

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

June 30 2022

Fujitsu LTD. Data & security Research Laboratories

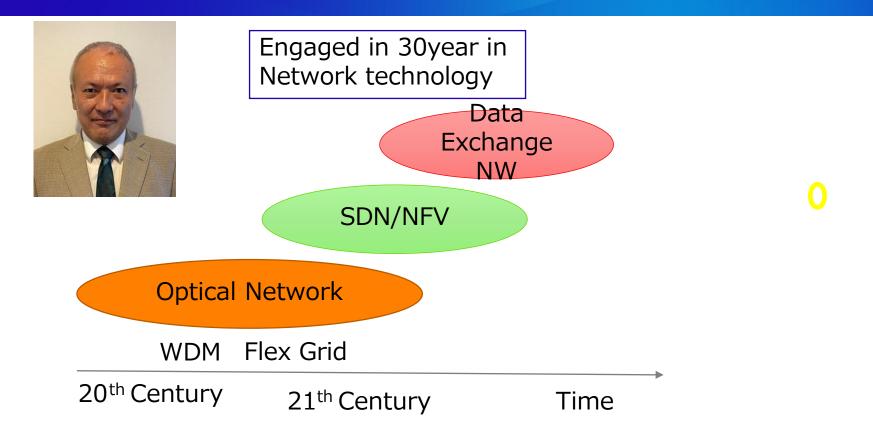
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Self introduction



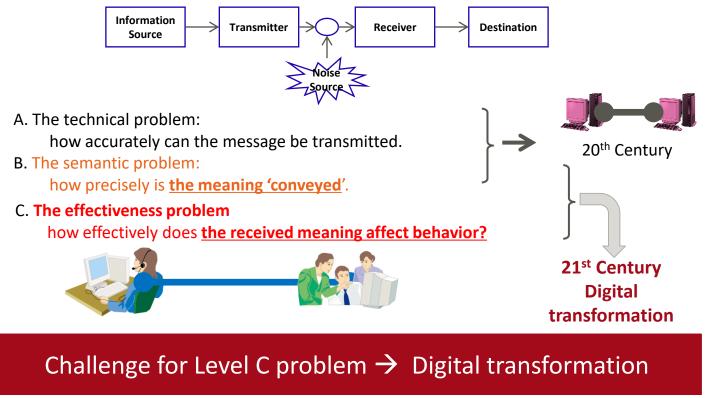


Digital transformation

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Communication point of view

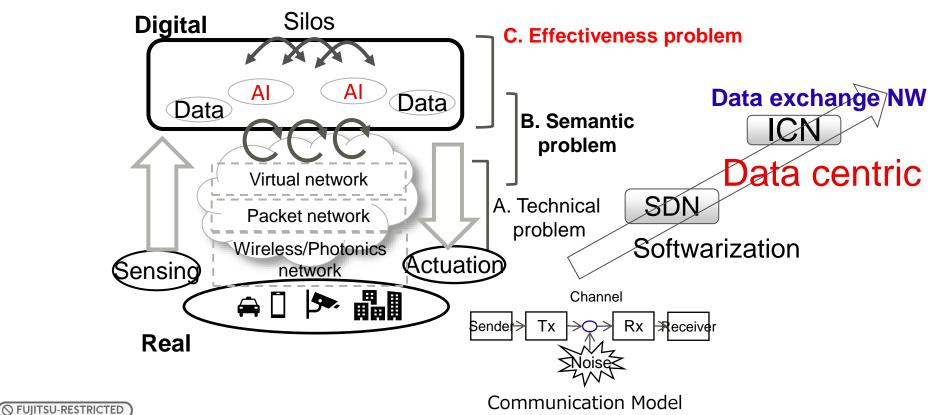
○Three levels of problems in communication by Shannon Weaver (1949)





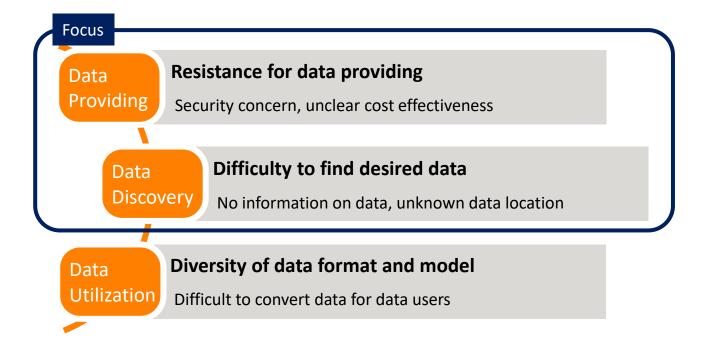
Network evolution towards Digital transformation





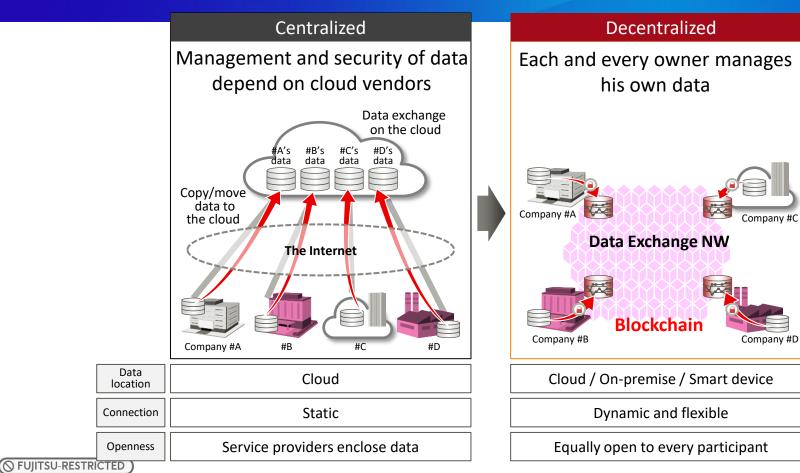
Challenges on data exchange





Decentralized: a more trustworthy data exchange

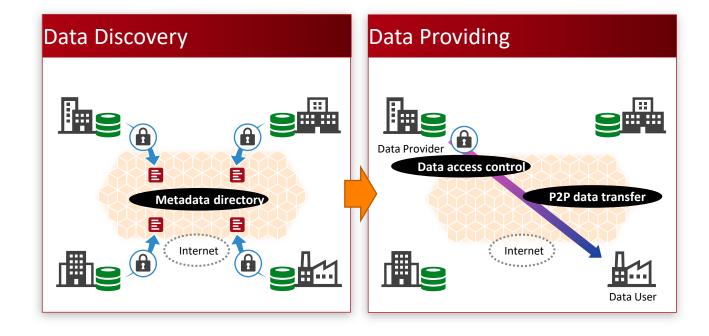




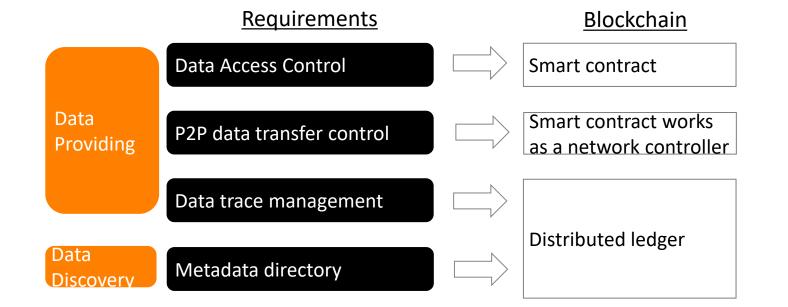
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Requirements for decentralized data exchange





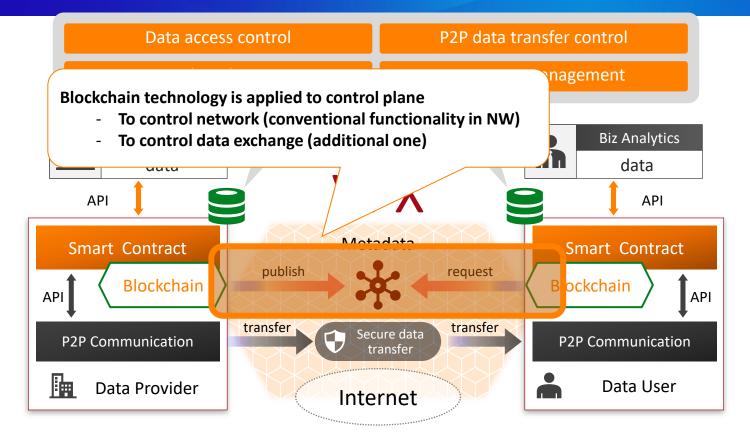




Fujitsu's technology applying blockchain to NW control enables safe and reliable data exchange NW

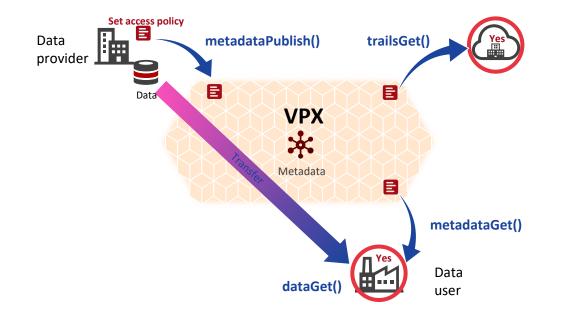
VPX: Virtual Private digital eXchage





Major APIs for VPX users







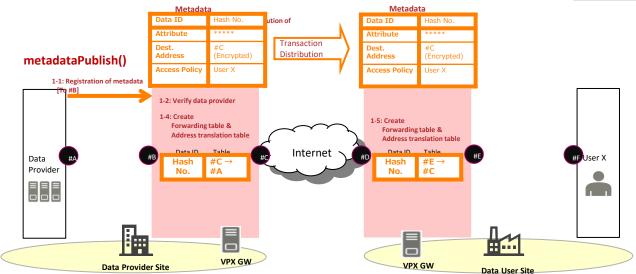
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VPX API procedures

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Step 1: Publish Metadata

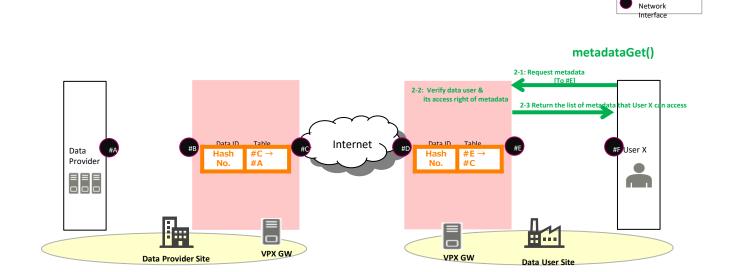




VPX API procedures



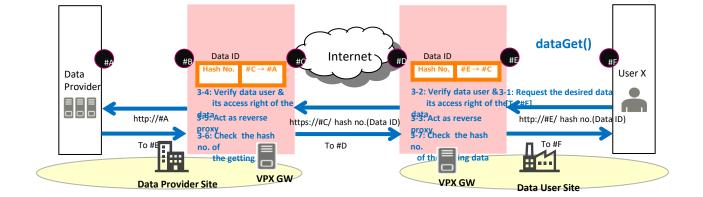
Step 2: Find desired data



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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

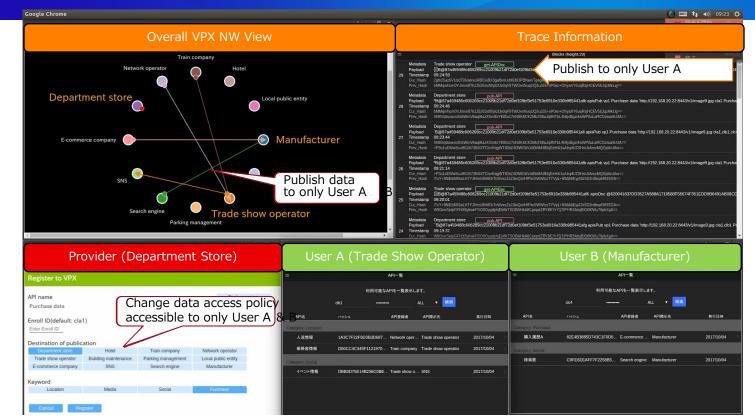
All requests and data go through VPX gateways, thus hiding the location of actual data from VPX participants

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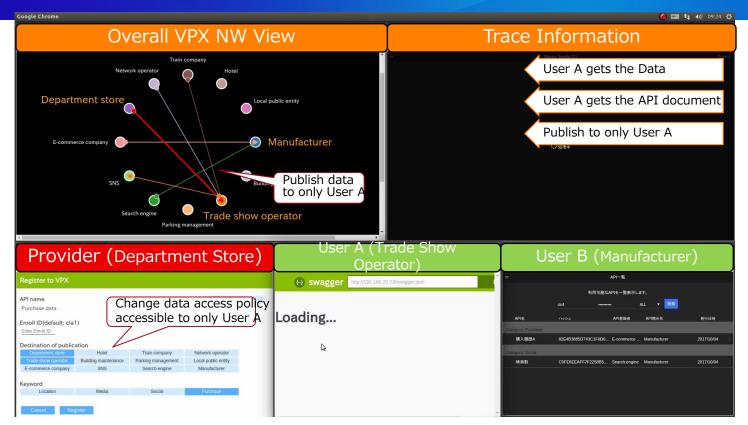
How it works





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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()



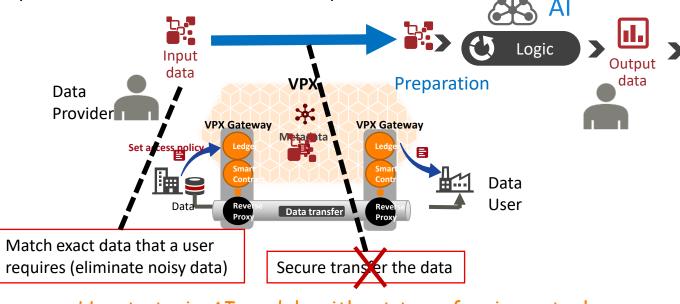
The log of metadataPublish()

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			
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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



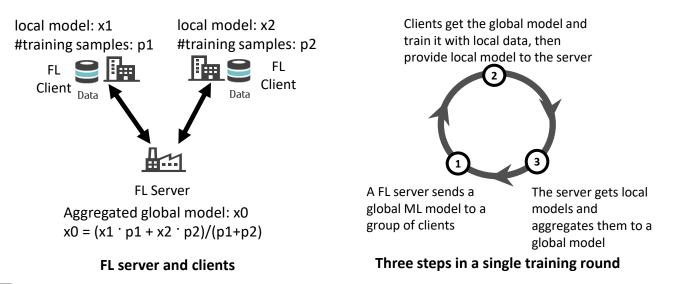
How to train AI models without transferring actual data from data providers?

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.



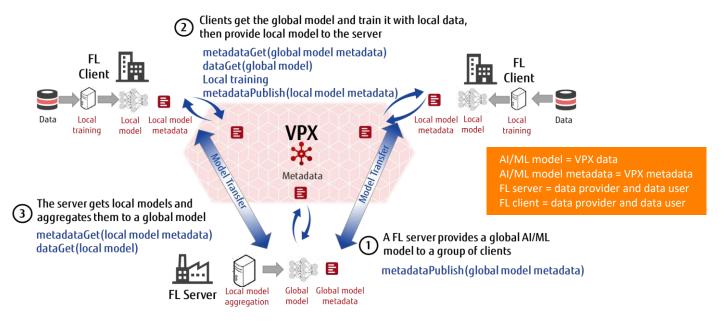
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Federated learning on VPX

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

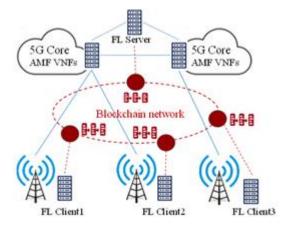


A single training round in FL

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

Traffic Prediction Use Case





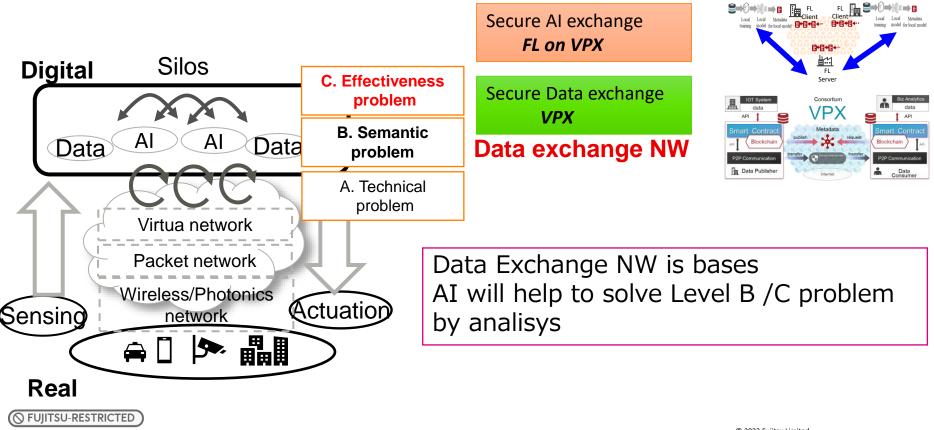
Presented at Netsoft 2021

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



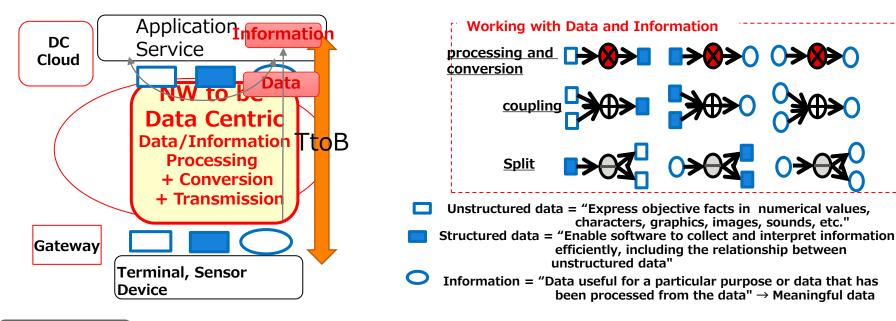
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Future direction



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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