

# **Networking to be data centric with trust** -Data Exchange Network utilize blockchain-

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# **Self introduction**





### **Digital transformation**

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# **Communication point of view**

○Three levels of problems in communication by Shannon Weaver (1949)





### Network evolution towards Digital transformation





# Challenges on data exchange





### **Decentralized:** a more trustworthy data exchange





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#### **Requirements for decentralized data exchange**









Fujitsu's technology applying blockchain to NW control enables safe and reliable data exchange NW

#### VPX: Virtual Private digital eXchage





#### Major APIs for VPX users







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#### VPX API procedures

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#### Step 1: Publish Metadata





### **VPX API procedures**



**Step 2:** Find desired data



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### VPX API procedures

Step 3: Transfer actual data







### **VPX API procedures**



Step 1: Publish Metadata Step 2: Find desired data Step 3: Transfer actual data Network Interface Metadata Metadata Data ID 1-3: Distribution of metadata \*\*\*\*\* Attribute Attribute Dest. #C Dest. #C Address (Encrypted) Distribution (Encrypted) Address metadataPublish() metadataGet() Access Policy User X Access Policy User X 2-1: Request metadata that User X can access 1-1: Registration of metadat [To #B] [To #E] 2-2: Verify data user & its access right of metadata 2-3 Return the list of Forwarding table & Forwarding table & Data ID Table Internet Data ID Table #F User X Data lash No. #C → #A Hash No.  $\#E \rightarrow \#C$ dataGet() Provider 3-1: Request the desired data 3-4: Verify data user & [To #E] its access right of the data its access right of the data 3-3: Act as reverse proxy http://#E/ hash no.(Data ID) 3-5: Act as reverse proxy https://#C/ hash no.(Data ID) http://#A 3-7: Check the hash no. 3-6: Check the hash no. of To #B of the getting data the getting data To #D To #F - -H VPX GW VPX GW Data Provider Site Data User Site

All requests and data go through VPX gateways, thus hiding the location of actual data from VPX participants

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#### How it works





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### VPX traces on the blockchain



- The log of each VPX API call is stored on the blockchain
- Participants can trace data exchange transactions

#### Trace information via trailsGet()

Blo	ock list						
age	: 1						
No	date	functionNames(*)	current_hash previous_hash				
21	2020-02-21 10:09:13 2020-02-21 10:09:13		and backbilleded 167492a8f8d580755b2113c138d8e81e54c1c1a9				
20	2020-02-21 10:09:01 2020-02-21 10:09:01		638abce_13a0c8e7dc9d7794cd7bba721afe05cc9013b72bd7f9d60453ba3mc c12ee7e5117df823d79399f36536bc06048ae7e1596cae9549495c1026852f19				
19	2020-02-21 10:08:52	metadataPublish()	c12ee7e5117df823d79399f36536bc06048ae7e1596cae9549495c1026852f19 dafe5e91aad060f2cfee416a73bec29b3705fd853ff2870f5c244d0e9b5bbefc				
18	2020-02-21 10:08:43 2020-02-21 10:08:43		dafe5e91aad060f2cfee416a73bec29b3705fd853ff2870f5c244d0e9b5bbefc 7db651780ef710fe220b9f2fb040b4f15e30cf0b39a0dbb7642dc2d9909850bc				
17	2020-02-21 10:08:30 2020-02-21 10:08:30		7db651780ef710fe220b9f2fb040b4f15e30cf0b39a0dbb7642dc2d9909850bc 541bc7017924f75796f6231d812b633240ea74cda49e767a3e2023e5dc885104				
16	2020-02-21 10:08:21 2020-02-21 10:08:21		541bc7017924f75706f6231d812b633240ea74cda49e767a3e2023e5dc885104 13961aa8f7bb85675beedf1ed629012bebab06704d8305aadd4c58ce19710c58				
15	2020-02-21 10:08:11 2020-02-21 10:08:11		13961aa8f7bb85675beedf1ed629012bebab06704d8305aadd4c38ce19710c58 b0d3be9cf2b7960cd124e481ee90586c377db6b987e7a0af9246cc4162229c05				
14	2020-02-21 10:07:58	metadataPublish()	bdd3be9cf2b7960cd124e481ee90586c377db6b987e7a0af9246cc4162229c05 e19ba9ab9924bec7182eb414cfc029817b6162f0ab99fcb309ebbs7ca93a21f				
	2020-02-21 10:07:43 2020-02-21 10:07:43		e19ba9ab9924bec7f182eb414cfe029817b6162f0ab99fcb309ebba7ca93a21f 99cbf6bdc12f4679e7ca0e3b44cb123586a3bbc0dd37857aa44fe4efd1616e33				
	2020-02-21 10:07:39 2020-02-21 10:07:39 2020-02-21 10:07:41 2020-02-21 10:07:41	dataGetConsumer() dataGetSupplier()	99cb/65bdc1254679e7ca0e3b44cb123586a38bc0dd37857aa44fe4efd1616e33 31e3ea9036bbc0d517a69ce861c0bc98d4ee3bfbd034b9dbe6d69047af323f8				
	2020-02-21 10:07:25 2020-02-21 10:07:25		31e3ea9036b0cf0f517a69ce861c0bc98d4ee3bfbd034b9dbe6d69047af323f8 2e05b57b90e0f7e93d5648a6443012c6e077ceaa7ie71292e011c8a46b988d3d				
10	2020-02-21 10:07:19	metadataPublish()	2e05b57b90e0f7e93d5648a6443012c6e077ceaa7fe71292e011c8a46b988d3d f20814b2598bf53cf784fb148dfd81b06cba5f6f7efa20a82fea0845ae0ca531				
2	2020-02-21 09:55:11 2020-02-21 09:55:11		120814b2598bf53cf784fb148dfd81b06cba5f6f7efa20a82fea0845ae0ca531 6cfd29f9e0f9a947b96fc1eb5fb45ae08e65bb0a7238444b7a4a433f6349a598				
120	2020-02-21 09:54:59 2020-02-21 09:54:59		6cfd29/9e0/9a947b96fc1eb5fb45ae08e65bb0a7238444b7a4a433f6349a598 bc42018efbeb1c5b6433291feca6ca414e57a9549ed06cfd08b7045c4d74c571				
	2020-02-21 09:54:16	metadataPublish()	bc42018 bcb1c5b6433291feca6ce414e57a9549ed06cfd08b7045c4d74c571 8bc 55c115b11611625ce414e57a9549ed06cfd08b7045c4d74c571				
â	2020-02-21 09:33:37	metadataPublish()	648a. edb99bd20c6861f2d5d8268c369e326d5c74d396f6dl4d1f065a267				
	2020-02-21 09:32:34	metadataPublish()	648d828e2edb99bd20c6861f2d5d8268c369e326d5c740396f6df4d1f065a267 7f42816ad70a4de224618c382d253990a02d29d39ff55bf2e1b90e98ffbede716				

#### The log of dataGet()



#### The log of metadataPublish()

C @ #Mancodug	EE 192.168.40.206:9000/detail19	(html		-
Block				ba
No. 19				
	1823/129399/3653650604846			
	60/2cfee416e73bec29b3705fd8 ISO153ee0c72240229ece1319b			
Regardion #1				
FunctionNerro(*)	metadataPublich()			
Dote	2020 02 21 10:08:52			
version				
staticAttribute				
dynamicAttribute				
vpsPtrametechash(data ID)	camera1			
vpsParametecowner.enrolld	uner1@org1			
vpiPerameter.owner.address	DataOwner@example.com			
vpiiPtrametecownecorg	org1			
vpxPbratmeter.openTo	l bestelligenter Persiteligenter Persiteligenter			
vpi/Peramoter.deta.url	http://api-gw0/reg_user1.bit			
vpsParameter.data.open lo	1 - General Laft, "Josepheral", - Constant of the State of State of the State - Constant of the State of State of the State - Constant of the State of State of the State - Constant of the State of the State of the State - Constant of the State of the State of the State - Constant of the State of the State of the State - Constant of the State of the State of the State - Constant of the State of the State of the State - Constant of the State of the State of the State - Constant of the State			
vpsPerameter.doc.url	Hilp://api-gwil/api.doc			

# **Application : data exchange for Al**

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- High quality of AI requires high quality of Data
- Data exchange is to "find data and transfer", which is needed for AI training, validation, and testing phases
- However, data providers sometime do not want to provide actual data



How to train AI models without transferring actual data from data providers?

# **Federated learning**



○ Federated learning (FL) is a distributed AI/ML, which trains AI/ML models locally at clients with data

- FL usually involves a central server and a group of clients
- $\odot\,$  FL can have hundreds of training rounds when converged
  - Each training round includes three steps, as shown below
- FL server aggregates received local models from clients, e.g., weighted avg.



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## **Federated learning on VPX**

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#### ○ VPX seamlessly provides a secure, distributed platform for FL tasks



A single training round in FL

Qiong Zhang, et.al Demo: A Blockchain Based Protocol for Federated Learning presented at ICNP2020

### **Traffic Prediction Use Case**





#### Presented at Netsoft 2021

#### Demo: A Blockchain Based Protocol for Secure Aggregation in Federated Learning

Qiong Zhang, Paparao Palacharla Fujitsu Network Communications, Richardson, Texas, USA Motoyoshi Sekiya, Junichi Suga, Toru Katagiri Fujitsu Laboratories Limited, Kawasaki, Japan



# Summary : our approach for "Level C" problem



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# **Future direction**



Data are securely exchanged between App, Things then transform to information

Data are transform to info during data exchange through network Top to Bottom in trust be important





# Thank you

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