W-DaM: Weather Data Management in Smart Agriculture using Blockchain-as-a-Service

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Talk Outline

- Introduction.
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- Novel Contributions
- IoT Hub
- Blockchain-as-a-Service(BaaS)
- Blockchain and Use cases
- Connections
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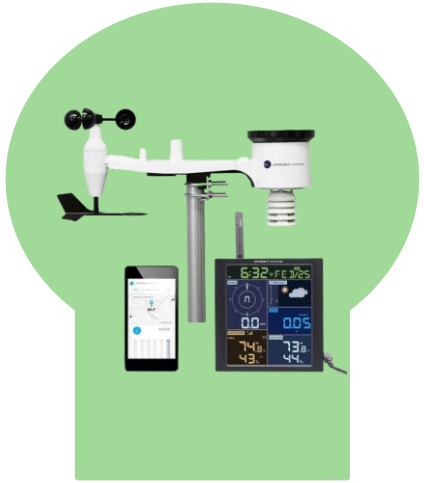
- Implementation.
- Results.
- Conclusion with Future work.

Introduction

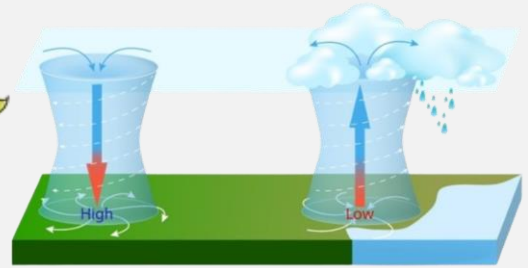


Meteorological Observation Center

Weather IoAT device for farming

DATA

Wind



Air pressure

Temperature & Humidity

Precipitation

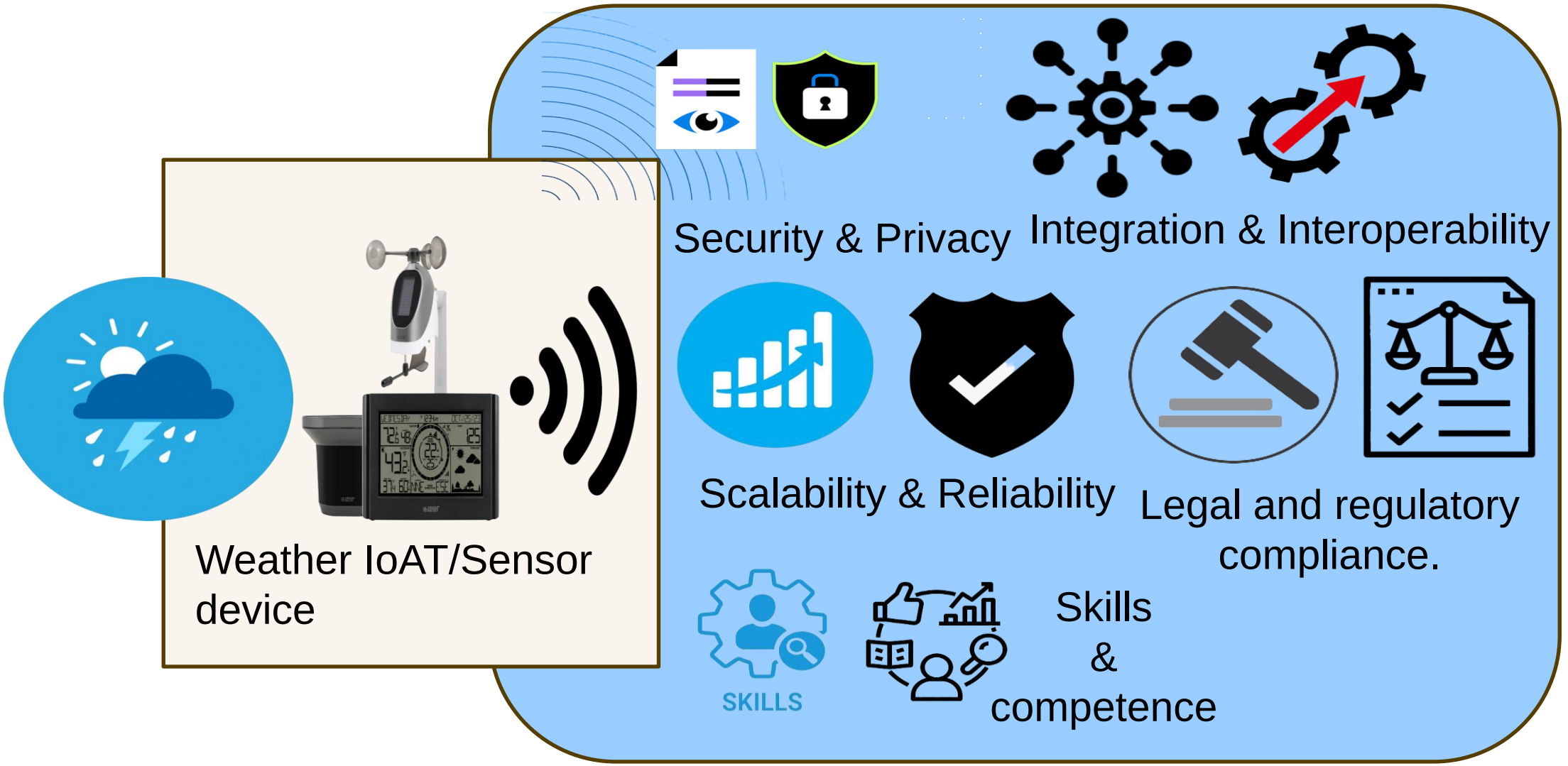
Sunlight

Leads to

Healthy Crops

1-degree differences in the forecast accuracy can affect farmers.

Motivation for W-DaM



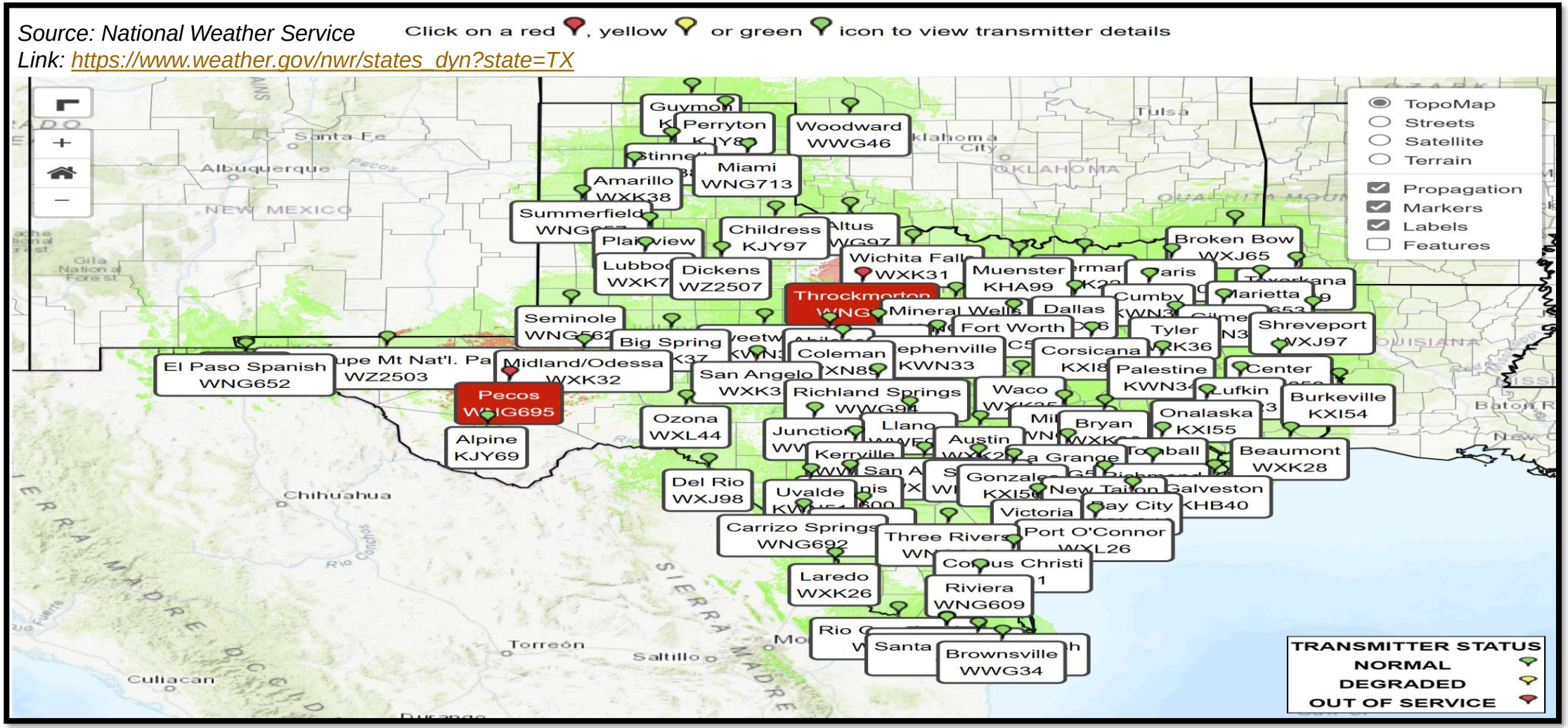
Related Works

Application	IoT/Sensor	Communication	Data storage	Security Level	Computation
Purwandari et al. [4]	Yes	Single	Centralized	Low-High Risks	High
Andrian et al. [5]	Yes	Single	Decentralized-IPFS	High	High
Kodali and Sahu [6]	Yes	Single	Centralized	Low-High Risks	High
Tsao et al. [7]	Yes	Single	Distributed-(MQTT)	Low-High Risks	High
Osiorio et al. [8]	Yes	Single	Centralized	Low-High Risks	High
W-DaM [Current -Paper]	Yes	Bi-Directional	IoT Hub+ Decentralized	High	Low

Novel Contributions

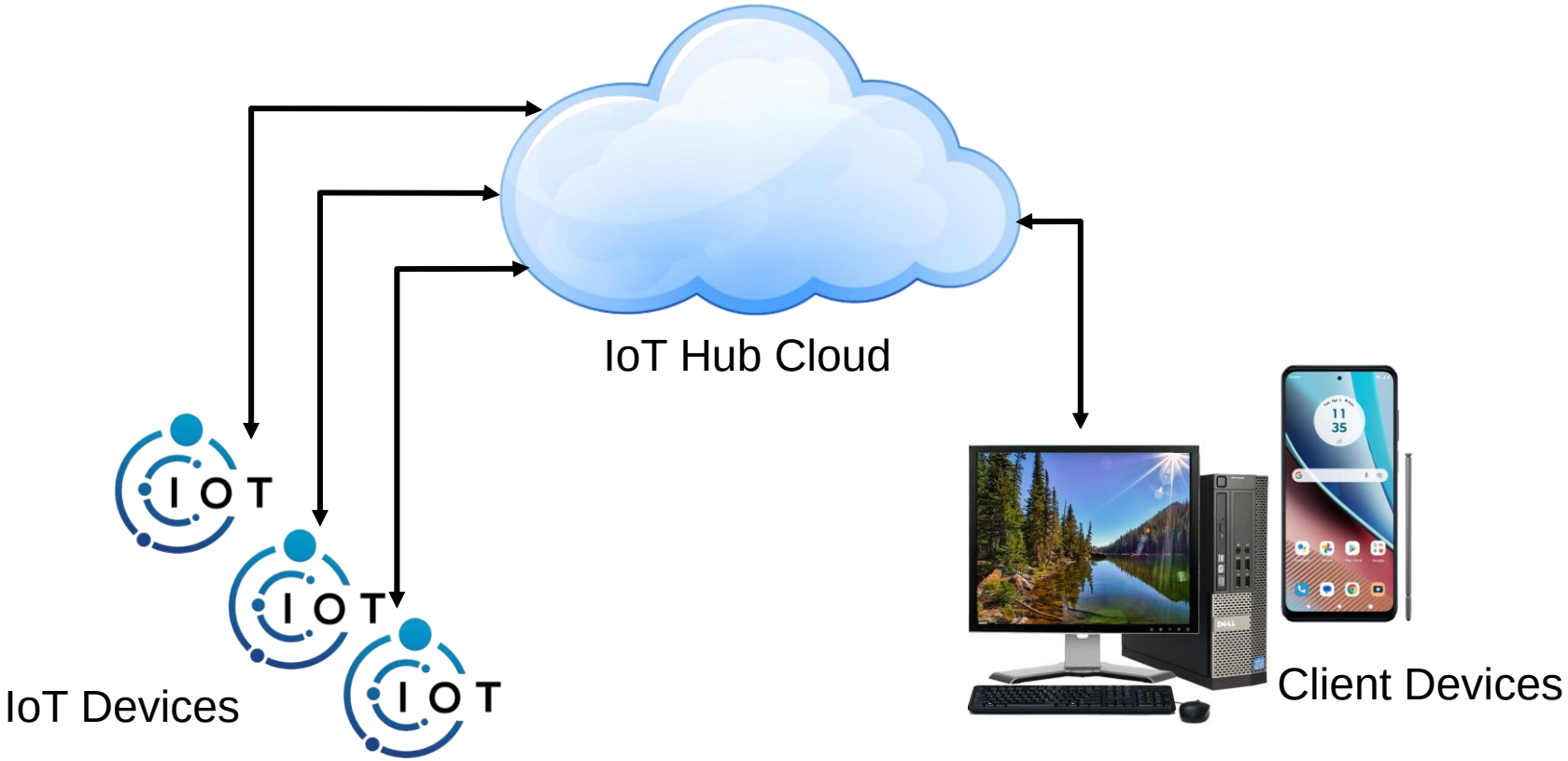
- Connecting Internet-of-Agro-Things towards IoT-Hub for real-time weather data storage and bi-communication between various devices.
- The Blockchain-as-a-Service technology for added security and storage for weather data flow to mitigate uncertain facts and improve data quality.
- Increasing weather data precision and avoiding 1-degree differences in the forecast accuracy.
- Propose a novel architecture for a weather-quality data management system with hashing refuge through blockchain service in IoT Hub.
- Results comparing traditional weather data management systems and current W-DaM.

Weather forecasting Cites



What is IoT Hub?

- An IoT hub is a way to centrally manage bi-directional communications between IoT devices and an IoT application.



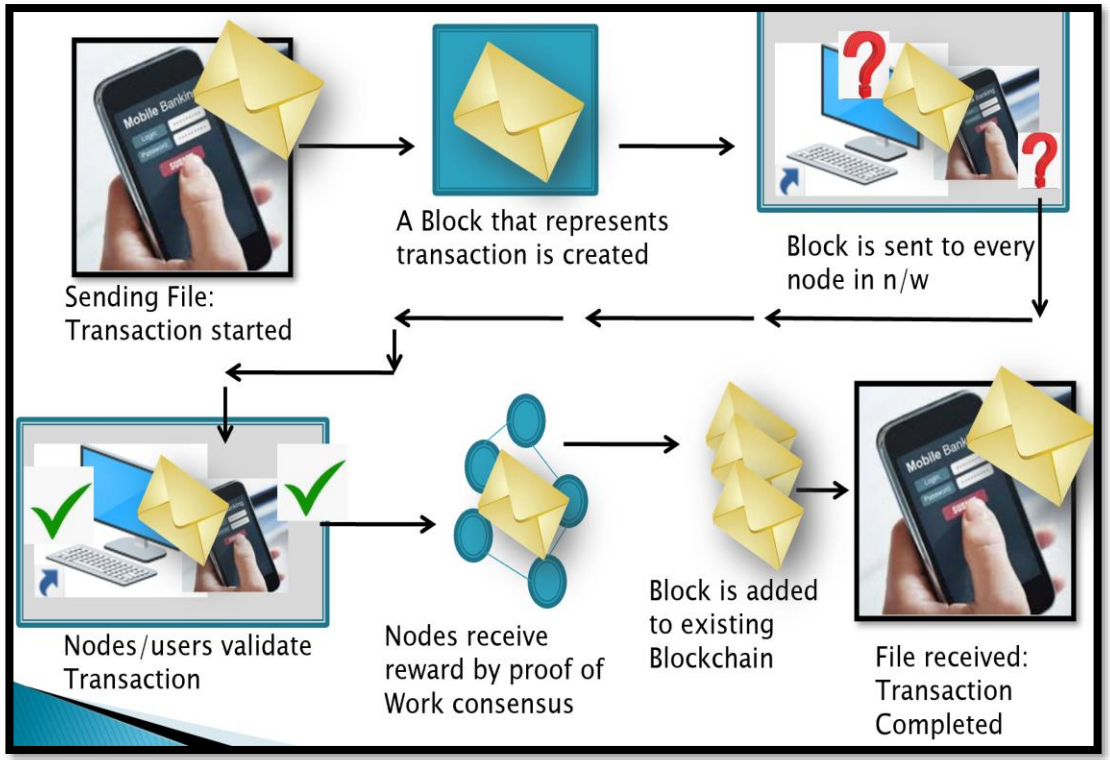
What is BaaS?

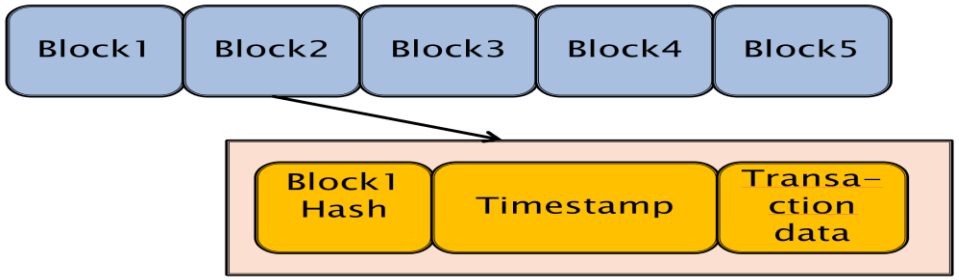
- Blockchain-as-a-service (BaaS) is the third-party creation and management of cloud-based networks for companies building blockchain applications.

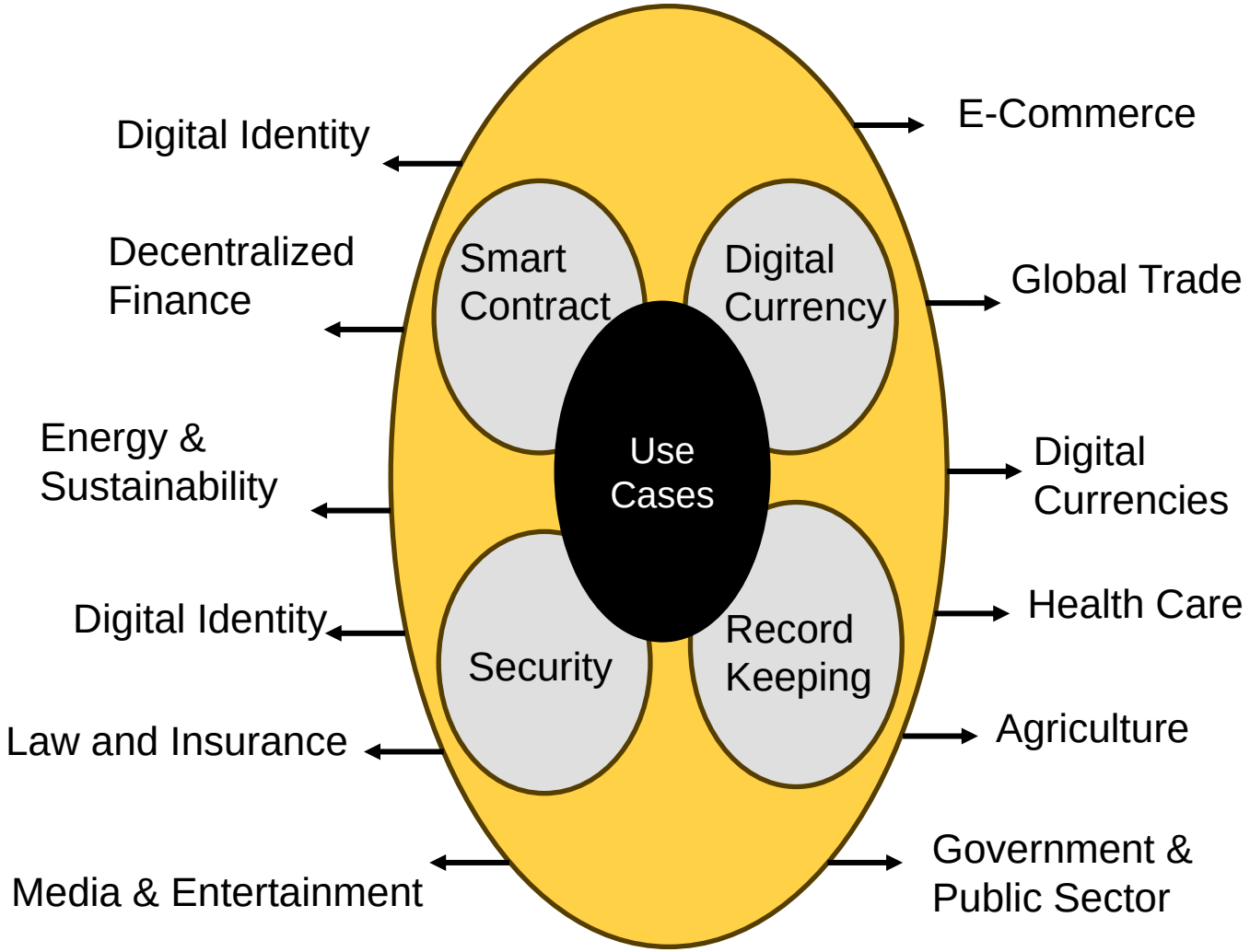
- The BaaS model allows companies to access a blockchain provider‘s services which can help access/develop blockchain-based applications.

- Examples of BaaS Providers: Amazon AWS, Azure, IBM, Ardor

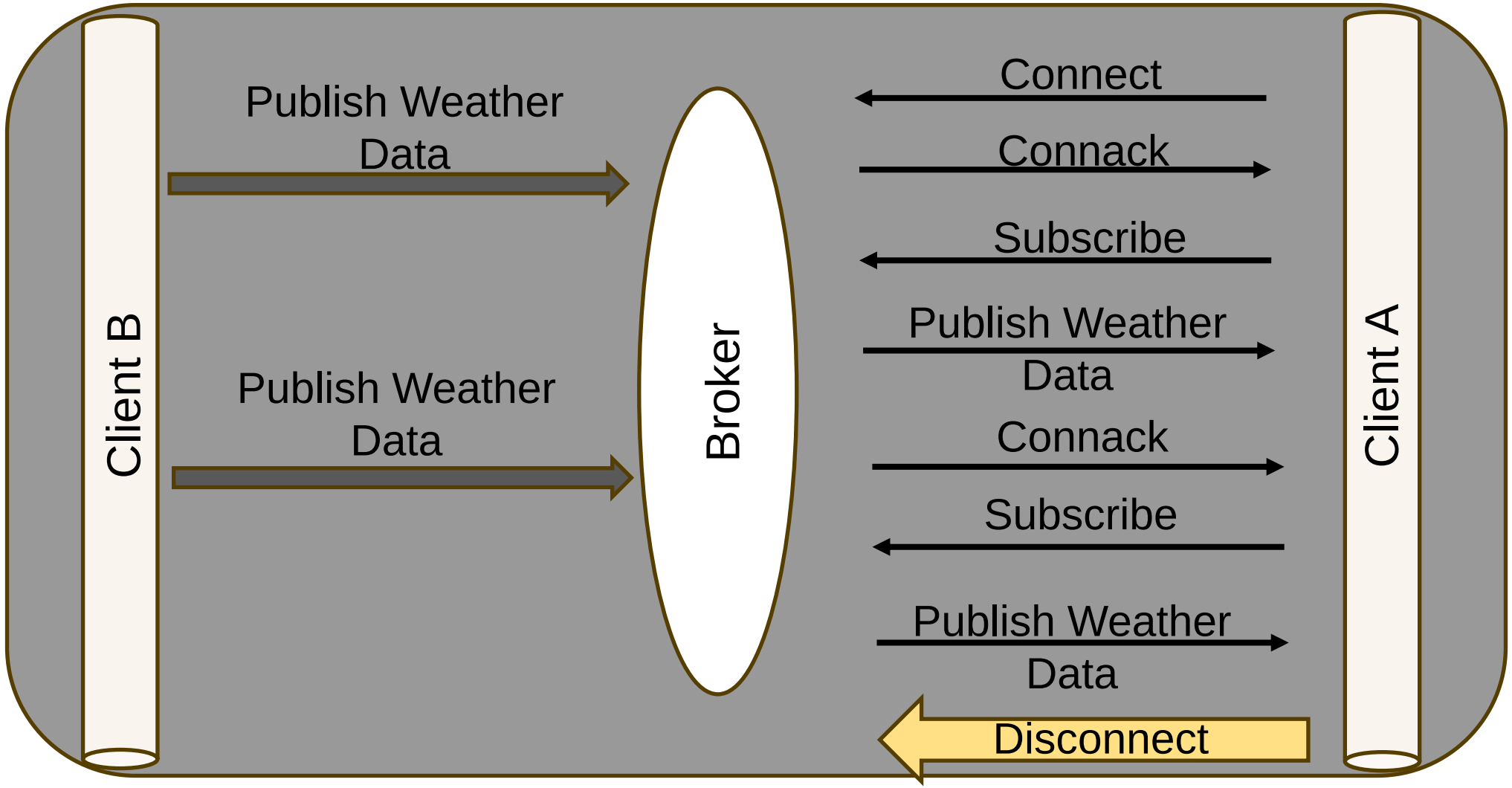
Blockchain and its UseCases



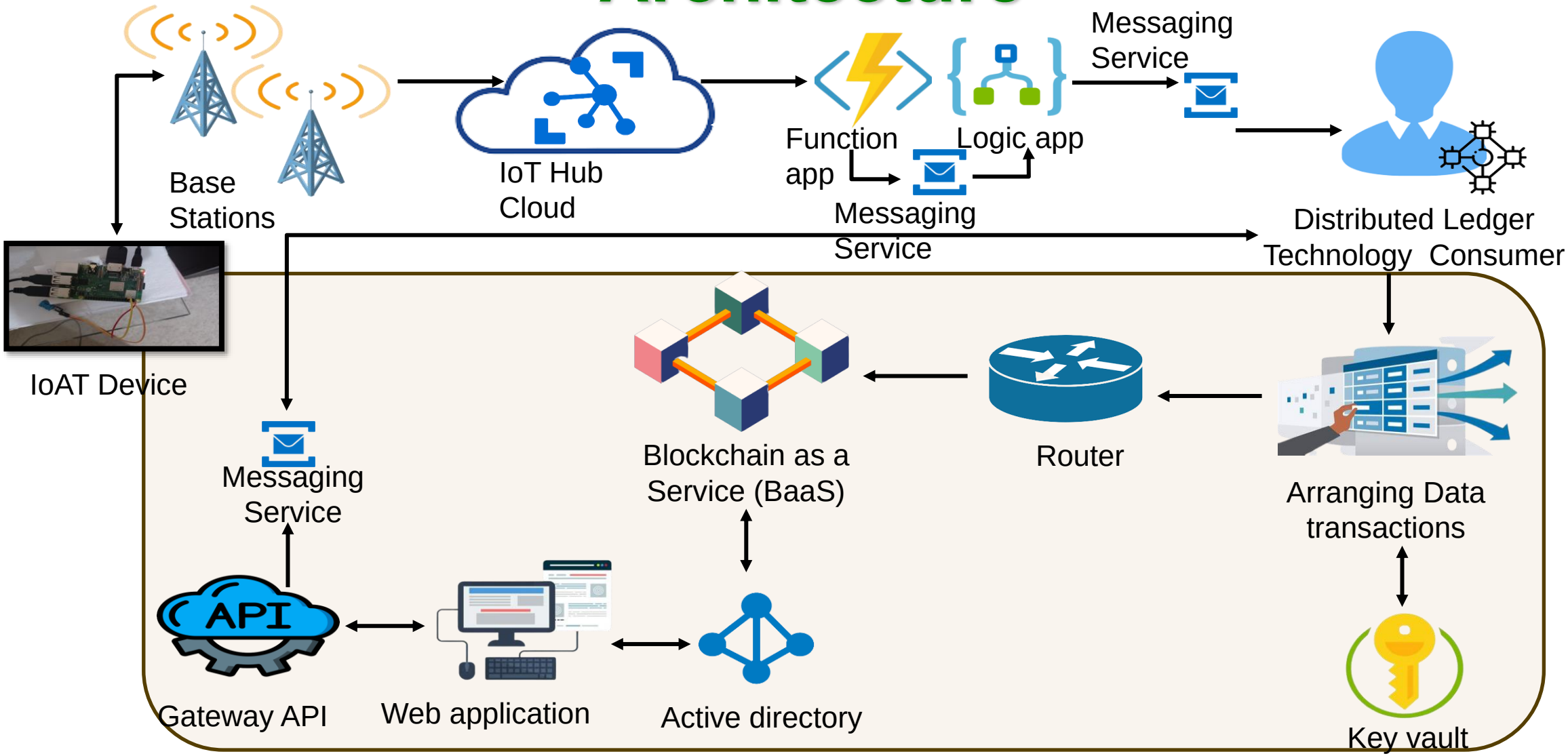




Connect to IoT Hub - MQTT Protocol



Architecture



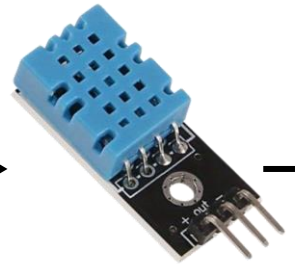
Proposed Algorithm

- 1: $H_{name}, P_{WD} \longleftarrow IoT_{Hub}$.
- 2: Data transmission using MQTT Protocol between different en- tities. Client A is the IoT Hub, and Client B is the IoT De- vice/Sensor.
- 3: Generate $D_{id} \longleftarrow Cl_{id}$.
- 4: MQTT $\longrightarrow$ $MQTT_{broker}$,ClientsA,B,C..n
- 5: Cl_ACONNECT $\longrightarrow$ $MQT_{Tbroker}$ $\longrightarrow$ Cl_B
- 6: **if** Cl_A equalto D_{idA} **then**
- 7: Cl_BPUBLISH$_{temp,hum}$ $\longrightarrow$ $MQTT_{broker}$
- 8: $MQTT_{broker}$ stores $Cl_{B,temp,hum}$ through R_{flag}
- 9: $MQTT_{broker}$ $\longrightarrow$ CONNACK $\longrightarrow$ Cl_A
- 10: Cl_A subscribes to $MQTT_{broker}$
- 11: $MQTT_{broker}$PUBLISH $\longrightarrow$ $Cl_{A,temp,hum}$
- 12: Cl_A DISCONNECT $MQTT_{broker}$
- 13: IoT_{Hub} $\longrightarrow$ Initialize and Add End$_{points}$

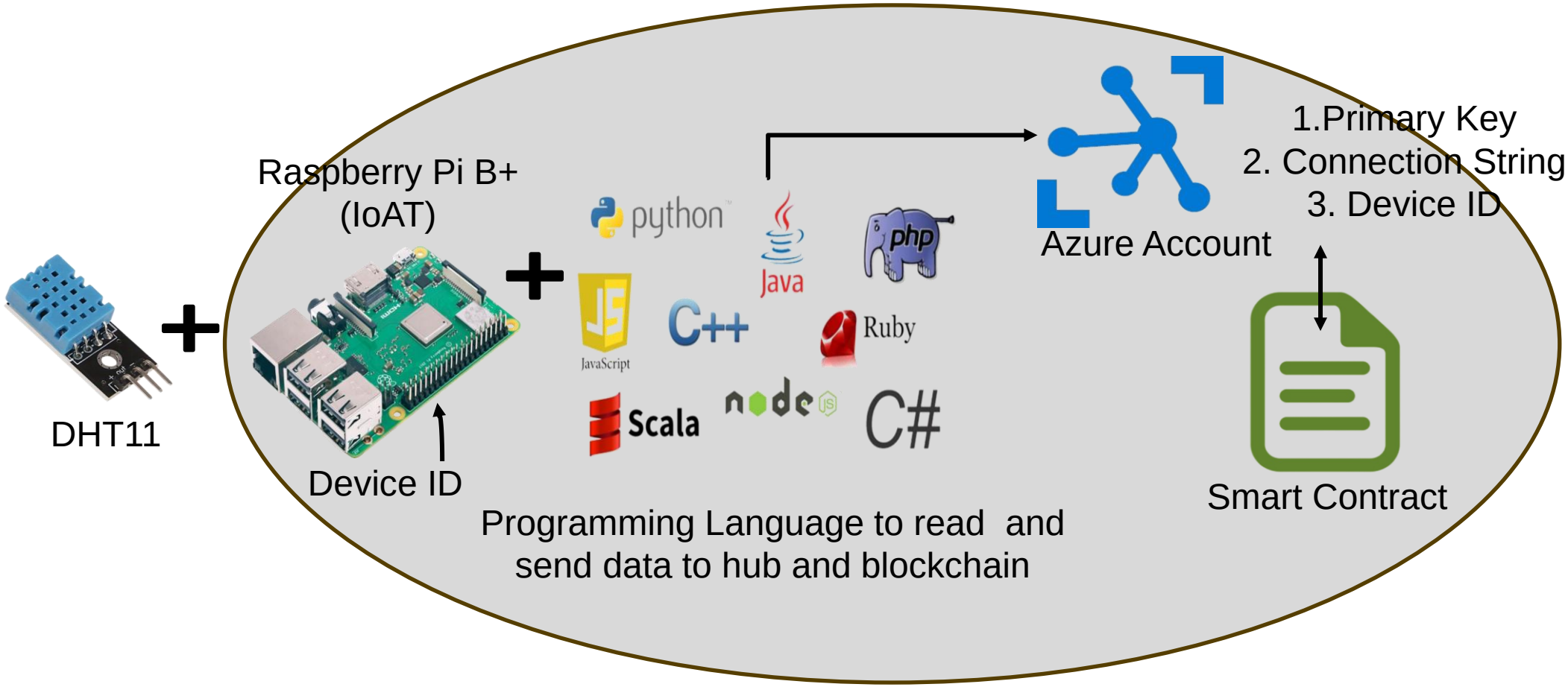
Proposed Algorithm

- 14: IoT_{Hub} ⟶ Add Route and fallback Route
- 15: I_{app} ⟵ $IoT_{Hub,new\ message}$, user, T_{data}
- 16: I_{app} ⟶ call SP
- 17: SCinitialize ⟵ SP ⟵ input Did
- 18: BC ⟵ SC ⟵ $IoT_{Hub,new\ message}$
- 19: **else**
- 20: Discard operation.
- 21: End the Process
- 22: **end if**
- 23: Repeat the steps from 1 through 22 every time IoT Collects Weather Data.

Technologies used for Implementation

- Raspberry Pi 3B+ Model →  → IoAT Device
- DHT 11 Sensor →  → To Read Temperature & Humidity Data
- Azure IoT Hub →  → Edge Layer
- Blockchain-as-a-Service(BaaS) → 

W-DaM Implementation



W-DaM Performance Results

Application	Storage	Time Taken	Cost	Accuracy
Purwandari et al. [4]	Centralized	2.23s [14]	High	Low
Andrian et al. [5]	Decentralized-IPFS	13s [13]	High	High
Kodali and Sahu [6]	Centralized	2.23s [14]	High	Low
Tsao et al. [7]	Distributed-(MQTT)	3s [13]	High	High
Osiorio et al. [8]	Centralized	2.23s [14]	High	Low
W-DaM [Current-Paper]	**IoT Hub +Blockchain**	**4.3s[13],[14]**	**Low**	**Very High**

Conclusion & Future Direction

- A novel way of weather data management with the help of IoT Hub and using Blockchain-as-a-Service.
- We solve the issues related to multiple IoT device communication through Hub and provide weather data security with the service of Blockchain.
- The system is resistant and reliable to threats and data attacks through the authentication of devices.
- We show that IoT Hub and Blockchain have proven to be accurate in storing and sharing weather data.


Thank
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