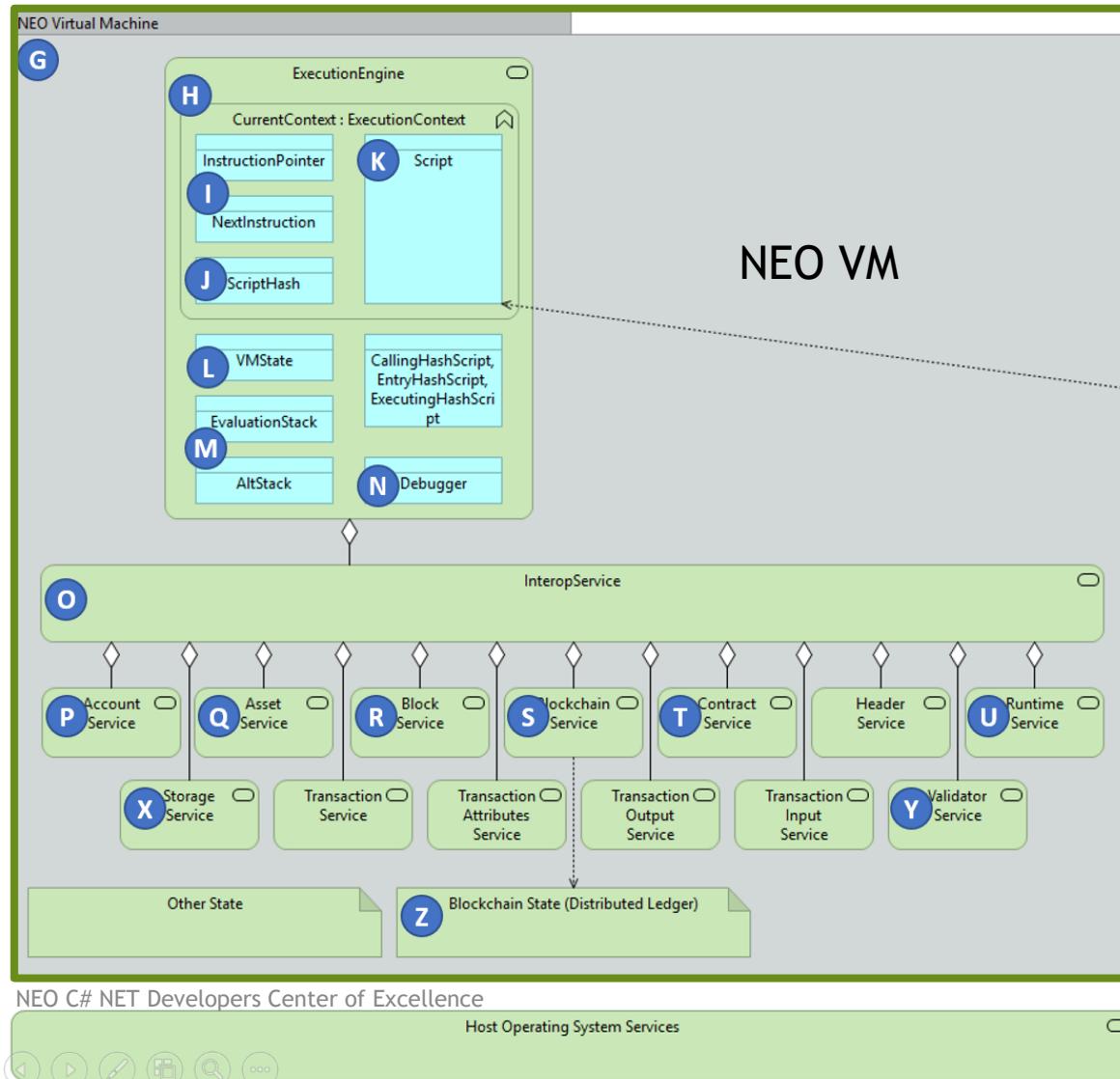
(16%) are traditional and make decisions based on past experience. They are often economically unable to take risks on new ideas.

# BREAK - 15 MINUTES

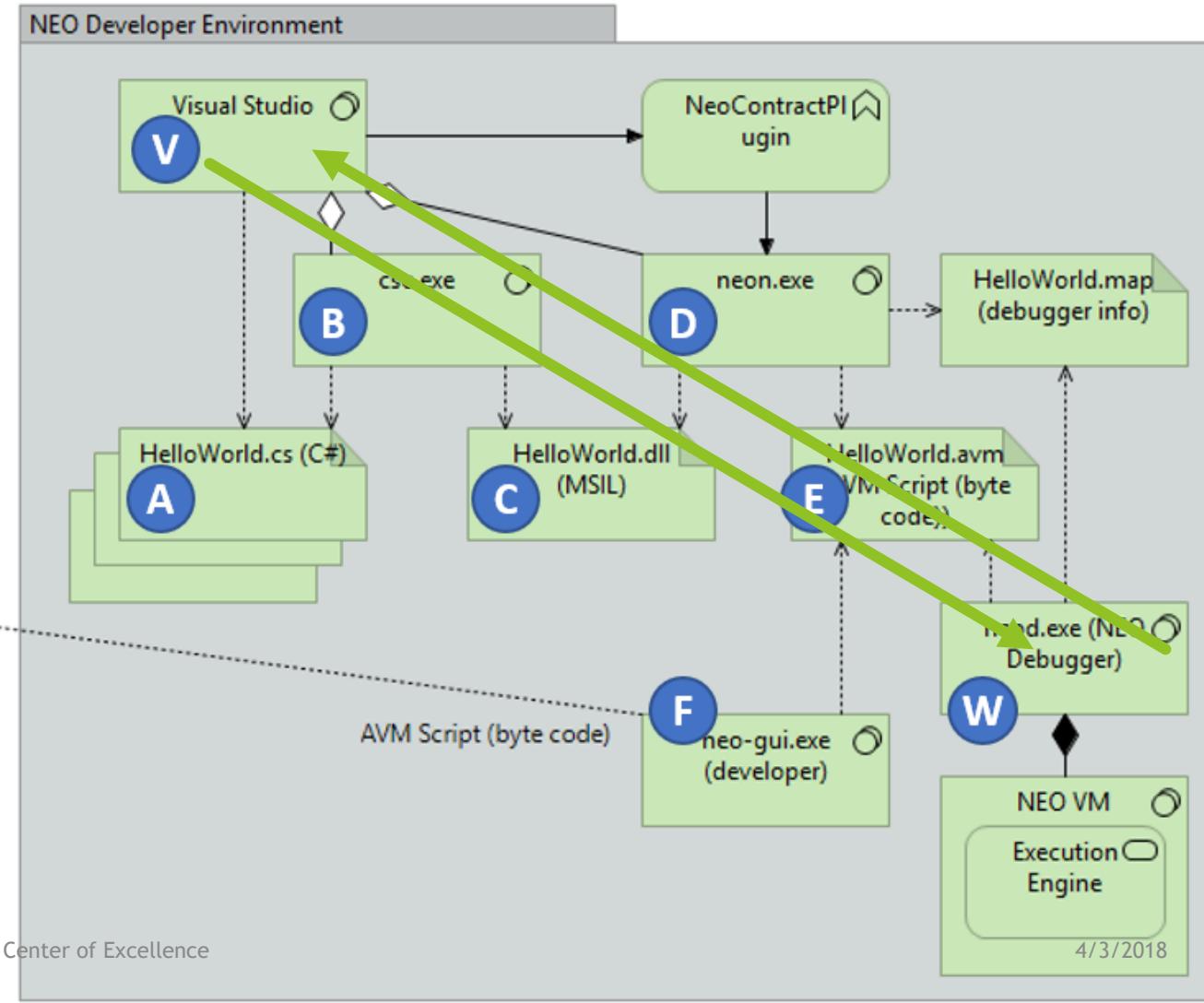


# 5. NEO Architecture

# NEO Reference Architecture (neo-charm)



# NEO Reference Architecture: Developer



C# Source Code  
.cs

csc.exe

Microsoft Intermediate Language (.dll)

neon.exe

NEO VM Byte Code (.avm)

neod.exe

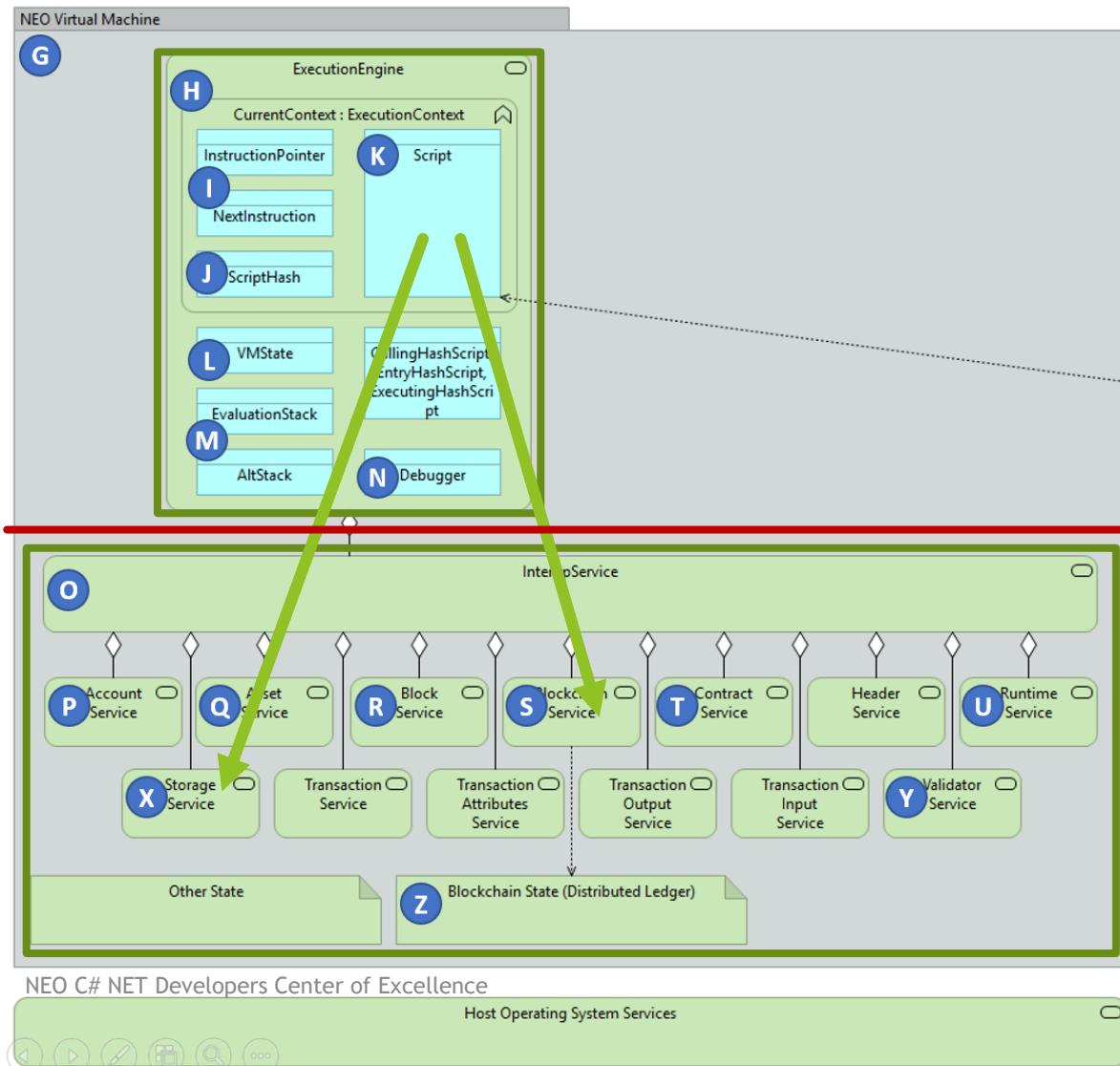
NEO VM

# NEO System Fees

<http://docs.neo.org/en-us/sc/systemfees.html>

System Calls	NEO [Gas]	Instruction OpCodes	NEO [Gas]
Runtime.CheckWitness	0.2	OpCode.PUSH16 [or less]	0.00
Blockchain.GetHeader	0.1	OpCode.NOP	0.00
Blockchain.GetBlock	0.2	OpCode.APPCALL	0.01
Blockchain.GetTransaction	0.1	OpCode.TAILCALL	0.01
Blockchain.GetAccount	0.1	OpCode.SHA1	0.01
Blockchain.GetValidators	0.2	OpCode.SHA256	0.01
Blockchain.GetAsset	0.1	OpCode.HASH160	0.02
Blockchain.GetContract	0.1	OpCode.HASH256	0.02
Transaction.GetReferences	0.2	OpCode.CHECKSIG	0.10
Account.SetVotes	1	OpCode.CHECKMULTISIG [per signature]	0.10
Validator.Register	1000	Other OpCodes	0.001
Asset.Create (system asset)	5000	• Constants	
Asset.Renew (system asset)	5000	• Flow Control	
Contract.Create	500	• Stack	
Contract.Migrate	500	• String	
Storage.Get	0.1	• Logical	
Storage.Put [per KB]	1.0	• Arithmetic	
Storage.Delete	0.1	• Cryptography	
Other OpCodes	0.001	• Structure	
		• Exceptions	

# NEO Reference Architecture: NEO Virtual Machine



System Calls	NEO [Gas]
Runtime.CheckWitness	0.2
Blockchain.GetHeader	0.1
Blockchain.GetBlock	0.2
Blockchain.GetTransaction	0.1
Blockchain.GetAccount	0.1
Blockchain.GetValidators	0.2
Blockchain.GetAsset	0.1
Blockchain.GetContract	0.1
Transaction.GetReferences	0.2
Account.SetVotes	1
Validator.Register	1000
Asset.Create (system asset,	5000
Asset.Renew (system asset)	5000
Contract.Create	500
Contract.Migrate	500
Storage.Get	0.1
Storage.Put [per KB]	1.0
Storage.Delete	0.1
Other OpCodes	0.001

# 6. Module 2 Labs

NEO Smart Contract Patterns: Process Operation, Domain Name Server, NEP5 Token

# Lab 4 - lab4\_processoperationpattern.cs

NEO Smart Contract Patterns

```
6  namespace lab4_processoperationpattern
7  {
8      public class lab4_processoperationpattern : SmartContract
9      {
10         public static object Main(string operation, params object[] args)
11         {
12             object result = false; // = 0 (zero)
13
14             if (args.Length == 0)
15             {
16                 Runtime.Log("Missing parameters");
17                 result = false;
18             }
19             else
20             {
21                 if (operation == "query")
22                 {
23                     Runtime.Notify("query", args[0]);
24                     result = args[0];
25                 }
26                 else if (operation == "delete")
27                 {
28                     Runtime.Notify("delete", args[0]);
29                     result = true;
30                 }
31                 else if (operation == "register")
32                 {
33                     Runtime.Notify("register", args[0]);
34                     result = true;
35                 }
36                 else if (operation == "transfer")
37                 {
38                     Runtime.Notify("transfer", args[0]);
39                     result = true;
40                 }
41                 else
42                 {
43                     result = false;
44                 }
45             }
46             return result;
47         }
48     }
```

# Process Operation Pattern

```
public static object Main(string operation,  
                         params object[] args)
```

## Parameters

- ▶ **operation** task to be performed by the smart contract
- ▶ **args** parameters need for a specific task

## Return Value

- ▶ **object** bool, simple value, entity, array of objects

```
public static object Main(string operation, params object[] args)  
{  
    object result = false; // = 0 (zero)  
  
    if (args.Length == 0)  
    {  
        Runtime.Log("Missing parameters");  
        result = false;  
    }  
    else  
    {  
        if (operation == "query")  
        {  
            Runtime.Notify("query", args[0]);  
            result = args[0];  
        }  
        else if (operation == "delete")  
        {  
            Runtime.Notify("delete", args[0]);  
            result = true;  
        }  
        else if (operation == "register")  
        {  
            Runtime.Notify("register", args[0]);  
            result = true;  
        }  
        else if (operation == "transfer")  
        {  
            Runtime.Notify("transfer", args[0]);  
            result = true;  
        }  
        else  
        {  
            result = false;  
        }  
    }  
}  
return result;
```

```
public static object Main(string operation, params object[] args)
{
    object result = false; // = 0 (zero)

    if (args.Length == 0)
    {
        Runtime.Log("Missing parameters");
        result = false;
    }
    else
    {
        if (operation == "query")
        {
            Runtime.Notify("query", args[0]);
            result = args[0];
        }
        else if (operation == "delete")
        {
            Runtime.Notify("delete", args[0]);
            result = true;
        }
        else if (operation == "register")
        {
            Runtime.Notify("register", args[0]);
            result = true;
        }
        else if (operation == "transfer")
        {
            Runtime.Notify("transfer", args[0]);
            result = true;
        }
        else
        {
            result = false;
        }
    }
    return result;
}
```

# Lab 5 - lab5\_domain.cs

NEO Smart Contract Patterns

# NEO Account Addresses, Keys and Key Lengths

Description	Length (byte[]/HexString)	Examples (Bold Lengths)
Address1	(34/68)	AcCHOikUq9cP6SMESHufCEMwADJNcTwnAv
Address1 WIF	(52/104)	L3f7C21q4Mu5FzZsDuCMeHqwJ1apHYCrwzU2821p1opaM43BAMKo
Address1 PublicKeyHex	(33/66)	02c44534465c8b21f659eba5708e69edae1ddd6f8cd63004095f8e39493cf54e82
Address1 PrivateKeyHex	(32/64)	c016e1c8a193cc1a28a15464106b91b52727547a3a36f40a8bfebd9933d1963c
Address1 ScriptHash	(20/40)	e000aa6a0ab08af8aa78b19d481e5b5c40d8be0e = Address1.AsScriptHash();
Address2	(34/68)	AK2nJJpJr6o664CWJKi1QRXjqeic2zRp8y
Address2 WIF	(52/104)	KxDgvEKzgSBPPfuVfw67oPQBSjidEiqTHURKSDL1R7yGaGYAeYnr
Address2 PublicKeyHex	(33/66)	031a6c6fbfdf02ca351745fa86b9ba5a9452d785ac4f7fc2b7548ca2a46c4fcf4a
Address2 PrivateKeyHex	(32/64)	1dd37fba80fec4e6a6f13fd708d8dcb3b29def768017052f6c930fa1c5d90bbb
Address2 ScriptHash	(20/40)	23ba2703c53263e8d6e522dc32203339dcd8eee9 = Address2.AsScriptHash();
TxID, AssetID	(32/64)	687b68a1159429dc558e4fc7590e391d52f1ef79a12922f941daa37c00334ec5

lab5\_domain.cs\* X

C# lab5\_domain lab5\_domain

```
1  using Neo.SmartContract.Framework;
2  using Neo.SmartContract.Framework.Services.Neo;
3  using System;
4  using System.Numerics;
5
6  //Testing:
7  // operation,    args
8  // -----, -----
9  // "query",      ["test.com"]
10 // "register",   ["test.com", "AK2nJJpJr6o664CWJKi1QRXjqeic2zRp8y"]
11 // "delete",     ["test.com"]
12 // "transfer",   ["test.com", "AK2nJJpJr6o664CWJKi1QRXjqeic"]
13
14 namespace lab5_domain
15 {
16     public class lab5_domain : SmartContract
17     {
18         public static object Main(string operation, params object[] args)
19         {
```

lab5\_domain.cs\* X

C# lab5\_domain lab5\_domain

```
18     public static object Main(string operation, params object[] args)
19     {
20         object result = false; // = 0 (zero)
21
22         if (args.Length == 0)
23         {
24             Runtime.Log("No domain named supplied");
25             result = 0;
26         }
27         else
28         {
29             string domain_name = (string)args[0];
30             if (operation == "query")
31             {
32                 result = QueryDomain(domain_name);
33             }
34             else if (operation == "delete")
35             {
36                 result = DeleteDomain(domain_name);
37             }
38         }
39     }
40 }
```

```
38     else if (operation == "register")
39     {
40         if (args.Length < 2)
41         {
42             Runtime.Log("Required arguments: [\"domain_name\", \"owner\"]");
43             result = 0;
44         }
45         else
46         {
47             byte[] owner = (byte[])args[1];
48             result = RegisterDomain(domain_name, owner);
49         }
50     }
51     else if (operation == "transfer")
52     {
53         if (args.Length < 2)
54         {
55             Runtime.Log("Required arguments: [\"domain_name\", \"to_address\"]");
56             result = 0;
57         }
58         else
59         {
60             byte[] to_address = (byte[])args[1];
61             result = TransferDomain(domain_name, to_address);
62         }
63     }
64     else
65     {
66         result = false;
67     }
68 }
69
70     return result;
71 }
```

```
73     private static object QueryDomain(string domain_name)
74     {
75         object result = 0;
76
77         Runtime.Notify("QueryDomain", domain_name);
78
79         StorageContext ctx = Storage.CurrentContext;
80         byte[] owner = Storage.Get(ctx, domain_name);
81         if (owner.Length == 0)
82         {
83             Runtime.Notify("Domain is not registered", domain_name);
84             result = 0;
85         }
86         else
87         {
88             result = owner;
89         }
90
91         return result;
92     }
```



```
94     private static bool RegisterDomain(string domain_name, byte[] owner)
95     {
96         bool result = false;
97
98         Runtime.Notify("RegisterDomain", domain_name, owner);
99
100        if (!Runtime.CheckWitness(owner))
101        {
102            Runtime.Notify("Owner argument is not the same as the sender", owner);
103            result = false;
104        }
105        else
106        {
107            StorageContext ctx = Storage.CurrentContext;
108            byte[] exists = Storage.Get(ctx, domain_name);
109            if (exists.Length != 0)
110            {
111                Runtime.Notify("Domain is already registered", domain_name, exists);
112                result = false;
113            }
114            else
115            {
116                Storage.Put(ctx, domain_name, owner);
117                result = true;
118            }
119        }
120    }
121    return result;
122 }
```

```
124     private static bool TransferDomain(string domain_name, byte[] to_address)
125     {
126         bool result = false;
127
128         Runtime.Notify("TransferDomain", domain_name, to_address);
129
130         StorageContext ctx = Storage.CurrentContext;
131         byte[] owner = Storage.Get(ctx, domain_name);
132         if (owner.Length == 0)
133         {
134             Runtime.Notify("Domain is not registered", domain_name);
135             result = false;
136         }
137         else
138         {
139             if (!Runtime.CheckWitness(owner))
140             {
141                 Runtime.Notify("Sender is not the owner on this domain, cannot transfer", domain_name);
142                 result = false;
143             }
144             else
145             {
146                 if (to_address.Length != 34)
147                 {
148                     Runtime.Notify("Invalid new owner address. Must be exactly 34 characters", to_address);
149                     result = false;
150                 }
151                 else
152                 {
153                     Storage.Put(ctx, domain_name, to_address);
154                     result = true;
155                 }
156             }
157         }
158
159         return result;
160     }
```

```
124     private static bool TransferDomain(string domain_name, byte[] to_address)
125     {
126         bool result = false;
127
128         Runtime.Notify("TransferDomain", domain_name, to_address);
129
130         StorageContext ctx = Storage.CurrentContext;
131         byte[] owner = Storage.Get(ctx, domain_name);
132         if (owner.Length == 0)
133         {
134             Runtime.Notify("Domain is not registered", domain_name);
135             result = false;
136         }
137         else
138         {
139             if (!Runtime.CheckWitness(owner))
140             {
141                 Runtime.Notify("Sender is not the owner on this domain, cannot transfer", domain_name);
142                 result = false;
143             }
144             else
145             {
146                 if (to_address.Length != 34)
147                 {
148                     Runtime.Notify("Invalid new owner address. Must be exactly 34 characters", to_address);
149                     result = false;
150                 }
151                 else
152                 {
153                     Storage.Put(ctx, domain_name, to_address);
154                     result = true;
155                 }
156             }
157         }
158
159         return result;
160     }
```

```
162     private static bool DeleteDomain(string domain_name)
163     {
164         bool result = false;
165
166         Runtime.Notify("DeleteDomain", domain_name);
167
168         StorageContext ctx = Storage.CurrentContext;
169         byte[] owner = Storage.Get(ctx, domain_name);
170         if (owner.Length == 0)
171         {
172             Runtime.Notify("Domain is not registered", domain_name);
173             result = false;
174         }
175         else
176         {
177             if (!Runtime.CheckWitness(owner))
178             {
179                 Runtime.Notify("Sender is not the owner on this domain, cannot delete", domain_name);
180                 result = false;
181             }
182             else
183             {
184                 Storage.Delete(ctx, domain_name);
185                 result = true;
186             }
187         }
188
189         return result;
190     }
191 }
```

# Lab 6 - lab6\_NEP5pattern.cs

NEO Smart Contract Patterns

lab6\_NEP5pattern.cs

C# lab6\_NEP5pattern

lab6\_NEP5pattern.NEP5Base

TotalSupply

```
1  using Neo.SmartContract.Framework;
2  using Neo.SmartContract.Framework.Services.Neo;
3  using System;
4  using System.Numerics;
5
6  // NEP5 Token Proposal: https://github.com/neo-project/proposals/blob/master/nep-5.mediawiki
7
8  namespace lab6_NEP5pattern
9  {
10     public class NEP5Base
11     {
12         public BigInteger TotalSupply;
13         public string Name;
14         public string Symbol;
15         public byte Decimals;
16         public byte[] OwnerAccountScriptHash;
17     }
18
19     public class lab6_NEP5pattern : SmartContract
20     {
21         static readonly byte[] _OwnerAccountScriptHash = "ATrzHaicmhRj15C3Vv6e6gLfLqhSD2PtTr".ToScriptHash();
22
23         public static event Action<byte[], byte[], BigInteger> transfer;
24
25         public static object Main(string operation, params object[] args)
26         {
27             object result = false; // = 0 (zero)
28
29             NEP5Base TOKENBASE = new NEP5Base { TotalSupply = 10000,
30                                              Name = "My Test Token",
31                                              Symbol = "MTT",
32                                              Decimals = 8,
33                                              OwnerAccountScriptHash = _OwnerAccountScriptHash };
```

lab6\_NEP5pattern.cs X

C# lab6\_NEP5pattern lab6\_NEP5pattern.NEP5Base TotalSupply

```
35     if (operation == "totalSupply")
36     {
37         Runtime.Notify("totalSupply");
38         result = TotalSupply(TOKENBASE);
39     }
40     else if (operation == "name")
41     {
42         Runtime.Notify("name");
43         result = Name(TOKENBASE);
44     }
45     else if (operation == "symbol")
46     {
47         Runtime.Notify("symbol");
48         result = Symbol(TOKENBASE);
49     }
50     else if (operation == "decimals")
51     {
52         Runtime.Notify("decimals");
53         result = Decimals(TOKENBASE);
54     }
55     else if (operation == "balanceOf")
```

```
55     else if (operation == "balanceOf")
56     {
57         if (args.Length < 1)
58         {
59             result = false;
60         }
61         else
62         {
63             byte[] account = (byte[])args[0];
64             Runtime.Notify("balanceOf");
65             result = BalanceOf(TOKENBASE, account);
66         }
67     }
68     else if (operation == "transfer")
69     {
70         if (args.Length < 3)
71         {
72             result = false;
73         }
74         else
75         {
76             byte[] from = (byte[])args[0];
77             byte[] to = (byte[])args[1];
78             BigInteger amount = (BigInteger)args[2];
79             Runtime.Notify("transfer", args[0], args[1], args[2]);
80             result = Transfer(TOKENBASE, from, to, amount);
81         }
82     }
```

```
83         else if (operation == "deploy")
84     {
85         Runtime.Notify("deploy");
86         result = Deploy(TOKENBASE);
87     }
88     else
89     {
90         result = false;
91     }
92
93     return result;
94 }
95
96     private static BigInteger TotalSupply(NEP5Base TOKENBASE)
97     {
98         return TOKENBASE.TotalSupply;
99     }
100
101    private static string Name(NEP5Base TOKENBASE)
102    {
103        return TOKENBASE.Name;
104    }
105
106    private static string Symbol(NEP5Base TOKENBASE)
107    {
108        return TOKENBASE.Symbol;
109    }
110
111    private static byte Decimals(NEP5Base TOKENBASE)
112    {
113        return TOKENBASE.Decimals;
114    }
```

```
116     private static BigInteger BalanceOf(NEP5Base TOKENBASE, byte[] account)
117     {
118         BigInteger result = 0;
119
120         StorageContext ctx = Storage.CurrentContext;
121         BigInteger currentBalance = Storage.Get(ctx, account).AsBigInteger();
122
123         result = currentBalance;
124
125         return result;
126     }
127
128     private static bool Deploy(NEP5Base TOKENBASE)
129     {
130         bool result = false;
131
132         if (Runtime.CheckWitness(TOKENBASE.OwnerAccountScriptHash))
133         {
134             StorageContext ctx = Storage.CurrentContext;
135
136             // Create on-chain ledger entry for the owner of this token. Check to see if the ledger already
137             byte[] currentBalance = Storage.Get(ctx, TOKENBASE.OwnerAccountScriptHash);
138             if (currentBalance.Length == 0)
139             {
140                 Storage.Put(ctx, TOKENBASE.OwnerAccountScriptHash, TOKENBASE.TotalSupply);
141                 result = true;
142             }
143         }
144
145         return result;
146     }
```

```
148     private static bool Transfer(NEP5Base TOKENBASE, byte[] from, byte[] to, BigInteger amount)
149     {
150         bool result = false;
151
152         if (amount > 0)
153         {
154             if (Runtime.CheckWitness(from)) // is the account invoking this contract == "from" account
155             {
156                 if (from == to)
157                 {
158                     result = true;
159                 }
160                 else // from != to
161                 {
162                     StorageContext ctx = Storage.CurrentContext;
163
164                     // Get balance from the "from" ledger
165                     BigInteger fromBalance = Storage.Get(ctx, from).AsBigInteger();
166                     if (fromBalance > amount)
167                     {
168                         // Update "from" ledger
169                         Storage.Put(ctx, from, fromBalance - amount);
170
171                         // Update "to" ledger
172                         BigInteger toBalance = Storage.Get(ctx, to).AsBigInteger();
173                         Storage.Put(ctx, to, toBalance + amount);
174
175                         // Log a "transfer" event
176                         transfer(from, to, amount);
177
178                         result = true;
179                     }
180                 }
181             }
182         }
183
184         return result;
185     }
```

# End of Module 2

- ▶ Lab 4 - lab6\_processoperationpattern.cs
- ▶ Lab 5 - lab5\_domain.cs
- ▶ Lab 6 - lab6\_NEP5pattern.cs

# 7. Why NEO?

# NEO was created for Large Scale dApps\*

**No transaction fees**  
Initial 10 GAS fee is  
for free. Simple  
Smart Contracts can  
be run for free.

**Mainchain speeds**  
NEO 1000 - 10,000 TPS (single core)  
BTC 3 - 4 TPS  
ETH 10 - 20 TPS

**Confirmations needed**  
NEO 1 and only 1  
BTC 6+  
ETH 20+

**More freedom** for  
application developers  
to choose the business  
model that most suits to  
their business. Service  
and usage fees can be  
charged in any way off-  
chain.

\*dApps - Distributed Apps

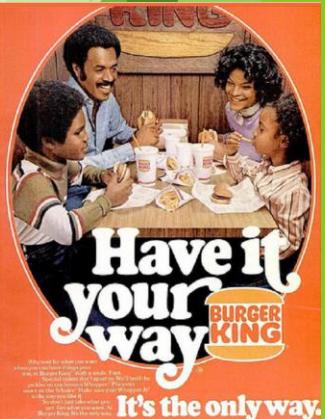
NEO C# NET Developers Center of Excellence

NEO Persistable Classes make Enterprise App Development real

## 8. 3<sup>rd</sup> Generation Distributed App (dApp) Platform

# NEO Smart Contracts: “Have it your Way”

- ▶ Develop, debug and test Smart Contracts in the language you prefer
  - ▶ C# (reference implementation)
  - ▶ Python, Java, Golang, JavaScript
- ▶ Develop, debug and test Client Apps using the frameworks you prefer
  - ▶ ASP.NET, WinForms, WPF, Console Applications, Window Services, ...
  - ▶ Node.JS
  - ▶ Python, Java, Golang, JavaScript



# NEO C# Developer Tool Suite (March 2018)

- ▶ NEO Blockchain Quick Start Guide for .NET Developers (mwherman2000/neo-dotnetquickstart)
- ▶ NEO Persistable Classes (NPC) Compiler (mwherman/neo-npcc)
- ▶ NEO NEON Compiler (neo-project/neo-compiler)
- ▶ NEO Debugger (CityOfZion/neo-debugger-tools)
- ▶ NEO Node/Wallet (Developer Edition) (CityOfZion/neo-gui-developer)
- ▶ NEO PrivateNet Docker Container (metachris/neo-privnet-with-gas)
- ▶ NEO TestNet Network (http://docs.neo.org/en-us/node/testnet.html)
- ▶ NEO MainNet Network

# NEO Smart Contracts: “Have it your way”

## ► Java

```
import org.neo.smartcontract.framework.SmartContract;

public class ContractAuthentication extends SmartContract {

    static boolean Main(byte[] signature)
    {
        Header header = Blockchain.getHeader(Blockchain.height());
        if (header.timestamp() < 1506933900)
            return false;
        // Paste the public key byte array here
        byte[] b = { 2, -99, 6, 102, 4, -41, 48, -96, -116, 23, 9, 72, -89, -104, -107, 2, -8, -70, -2,
                    96, 60, -21, 105, 105, -93, 103, -80, -113, 17, -61, 7, 20, -85 };
        return verifySignature(b, signature);
    }
}
```

## ► Python

<https://github.com/CityOfZion/python-smart-contract-workshop>

## ► Next slide

```
from boa.interop.Neo.Runtime import Log, Notify
from boa.interop.Neo.Storage import Get, Put, GetContext
def Main():
    context = GetContext()
    # This is the storage key we use in this example
    item_key = 'test-storage-key'
    # Try to get a value for this key from storage
    item_value = Get(context, item_key)
    msg = ["Value read from storage:", item_value]
    Notify(msg)
    if len(item_value) == 0:
        Notify("Storage key not yet set. Setting to 1")
        item_value = 1
    else:
        Notify("Storage key already set. Incrementing by 1")
        item_value += 1
    # Store the new value
    Put(context, item_key, item_value)
    msg = ["New value written into storage:", item_value]
    Notify(msg)
return item_value
```

# Smart Contract Development: NEO or ETH?

Compare/contrast Ethereum and the NEO Blockchain

## Ethereum

- ▶ ETH Smart contract == single object with a simple set of methods and simple types of data
- ▶ ETH is good for
  - ▶ Blockchain version 2.0 Alt tokens
  - ▶ Simple, single entity with only a few methods
- ▶ Beyond that?
  - ▶ Very little future for Ethereum as an Enterprise Application platform
  - ▶ “One trick pony” x 1500

## NEO

- ▶ NEO Smart contract == a program capable of supporting business logic involving dozens of different types of entities
- ▶ Unlimited potential as an Enterprise Application Platform
- ▶ Will drive acquisition of NEO
- ▶ Automatic accumulation of GAS
- ▶ Increased ability to participate in the NEO Smart Economy

The NEO Blockchain is better (superior) for Enterprise Distributed Applications

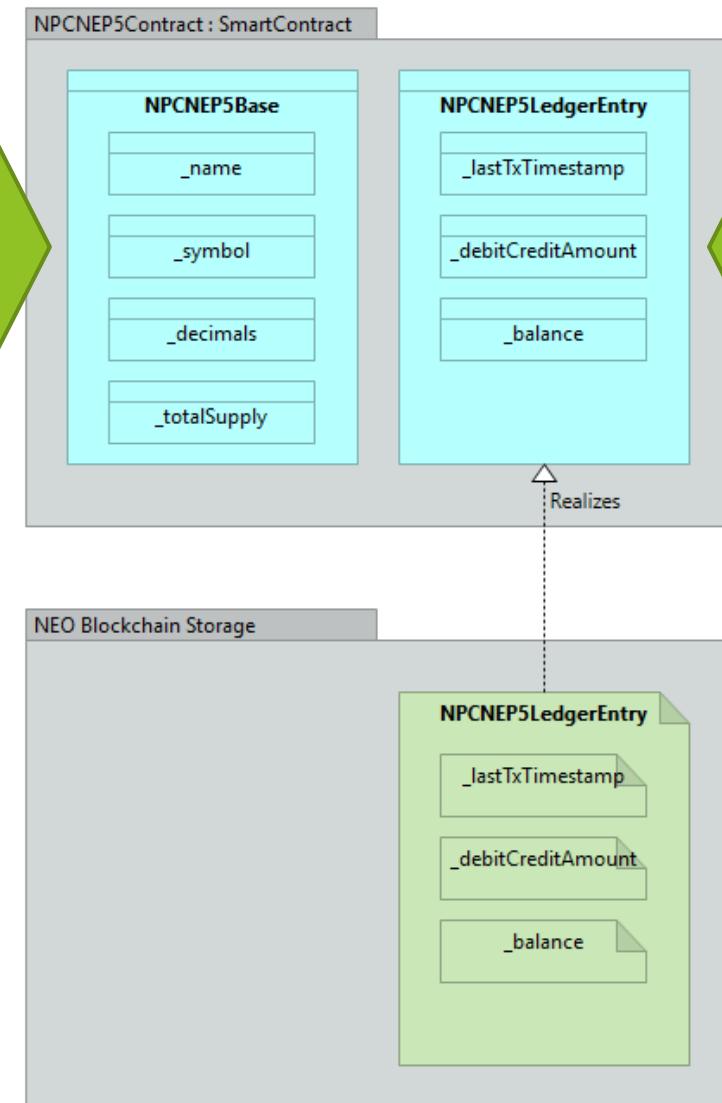
# NEO Persistable Classes (NPC) NEP5 Token

## Reference Implementation

```
namespace NPC.mwherman2000.NPCNEP5Token1.Model
{
    public interface NPCLevel0Basic { }
    public interface NPCLevel1Managed { }
    public interface NPCLevel2Persistable { }
    public interface NPCLevel3Deletable { }
    public interface NPCLevel4Collectible { }
    public interface NPCLevel4CollectibleExt { }

    public interface NPCLevel0CustomMethods { }
    public interface NPCLevel1CustomMethods { }
    public interface NPCLevel2CustomMethods { }
    public interface NPCLevel3CustomMethods { }
    public interface NPCLevel4CustomMethods { }

    public class NPCNEP5Base : NPCLevel0Basic,
                                NPCLevel1Managed
    {
        public string name;
        public string symbol;
        public Int32 decimals;
        public BigInteger totalSupply;
    }
}
```



```
namespace NPC.mwherman2000.NPCNEP5Token1.Model
{
    public partial class NPCNEP5LedgerEntry : NPCLevel0Basic,
                                            NPCLevel1Managed,
                                            NPCLevel2Persistable
    {
        public BigInteger lastTxTimestamp;
        public BigInteger debitCreditAmount;
        public BigInteger balance;
    }
}
```

# 9. Smart Contract Development using Entities

NEO is much more than a key-value data store: Smart Data

# NeoDraw - NEO Multi-Person Shared Whiteboard dApp

## NEO Blockchain as an Enterprise Application Platform



- ▶ NeoDraw is advanced proof-of-concept distributed application (dApp) for the NEO Persistable Classes (NPC) Entity-based dApp (e-dApp) Platform running on the NEO Blockchain.
- ▶ Uses 3 entities
  - ▶ UserCredentials
    - ▶ User name and User Password
  - ▶ UserPoint
    - ▶ Array of (X,Y) coordinates/user
  - ▶ NeoCounter
    - ▶ Tracks number points/user

# NeoDraw - NEO Multi-Person Shared Whiteboard dApp

## NEO Blockchain as an Enterprise Application Platform

```
UserCredentials.cs  ✎ X  UserPoint.cs  ✎ X  NeoCounter.cs  ✎ X
C# NPC.dApps.NeoDraw  C# NPC.dApps.NeoDraw  C# NPC.dApps.NeoDraw  ▾ C# NPC.dApps.NeoDraw.NeoCounter
1  namespace NPC.dApps.NeoDraw
2  {
3      public class UserCredentials
4      {
5          public string Username { get; set; }
6          public string Password { get; set; }
7          public string Email { get; set; }
8          public string Nickname { get; set; }
9          public string Bio { get; set; }
10         public string Avatar { get; set; }
11         public string LastSeen { get; set; }
12         public string LastActivity { get; set; }
13         public string LastIP { get; set; }
14         public string LastDevice { get; set; }
15     }
16 }
```

```
1  using System;
2  using System.Collections.Generic;
3  using System.Linq;
4  using System.Text;
5  using System.Threading.Tasks;
6  using System.Numerics;
7
8  namespace NPC.dApps.NeoDraw
9  {
10     public partial class NeoCounter : NPCLevel0Basic,
11                                 NPCLevel1Managed,
12                                 NPCLevel2Persistable,
13                                 NPCLevel3Deleteable,
14                                 NPCLevel4Collectible,
15                                 NPCLevel4CollectibleExt
16     {
17         public BigInteger currentNumber; // Next number to give out
18     }
19 }
```

```
20
21
22     {
23         public byte[] encodedUsername;
24         public byte[] encodedPassword;
25     }
26 }
```

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4/3/2018

87

# NPC Layered Functionality

## Level 0 Basic

- ▶ Basic class definition with no supporting methods

## Level 1 Managed

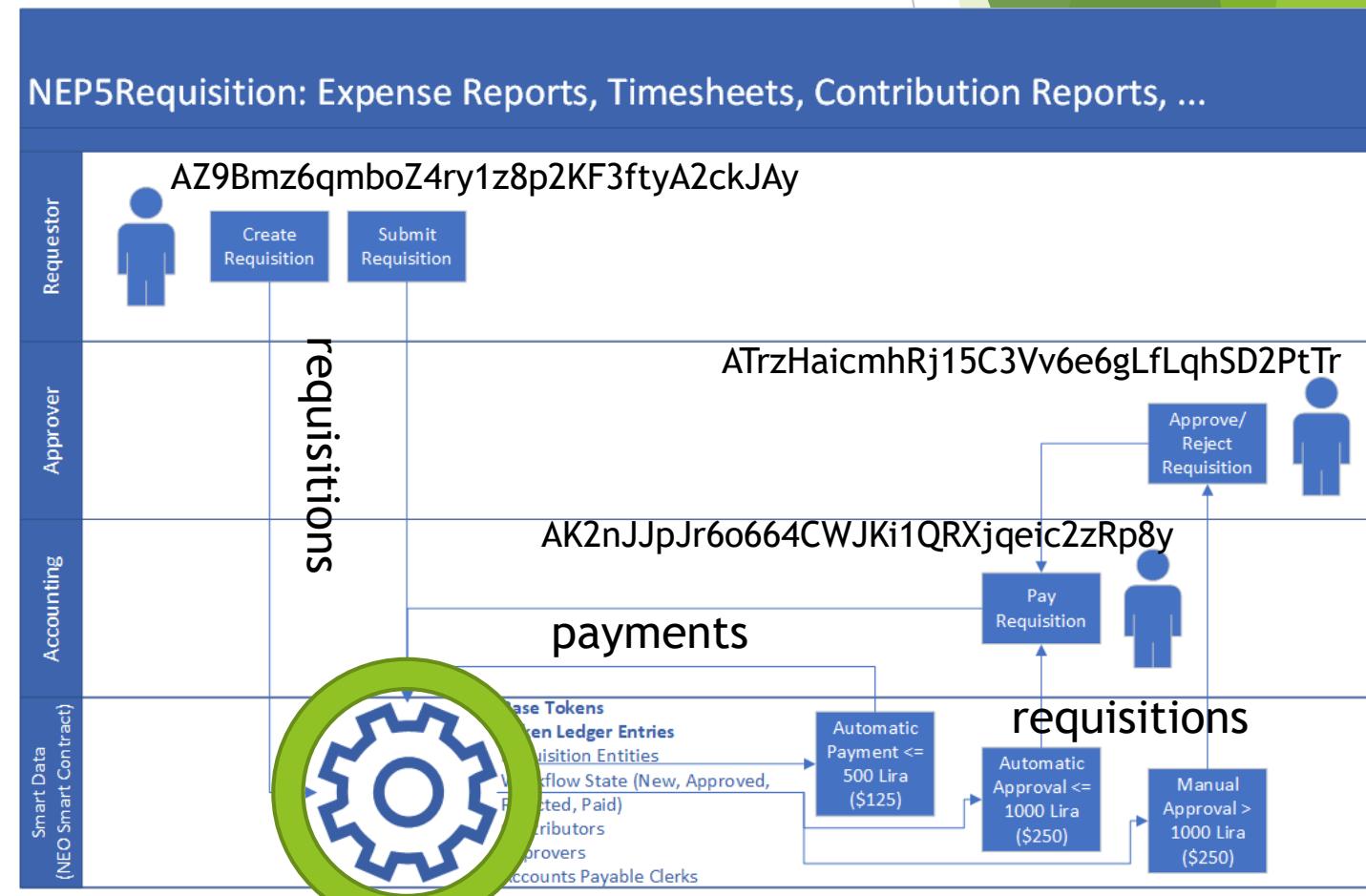
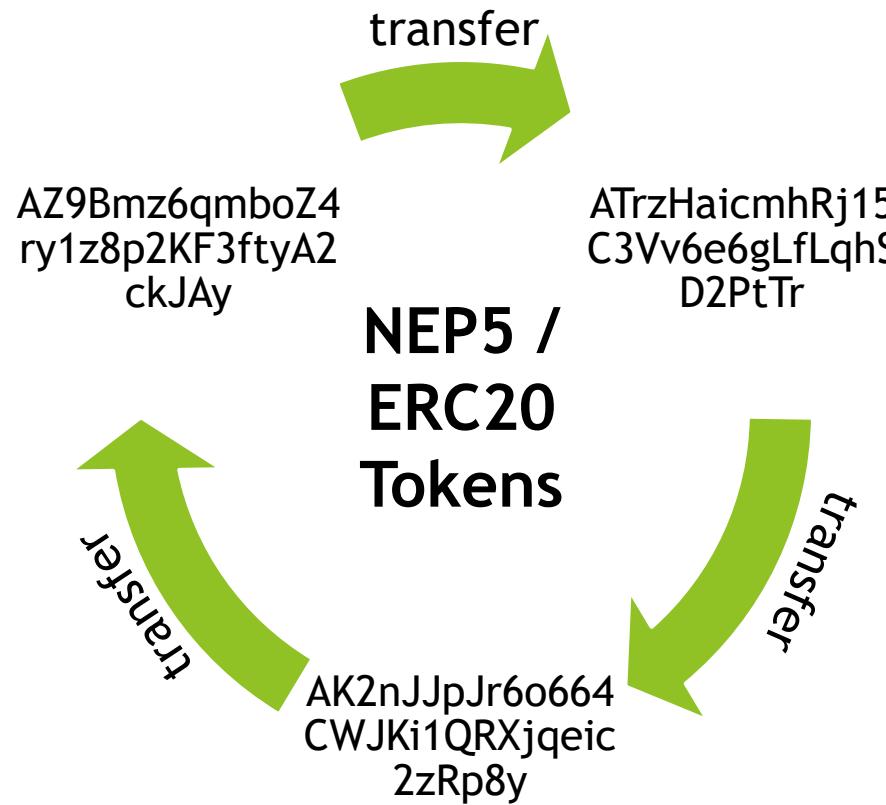
- ▶ `New()`
- ▶ `New(...)`
- ▶ `Null()`
- ▶ `IsNull(e)`
- ▶ `Set(e, ...)`
- ▶ `Setfieldname(e, value)`
- ▶ `Getfieldname(e)`
- ▶ `Log("label", e)`

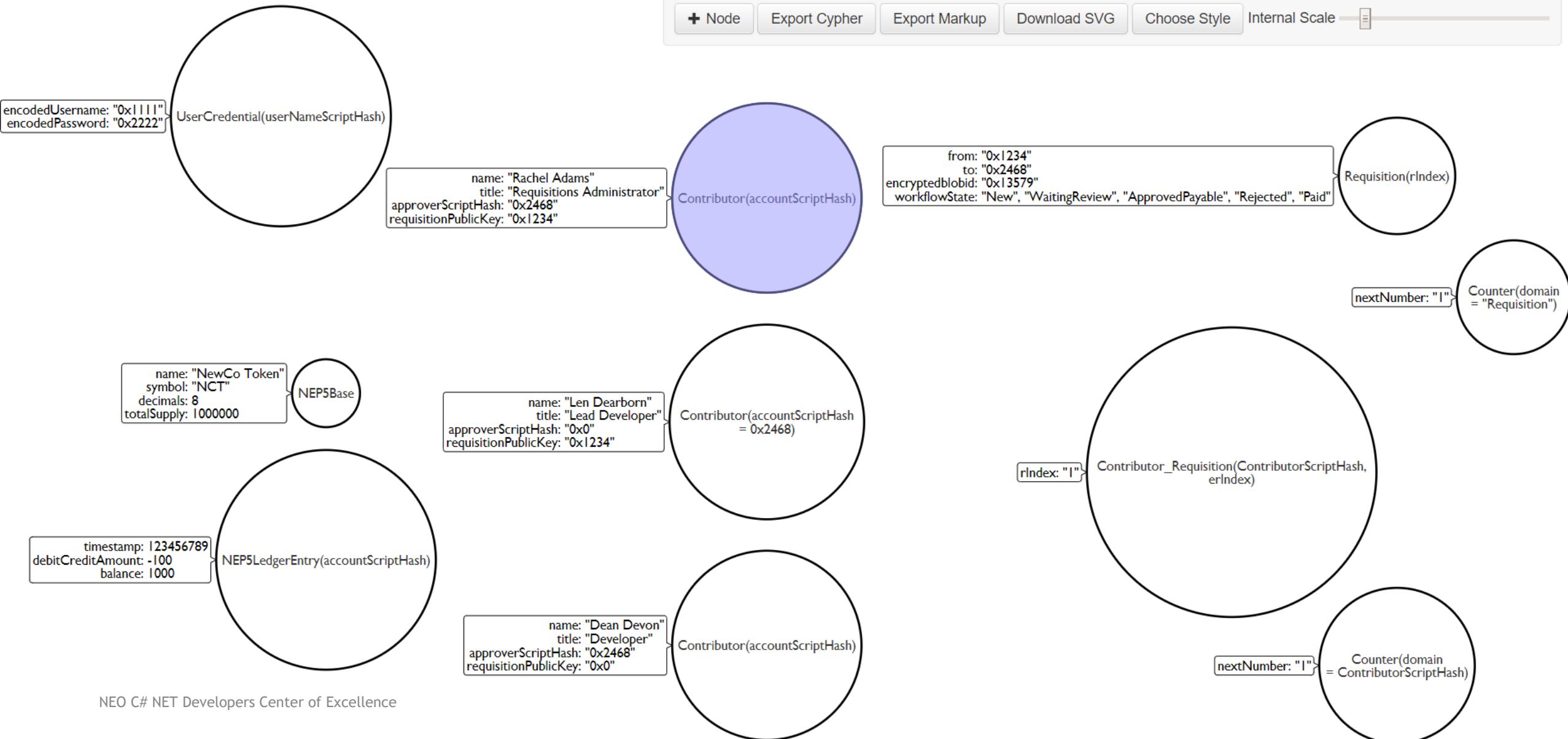
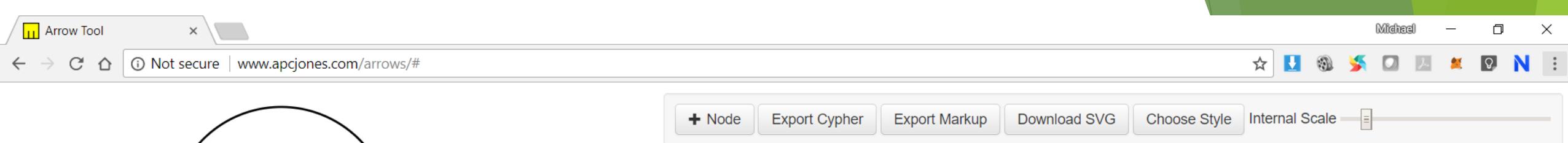
## Level 2 Persistable

- ▶ `Missing()`
- ▶ `IsMissing(e)`
- ▶ `Put(e, string key)`
- ▶ `Put(e, byte[] key)`
- ▶ `Get(string key)`
- ▶ `Get(byte[] key)`

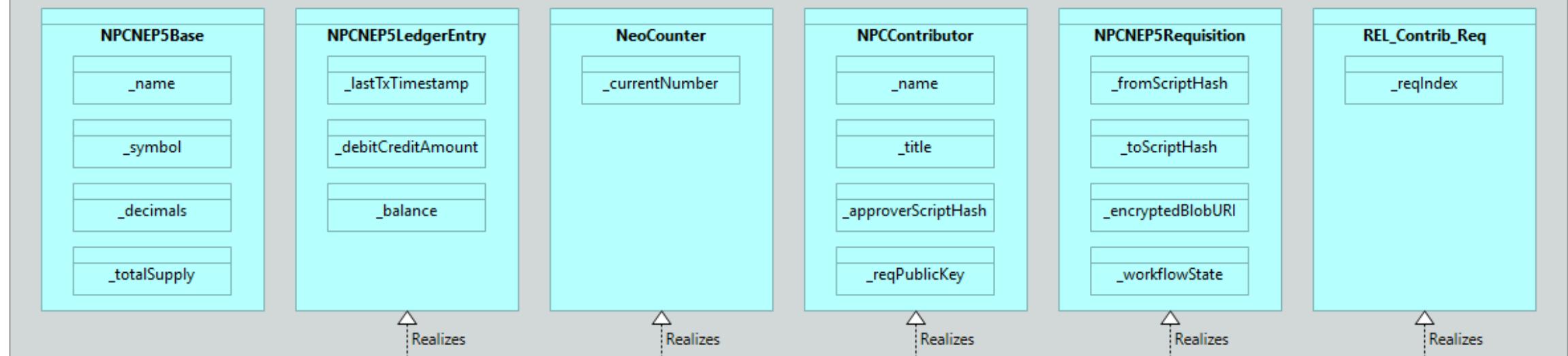
# Think Deeply about the NEO Smart Economy

“Future world where the boundary between real assets in the physical world and digital assets in the digital world has been removed.”

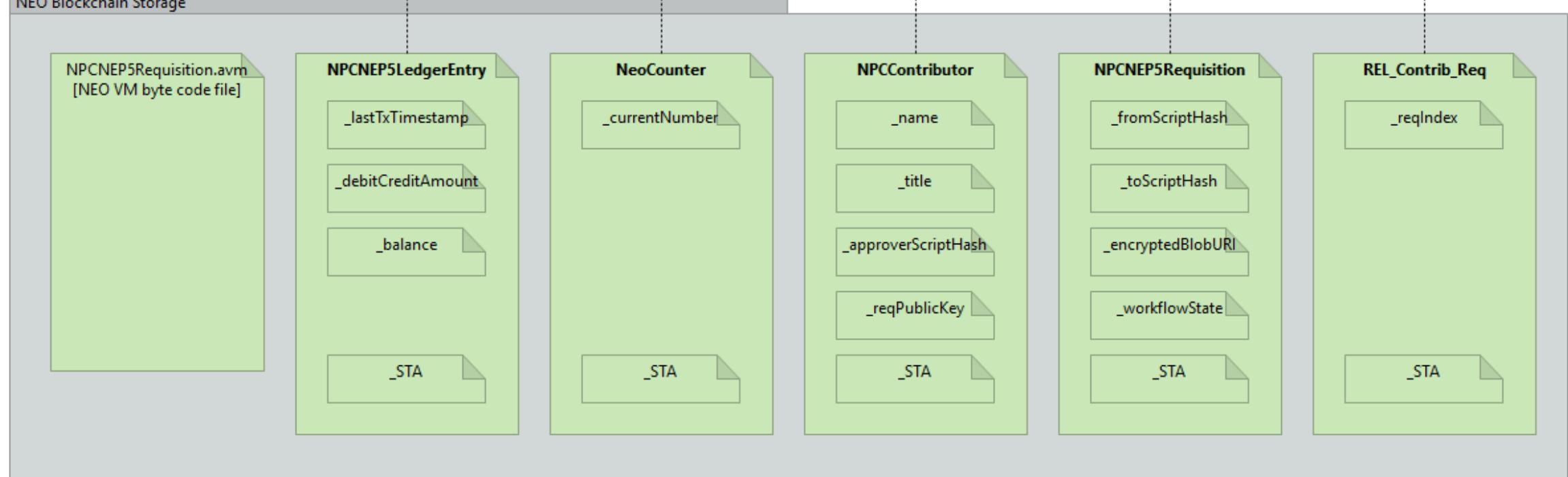




## NPCNEP5Contract : SmartContract



## NEO Blockchain Storage



# 10. NEO Evidence

# NEO Events



Second Wednesday evening of each month



NEO C#/.NET Developers Center of Excellence

HackCU Episode IV · University of Colorado Boulder  
600 Hackers · 24 Hours · February 24th and 25th 2018



# NEO Events (con't)



Second Thursday evening of each month



1 Week \$NEO Wallet Design Challenge!

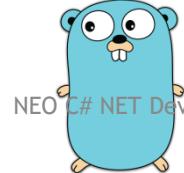
I will select 3 designs to each win 5 GAS.

- 1) Create a UI & UX Design for a slick NEO Wallet for desktop.
- 2) Email your submission to challenge@dean.press
- 3) Submission deadline is March 7th.
- 4) Winners announced within a few days.

Good luck! 🎉



# NEO dApp Competitions ~USD\$500K in prizes



NEO C# .NET Developers Center of Excellence

# 1st NEO Dev Competition

Nov. 20, 2017 - Mar. 31, 2018



The background features a dark, abstract network graph with glowing nodes and lines, symbolizing a decentralized or interconnected system.

 **NEO**  
smart economy

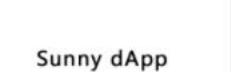
 Microsoft

CITY OF ZION IS LAUNCHING ITS SECOND

# DAPPS COMPETITION

And we want you to get involved

The City of Zion council is promoting a decentralised apps (dApps) competition to further elevate the NEO developer community.

 <b>NEX</b> by The NEX Team NEX combines the NEO blockchain with an off-chain matching engine to enable much faster and more complex trades than existing decentralized exchanges. <a href="#">Website</a> <a href="#">Whitepaper</a> <a href="#">Twitter</a> <a href="#">LinkedIn</a> <a href="#">Medium</a>	 <b>Moonlight</b> by The Moonlight Team Moonlight is a distributed workforce and analytical project management platform featuring a global public ledger of contributor work experience and a new match-making algorithm to effectively fulfill project needs. <a href="#">Website</a>	 <b>Red Pulse</b> by Red Pulse Red Pulse Tokens (RPX) are NEO tokens issued by Red Pulse, an event-driven research firm covering market events impacting Chinese companies, sectors and the overall economy. <a href="#">Website</a> <a href="#">Reddit</a> <a href="#">Contract</a>	 <b>AdEx</b> by adexnetwork AdEx is a decentralized ad exchange built on the blockchain and smart contracts. The core feature of AdEx will be the so-called AdEx User Profile - a personalized page that allows every end user to understand and control the ads delivered to them. <a href="#">Website</a> <a href="#">Medium</a> <a href="#">Facebook</a> <a href="#">Telegram</a> <a href="#">Twitter</a> <a href="#">Reddit</a>	 <b>NeoAuth</b> by @NeoAuth NeoAuth enables authentication over the NEO blockchain, allowing you to log in with a NEO address instead of an email and password. <a href="#">Website</a> <a href="#">Demo</a> <a href="#">GitHub</a> <a href="#">Whitepaper</a>	 <b>ZEEPIN</b> by ZEEPIN The Distributed Creative New Economy. ZEEPIN, a decentralized innovation community, is dedicated to promoting highly efficient circulation of innovation assets. Smart work. Creative life! <a href="#">Website</a> <a href="#">Telegram</a> <a href="#">Twitter</a> <a href="#">Facebook</a> <a href="#">Contract</a>	 <b>Qlink</b> by Alkin Li Qlink, developed by Qlink Foundation in Singapore, adopts the blockchain technology and creates a decentralized mobile network for P2Peer WiFi sharing, mobile data converted content distribution, enterprise telecom services and crowd-sourcing base stations (including <a href="#">Medium</a> <a href="#">Page</a> <a href="#">AMA summary</a> <a href="#">Contract</a>	 <b>Neo Smart IoT</b> by halo2328, phattar Control IoT (Internet of Things) devices via Neo smart contracts (first device is an ESP8266). <a href="#">Website</a> <a href="#">GitHub</a> <a href="#">Contract</a>	 <b>imusify</b> by DavidWalters123, geek96, Nikolaj K, metachris imusify is a free, blockchain based, incentivized and decentralized platform for music related digital content such as audio, video, apps, images, and blogging where anyone can join, contribute and get paid \$IMU. <a href="#">Website</a> <a href="#">GitHub</a>
 <b>Chain Line</b> by ruitatechstar Peer-to-peer courier platform. Couriers transport items to fulfill demands and earn courier fees. <a href="#">Website</a> <a href="#">GitHub</a>	 <b>Phantasma</b> by Rytis Phantasma is a platform where the users control their own content, instead of relying in third parties servers. The platform support any kind of transactions between users, e.g. email, chat, files, money transfers. NEO was used for this project due to its fast transactions and C# <a href="#">Demo</a> <a href="#">Website</a> <a href="#">GitHub</a>	 <b>NeoTrade</b> by barmas NeoTrade is a NEP5 trading platform. Inspired by EtherDelta, NeoTrade is a NEO based smart contract that allows users to deposit NEO, GAS or any other NEP-5 asset directly to the smart contract and trade amongst themselves. <a href="#">Website</a> <a href="#">GitHub</a>	 <b>Turing Complete Smart Contract</b> by Nikita K A smart contract which interprets encoded classical Turing machines. <a href="#">Youtube</a> <a href="#">GitHub</a>	 <b>KRYPTON.live</b> by MediaServe KRYPTON is a Smart Contract and ecosystem to provide SIP registration on the NEO blockchain using a KRYPTON compatible SIP provider. <a href="#">Youtube</a> <a href="#">Demo</a> <a href="#">GitHub</a>	 <b>Switcheo</b> by RovenKee, hennyhua, jacyuu Switcheo is a decentralised exchange built on NEO's blockchain. It supports trading of NEP-5 tokens and NEO system assets like GAS & NEO. It aims to be a truly decentralised exchange while still providing for a super user experience. <a href="#">Youtube</a> <a href="#">Website</a> <a href="#">GitHub</a>	 <b>Trip Shares</b> by xtalia Trip sharing with deposits. Travellers commit to a shared seat by depositing \$TRS NEP-5 tokens, which are used as insurance when the passenger cancels the trip after a set date. <a href="#">Website</a> <a href="#">GitHub</a>	 <b>BlockSaver</b> by impravice, monica Saving smart contract, with interests and fines. You can define how long to lock NEO and GAS assets, the smart contract defines an interest rate, and the system has a penalty for early withdrawal. <a href="#">GitHub</a>	 <b>Lucky NEO</b> by miroslavc, licorng, StefanDobach, WallyLeung, tammerman Lucky NEO allows anyone to send their extra gas to a raffle contest. One winner will be chosen every two weeks and automatically paid out. Lucky NEO uses an admin account to automatically pay out the winner to the address that sent the funds; so you don't have to follow <a href="#">Post</a> <a href="#">GitHub</a>
 <b>Neo Fund</b> by nickzq Neo Fund is a decentralised crowdfunding platform similar to Kickstarter. The basic function is to set a goal amount, and date limit. If the goal is reached the creator of the fund will be awarded the funds, and if not the contributors can redeem their funds again. <a href="#">GitHub</a>	 <b>Neo Raffle</b> by amarthu A smart contract that enables a raffle/lottery on the Neo blockchain. Send GAS, win GAS! This project also demonstrates a solid way to use random numbers in a smart contract <a href="#">Website</a> <a href="#">GitHub</a>	 <b>NepSwap</b> by block_sharan Protocol and smart contract for trading NEP-5 based assets.NepSwap is a protocol and smart contract for trading NEP-5 assets. This prototype idea is based on Etherdelta and Bancor. It doesn't have a personal token or ICO, this project is intended for community, and <a href="#">GitHub</a>	 <b>Smart Promise</b> by SergeyAntonenko, marilyona Smart Promise is an electronic journal of smart promises developed through Blockchain. User of such an environment receives a reward for each of his fulfilled promises. The concept of the idea contains the possibility to get a strong motivation to action that user pointed in <a href="#">Youtube</a> <a href="#">Website</a> <a href="#">GitHub</a> <a href="#">Whitepaper</a>	 <b>Sunny dApp</b> by JonhundreBerg This dApp allows you to insure against bad weather conditions on a given day. If the relative sunshine duration on that day is lower than 50 percent, you get paid. <a href="#">Website</a> <a href="#">GitHub</a>	 <b>NEO Name Service</b> by NewEconoLab(NEL) Distributed domain name service ending with .neo based on NEO blockchain <a href="#">Website</a> <a href="#">GitHub</a>	 <b>THEKEY</b> by THEKEY team THEKEY is a Decentralized Ecosystem of Identity Verification Tool Using National Big-data and Blockchain. THEKEY Project Team is now developing an identification verification (IDV) tool with blockchain based dynamic multi-dimension <a href="#">Website</a> <a href="#">GitHub</a> <a href="#">telegram</a> <a href="#">facebook</a> <a href="#">twitter</a> <a href="#">Contract</a>	 <b>蓝鲸淘</b> by 中·科技 蓝鲸淘智能资产去中心化管理平台，通过开源的区块链技术与智能合约规则，为用户提供点对点、无中介的数字资产流转服务，降低数字资产流转过程中的使用成本。 <a href="#">Website</a> <a href="#">GitHub</a>	 <b>TRINITY</b> by Trinity team Trinity is applicable to blockchain transfer of NEP-5 standard tokens. As a Neo-version lightning network, Trinity achieves real-time performance, low transaction fees, scalability, and privacy protection of Neo mainnet assets through state channels <a href="#">website</a> <a href="#">GitHub</a> <a href="#">telegram</a> <a href="#">twitter</a> <a href="#">Contract</a>
 <b>GAME.FUND</b> Developers Center of Excellence	 <b>CONCIERGE</b>	 <b>Damn Single</b>	 <b>AISC</b> AI SMART CONTRACT	 <b>ORBIS</b>	 <b>NARRATIVE</b>	 <b>Aphelion</b>	 <b>Blockchain Store</b>	 <b>Bridge Protocol</b>

# Where We Are: Weiss Ratings

Press Esc to exit full screen

**A: Excellent**  
(0)



**B: Good**  
(5)

- Ethereum
- EOS
- **NEO**
- Cardano
- Steem

**C: Fair**  
(59)

- Bitcoin
- Bitcoin Cash
- Ripple
- Litecoin
- Qtum

**D: Weak**  
(18)

- Bitcoin Gold
- Metaverse

**Weiss**  
**Ratings**

Independent. Unbiased. Accurate. Trusted.

**Risk** - price volatility**Reward** - return fluctuations**Technology** - infrastructure and flexibility**Fundamentals** - currency specific factors, market, and public support

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# NEO News: Switchers

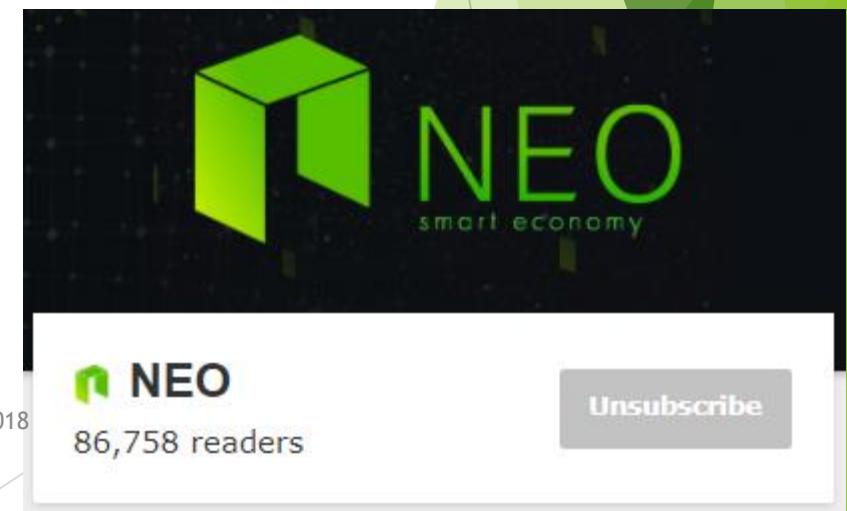
- ▶ [QTUM to NEO] THEKEY, a Decentralized Ecosystem of Identity Verification Tool Using National Big-data and [NEO] Blockchain  
[https://www.reddit.com/r/NEO/comments/7areac/ama\\_on\\_9th\\_nov\\_thekey\\_a\\_decentralized\\_ecosystem/](https://www.reddit.com/r/NEO/comments/7areac/ama_on_9th_nov_thekey_a_decentralized_ecosystem/)
- ▶ [ETH to NEO] Guardian Circle announce switch to NEO platform  
<https://neonewstoday.com/general/guardium-announce-switch-to-neo-platform/>  
*“...the more we dug into NEO, the more we realized that they had really great answers to every one of our concerns with Ethereum and many additional benefits that are unique to the NEO ecosystem.”*
- ▶ [ETH to NEO] Narrative project: Big News: KYC and Our Switch to NEO  
<https://blog.narrative.network/big-news-kyc-and-our-switch-to-neo-2f34215beef9>
- ▶ [ETH to NEO] Concierge.io NEO Token Sale  
<https://medium.com/@concierge.io/concierge-io-neo-token-sale-f870a0a27b04>
- ▶ [ETH to NEO] IMPORTANT NEWS FOR THE WOWOO COMMUNITY  
[http://wooonet.com/news.html#news\\_2018\\_6](http://wooonet.com/news.html#news_2018_6)
- ▶ [ETH to NEO] Three things to consider when choosing a blockchain for your project—or why Veris chose NEO.  
<https://medium.com/verisfoundation/three-things-to-consider-when-choosing-a-blockchain-for-your-project-or-why-veris-chose-neo-b4483135c382>
- ▶ [Blockchain agnostic strategy] Jibrel Network founder looking to switch from Ethereum to NEO  
<https://imgur.com/oHYTYi2>



# 11. Resources

# NEO Resources: Videos and Webcasts

- ▶ The New Vision - Da Hongfei  
<https://www.youtube.com/watch?v=th7jZlmoZBc>
- ▶ Malcolm Lerider: Clarification on NEO, GAS and Consensus Nodes  
<https://www.youtube.com/watch?v=iV4WREWtCil>
- ▶ A Deep Dive into NeoVM & NeoContract [English Subtitles]  
<https://www.youtube.com/watch?v=fLppte-guYE>
- ▶ NEO Persistable Classes (NPC) e-dApp Smart Contract Platform 2.0: Deep Dive  
<https://www.youtube.com/watch?v=Nj4-m2o94VE>
- ▶ NEO - Reddit  
<https://www.reddit.com/r/NEO/>



# NEO Resources: NEO DevCon 1, January 2018

- ▶ The New Vision - Da Hongfei | NEO DevCon 1  
<https://www.youtube.com/watch?v=th7jZlmoZBc>
- ▶ Opening Address - Scott Hunter, Microsoft | NEO DevCon 1  
<https://www.youtube.com/watch?v=ZFsu5HPU2xM>
- ▶ Ontology, The Technical Vision of Distributed Trust Networks | NEO DevCon 1  
<https://www.youtube.com/watch?v=QyaZz0vtONs>
- ▶ Imusify, Decentralized Platform for Music Related Digital Content | NEO DevCon 1  
<https://www.youtube.com/watch?v=dgmfO8nKJkE>
- ▶ NeoAuth, Login Using the NEO Blockchain | NEO DevCon 1  
<https://www.youtube.com/watch?v=F7teukbcblg>
- ▶ Phantasma, User-Owned Content | NEO DevCon 1  
<https://www.youtube.com/watch?v=cinexz6gjsU>
- ▶ NEO•ONE, Development Framework | NEO DevCon 1  
<https://www.youtube.com/watch?v=yWzjNhiZFmA>
- ▶ THEKEY, A Decentralized Ecosystem of An Identity Verification Tool | NEO DevCon 1  
<https://www.youtube.com/watch?v=St-UW0lPB7o>
- ▶ NEO's Global Vision and the Evolving Regulatory Environment - Miles Graham | NEO DevCon 1  
<https://www.youtube.com/watch?v=FidRGNeab3I>
- ▶ NEX, Decentralized Exchanges | NEO DevCon 1  
<https://www.youtube.com/watch?v=1005ed20e0Q>

# NEO Resources

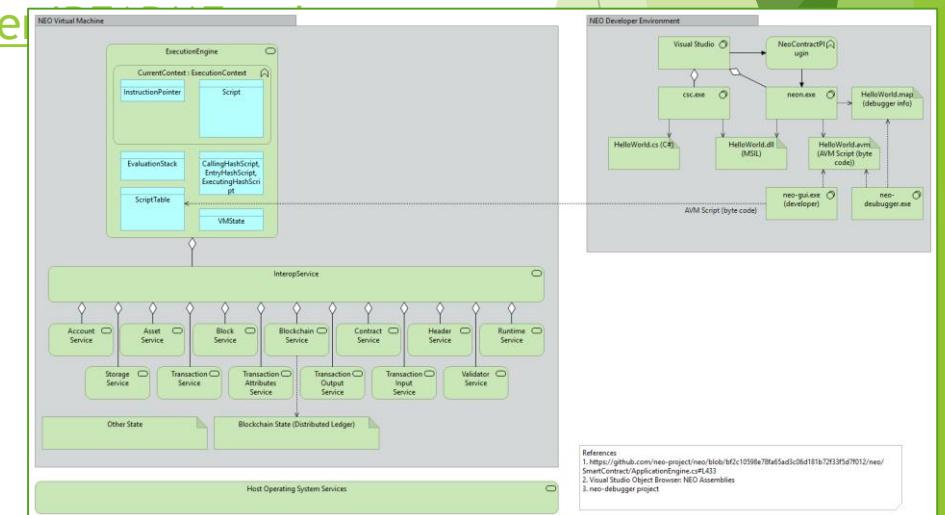
## General

- ▶ NEO.org  
<http://neo.org>
- ▶ NEO Tutorials (C#, Java, Python), API docs  
<http://docs.neo.org>
- ▶ NEO DevCon “The New Vision” Keynote by NEO Founder  
[https://www.youtube.com/watch?time\\_continue=3&v=th7jZlmoZBc](https://www.youtube.com/watch?time_continue=3&v=th7jZlmoZBc)



## Developers

- ▶ N NEO C# Developers Center of Excellence (neo-csharpcoe)  
<https://github.com/mwherman2000/neo-csharpcoe/blob/master/>
- ▶ Discord NEO Community (like Slack)  
<https://discord.gg/gqCYeup>
- ▶ The NEO Project  
<https://github.com/neo-project>
- ▶ City of Zion awesome-neo project: Developer Docs  
<https://github.com/CityOfZion/awesome-neo/#developer-documentation>



NEO C# .NET Developers Center of Excellence

# NEO Blockchain C# Developers Center of Excellence

<https://github.com/mwherman2000/neo-csharpcoe>

- ▶ Founder: Michael Herman ([neotoronto@outlook.com](mailto:neotoronto@outlook.com))
- ▶ NEO Blockchain end-to-end, detailed guidance for .NET developers
- ▶ Content purposely designed to help .NET developers ramp up and become productive more quickly
- ▶ Repository for content presented at the NEO C# NET Developers Center of Excellence meetup group
- ▶ Contents
  - ▶ NEO Blockchain Quick Start Guide for .NET Developers  
<https://github.com/mwherman2000/neo-dotnetquickstart>
  - ▶ NEO Blockchain Architecture Reference Model (ARM) for .NET Developers (neo-charm)  
<https://github.com/mwherman2000/neo-charm>
  - ▶ NEO C# NET Developers Center of Excellence  
<https://github.com/mwherman2000/neo-windocs/tree/master/events/2018-neo-blockchain-toronto>

# NEO Blockchain Quick Start Guide for .NET Developers

<https://github.com/mwherman2000/neo-dotnetquickstart/blob/master/README.md>

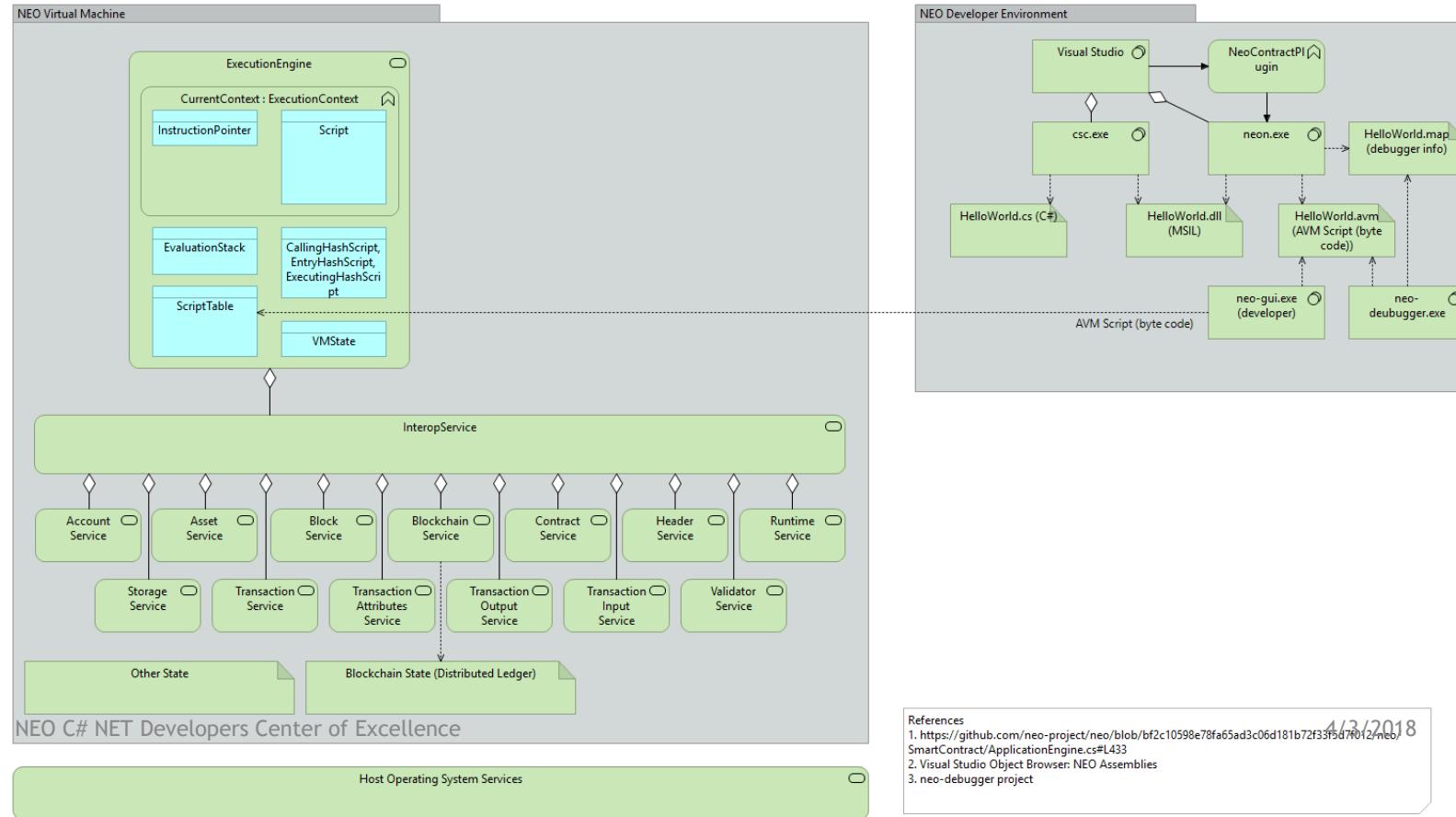
1. Pre-requisites and Recommendations
  2. Download and install Visual Studio 2017 Community Edition integrated development environment (IDE)
  3. Download and unpack NEO developer tool projects (source)
  4. Coffee time: Wait for previous activities to complete
  5. Install NeoContractPlugin Visual Studio extension
  6. Build and test NEO developer tool projects (from source)
  7. Download, install, and test Docker platform
  8. Download and test NEO privatenet Docker container
  9. Create and compile HelloWorld smart contract sample
  10. Deploy and test the HelloWorld smart contract
  11. Celebrate
- ▶ Appendix A - Checklist
  - ▶ Appendix B - Roadmap
  - ▶ Appendix C - Reset NEO privatenet Environment: Container, Wallets, and Clients

## Statistics

- ▶ 10 activities comprising 130 documented tasks (approximately)
- ▶ 140 screen shots (approximately)
- ▶ 7 batch files
- ▶ 2 JSON configuration files
- ▶ 1 C# code snippet

# NEO Blockchain Architecture Reference Model (ARM) for .NET Developers (neo-charm)

<https://github.com/mwherman2000/neo-charm/blob/master/README.md>





## Global Blockchain Compliance Hub

[Legal Disclaimer](#)

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[GERMANY](#)

[GIBRALTAR](#)

[HONG KONG](#)

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NEO C# .NET Developers Center of Excellence

[THE ISLE OF MAN](#)

### Welcome!

You've come to NEO's Global Blockchain Compliance Hub, an ongoing project aimed at compiling a public Github database that includes legal details related to blockchain and cryptocurrency for as many jurisdictions as possible worldwide. We're hoping this can become a community-driven community resource that will help folks interested in starting their own NEO-based blockchain projects think about regulation as they move towards the point where they'd need to actually seek counsel. We're undertaking this project because NEO is committed to compliant and sustainable growth, and we believe this sort of resouce is currently lacking.

If you're interested in contributing (by either updating a country page or creating a new one), please let us know - we're always looking for new partners. You can reach out to [milesgraham@neo.org](mailto:milesgraham@neo.org).

For each jurisdiction, we aim to answer the following information:

1. Non-profit/for-profit company registry requirements
2. Team member nationality requirements
3. Tax & auditing requirements
4. Governing laws/bylaw requirements
5. Laws related to token sales, blockchain, and digital proof
6. Securities-related laws
7. Privacy & data protection-related laws
8. Who bears final responsibility/liability in case something goes wrong?
9. What is a smart contract and is it legally binding?
10. How is dispute resolution integrated?
11. Can smart contracts be nullified?
12. Suggested readings

## 12. Next Steps

# Call to Action - Your Homework

1. Build something interesting on the NEO Blockchain

2. Join Discord

<https://discord.gg/gqCYeup> /  
<https://discord.gg/4TQujHj>

3. Use NEO C# Developers Center of Excellence (neo-csharpcoe)

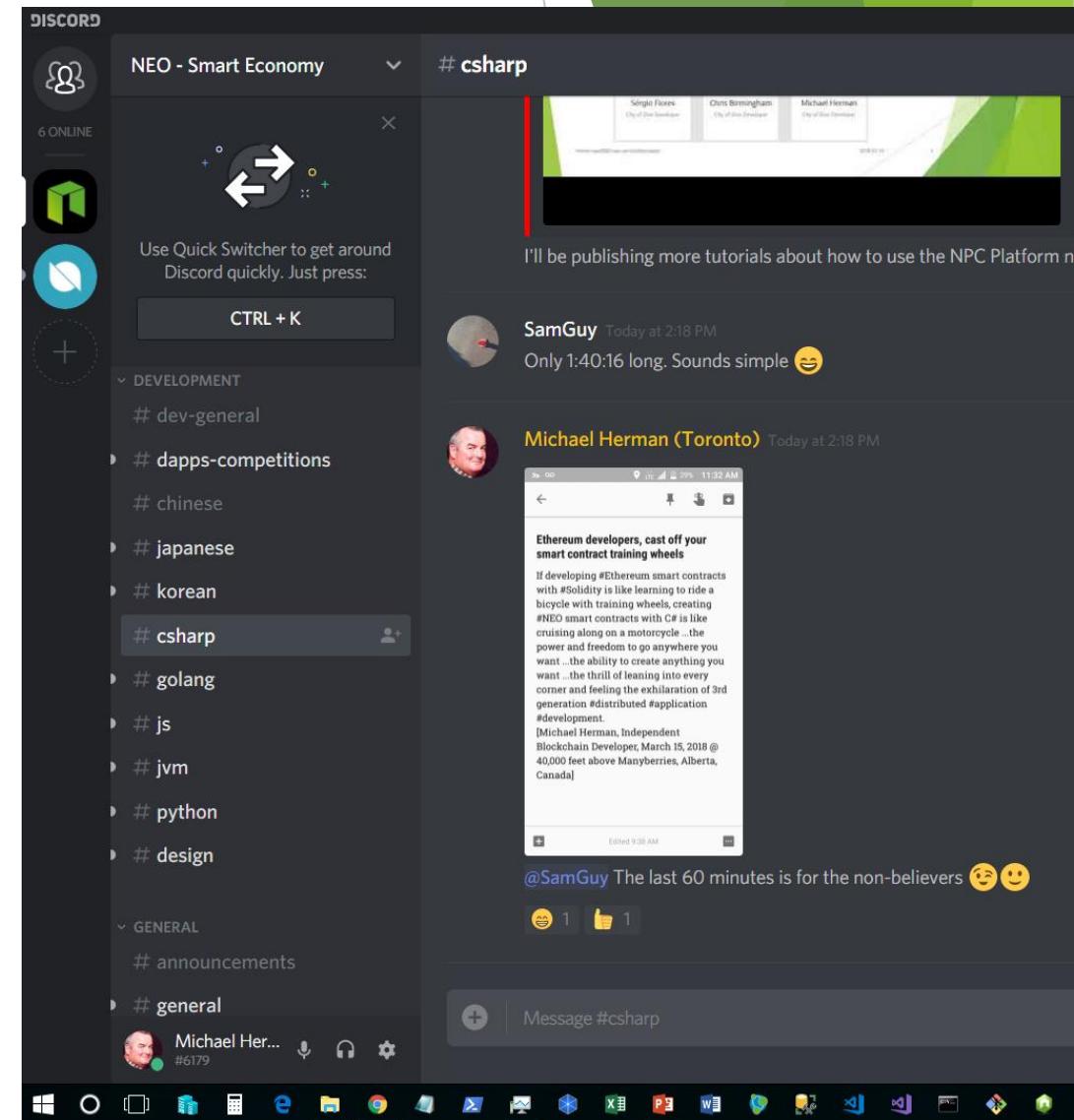
<https://github.com/mwherman2000/neo-csharpcoe/blob/master/README.md>

4. Start with NEO Blockchain Quick Start Guide for .NET Developers

<https://github.com/mwherman2000/neo-dotnetquickstart/blob/master/README.md>

5. Review Workshop for programming smart contracts with .NET, C# and Visual Studio (csharp-smart-contract-workshop)

<https://github.com/mwherman2000/csharp-smart-contract-workshop/blob/master/README.md>



# Reminder: When to use Blockchain Technology

“Blockchain: the force multiplier for the smart economy” [Microsoft]

## Questions to Ask

1. Is it a business process that crosses trust boundaries?
2. Do multiple parties manipulate the same data?
3. Are processes operating inefficiently or decisions delayed due to the number of intermediaries?
4. Does the business process involve low-value, manual verification steps?

## Use a Blockchain when there is a Need for

- ▶ Real-time transparency by connecting business processes across organizations
- ▶ Real-time, transparent access to a verifiable source of the truth across organization boundaries
- ▶ Introduce trust and increase efficiency amongst participants - reducing the need for intermediaries
- ▶ Improved efficiencies and increased confidence through automation and smart contracts that execute consistently.

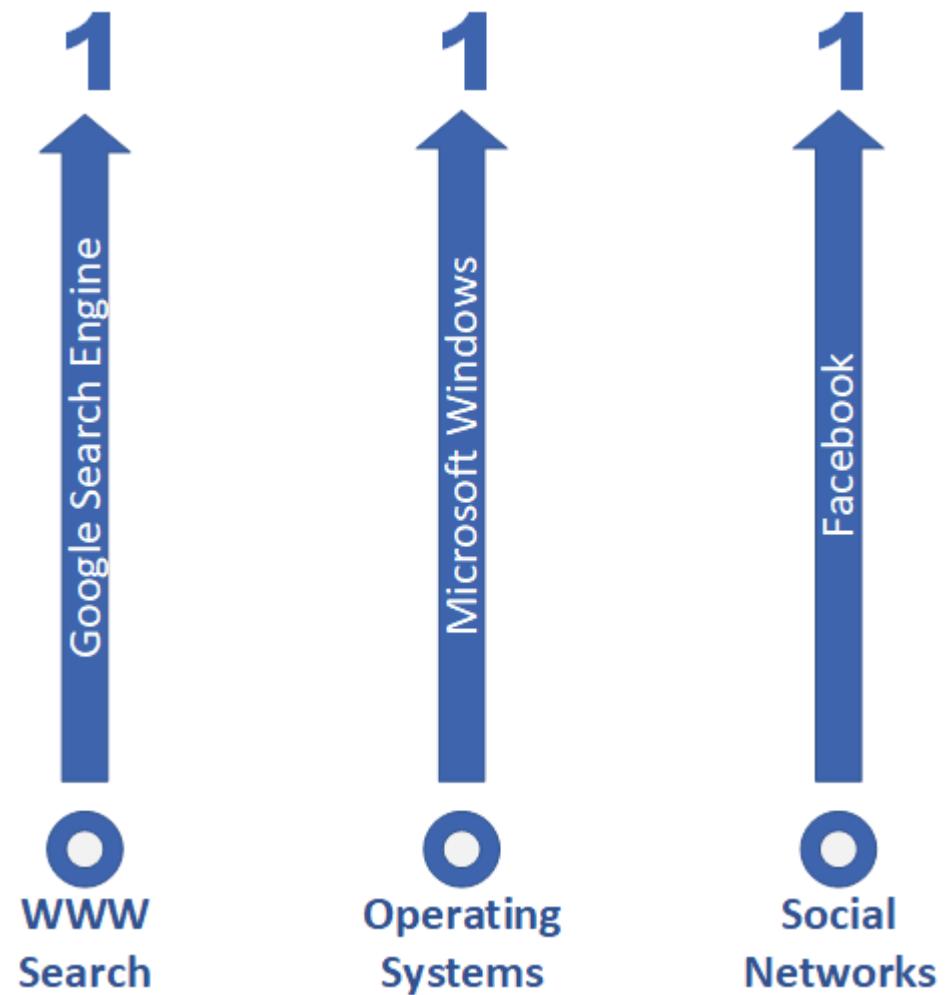
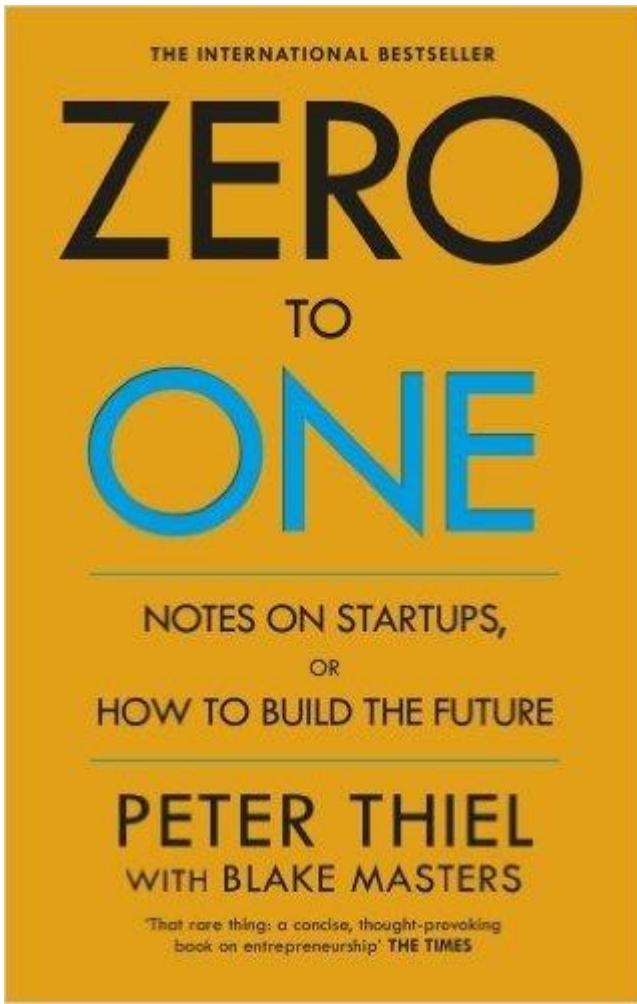
“Use blockchain technology when it matches the requirements of your application. Don’t automatically use blockchain technology simply because you’re re-platforming an existing application.” [Gartner 2018]

# Why is the NEO Blockchain important?

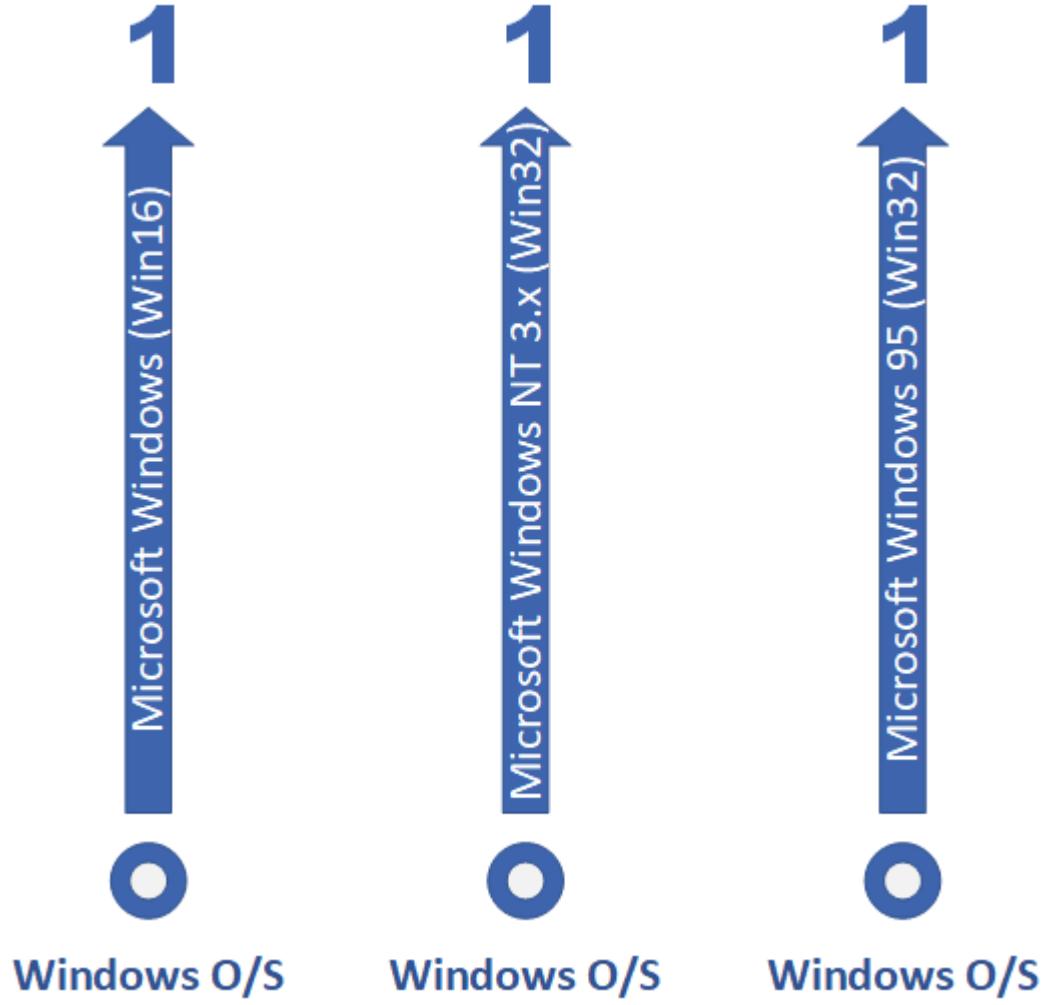
“The NEO Blockchain will as important or more important than Windows for enterprise distributed application development.”

[Michael Herman, March 2018]

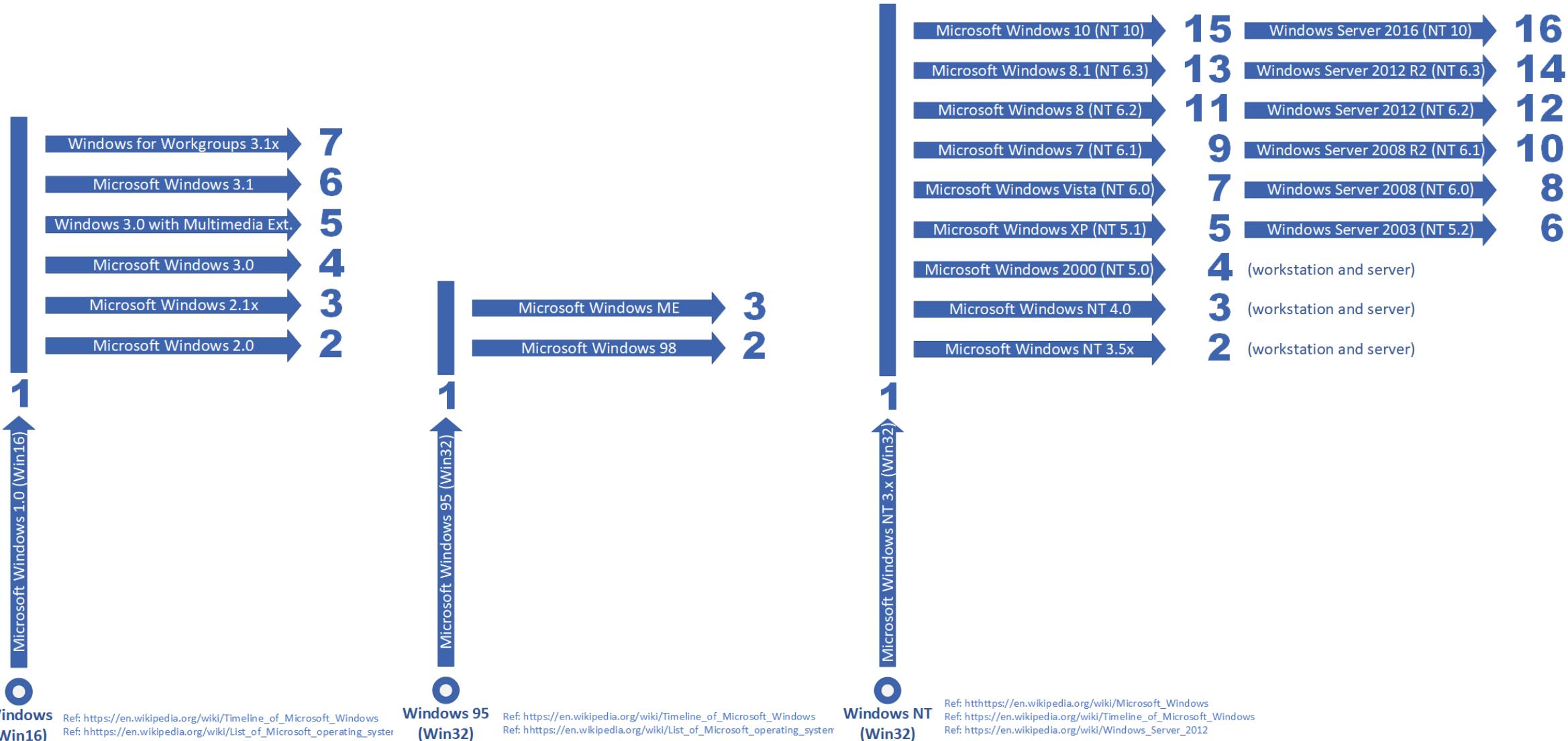
# “Zero to One” by Peter Thiel, Founder of PayPal



# Zero to One: Microsoft Windows



# Zero to One: Microsoft Windows



# Zero to One: NEO Blockchain Platform



1

3<sup>rd</sup> Gen: NEO Blockchain

Blockchain  
Technology  
(Enterprise dApps)

# Questions?

Michael Herman (Toronto) - Independent Blockchain Architect and Developer

E: <mailto:neotoronto@outlook.com>

M: <https://www.meetup.com/NEO-Blockchain-Toronto>

G: <https://github.com/mwherman2000/neo-csharpcoe/tree/master/events>

F: <https://www.facebook.com/neotoronto/>

T: <https://www.twitter.com/neotoronto>

# Backup Slides

# NEO Persistable Classes (NPC) YouTube Channel

[https://www.youtube.com/playlist?list=PLU-rWqHm5p46bIDXPNf4c2JP\\_AOkpnV5](https://www.youtube.com/playlist?list=PLU-rWqHm5p46bIDXPNf4c2JP_AOkpnV5)

The screenshot shows the YouTube channel page for "NEO Persistable Classes (NPC)". The channel has 7 videos and was updated today. The channel art features a green and white design with the text "neo-csharpco Community Blueprint" and "NEO Persistable Classes Platform 2.0". The channel description is: "A Very Efficient Object-Oriented dApp Platform for Global Scale Smart Economy Applications". The channel owner is Michael Herman. The video thumbnails are as follows:

- 1. How to run NPCdApp 1.0 - CoZ dApp Competition #2 [update 4] (13:46)
- 2. 11. Quick Cycle Edit-Compile-Debugging of C#.NEO Smart Contracts (12:29)
- 3. 13. NEO Persistable Classes (NPC) NEP5 Token Template: Preview (Part 1) (37:53)
- 4. 12. NEO Persistable Classes (NPC) Platform 2.1: Preview (35:55)
- 5. NEO Persistable Classes (NPC) Platform 2.0: Deep Dive (1:40:17)
- 6. NEO Persistable Classes 1.0: Deep Dive (Video 2 of 3) [Update 1] (1:24:17)
- 7. 11. Quick Cycle Edit Compile Debugging: Single Stepping and Profiling (26:42)

# Our Values as *Neoxplorers*

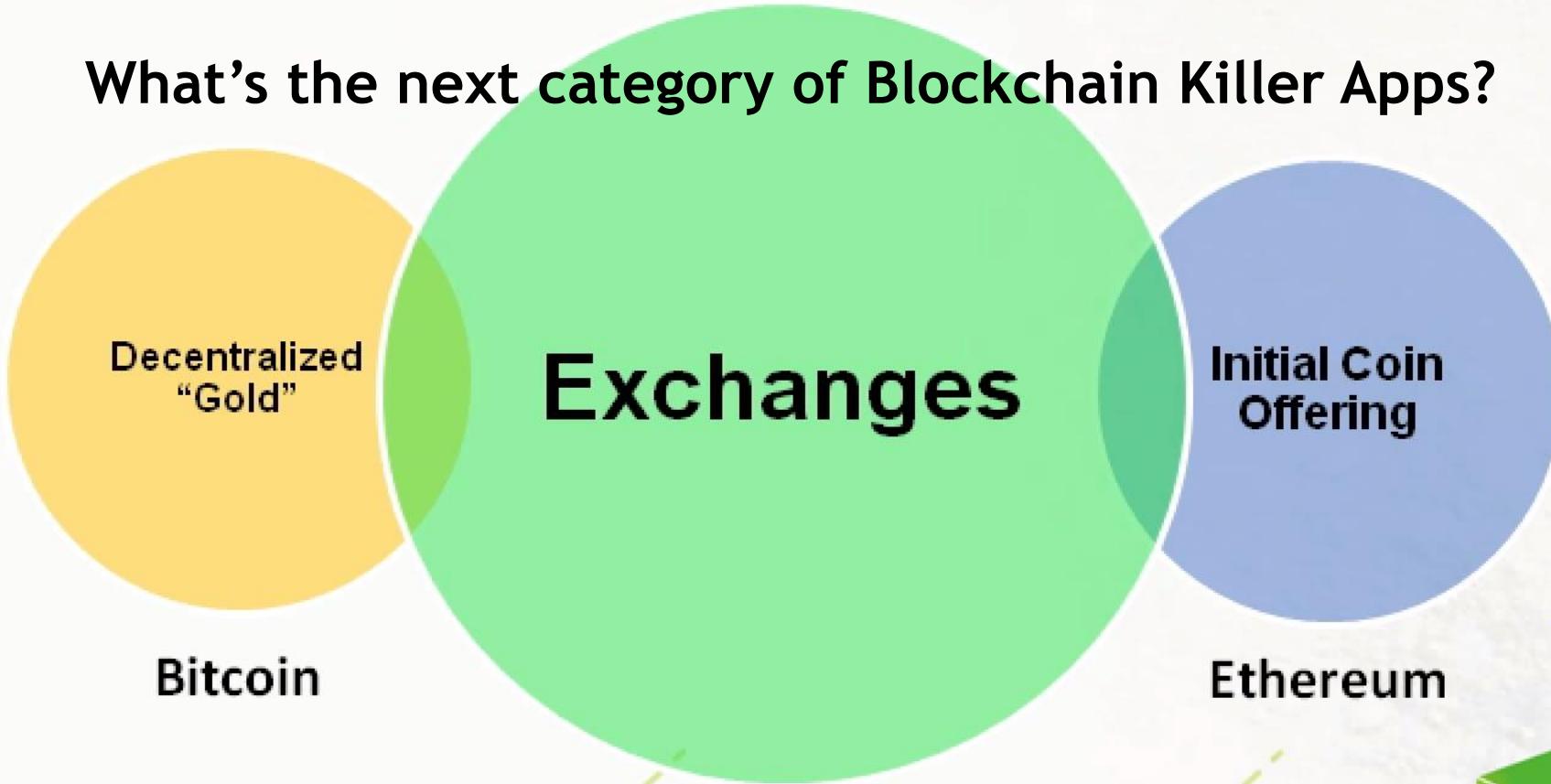
## We operate like the NEO Blockchain

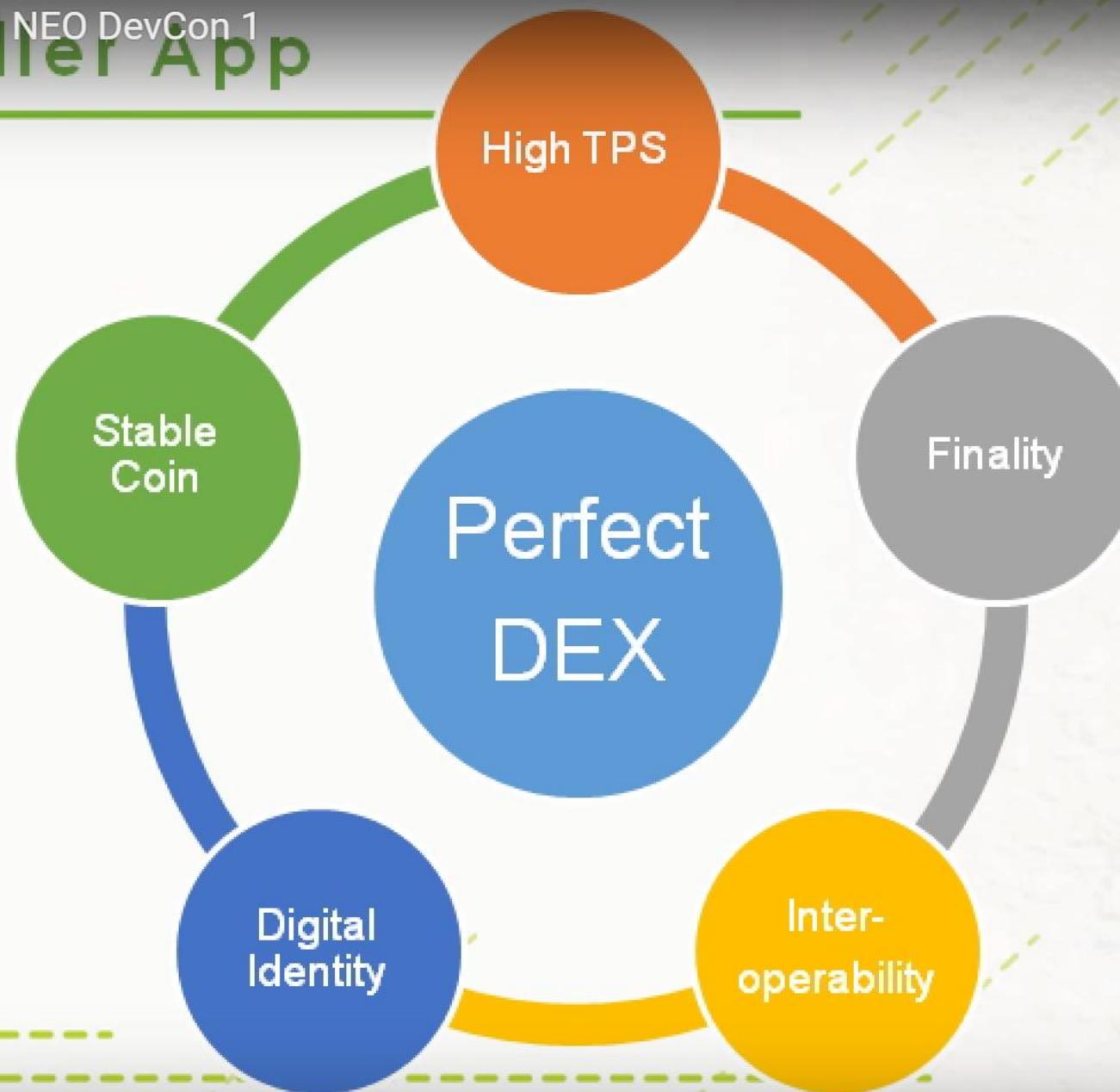
- ▶ Decentralized
- ▶ Community based
- ▶ Consensus driven
- ▶ Creators of value
- ▶ Store of value (knowledge)
- ▶ Transfer of value (training)
- ▶ Multi-disciplinary
- ▶ Multi-application
- ▶ Multi-technology

## We behave like the NEO Blockchain

- ▶ Robust
- ▶ Reliable
- ▶ Transparent
- ▶ Smart
- ▶ Open
- ▶ Non-discriminatory
- ▶ Participatory
- ▶ Diversity
- ▶ Committed

What's the next category of Blockchain Killer Apps?





NEO C# .NET Developers Center of Excellence



WHERE SHOULD  
WE FOCUS  
THIS YEAR?

"BLOCKCHAIN"



IT WILL  
CHANGE  
EVERYTHING.



EVERYBODY  
IS TALKING  
ABOUT IT.



THE POTENTIAL  
APPLICATIONS  
ARE ENDLESS.

WE DON'T  
WANT TO BE  
LEFT BEHIND.

WHAT  
EXACTLY IS  
BLOCKCHAIN?

ALSO,  
"ARTIFICIAL  
INTELLIGENCE"

