Status and Perspective of Field Sensor Network

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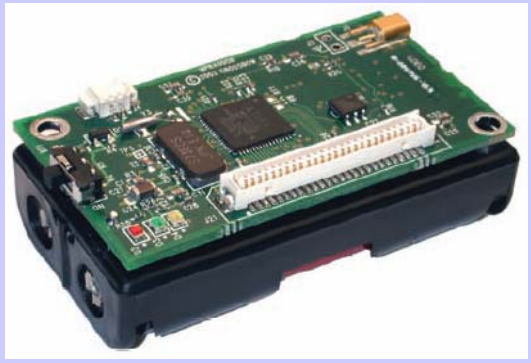
1st Stage: Sensor Networks Emerged (1999～)

Smart Dust



MOTE

NASA JPL, Sensor Web

Field Server

Commercial Products of Sensor Networks

elab experience

Panasonic

Xbow

T&D

National Instruments

Field Sensor Networks

NARO & IITB

CSIRO

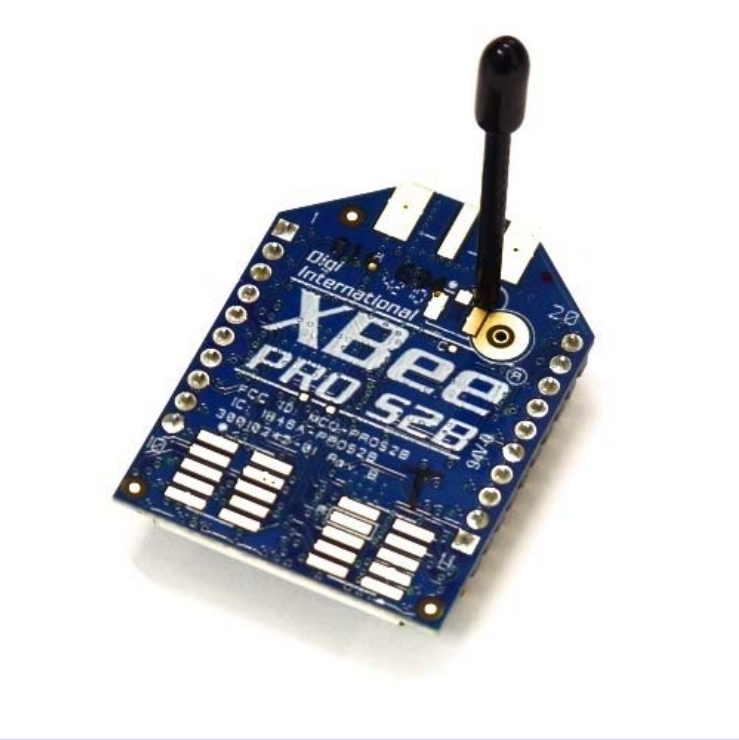
Fraunhofer

UC Berkley

Texas A&M

NASA

2nd Srtage: XBee: Becoming Popular Devices

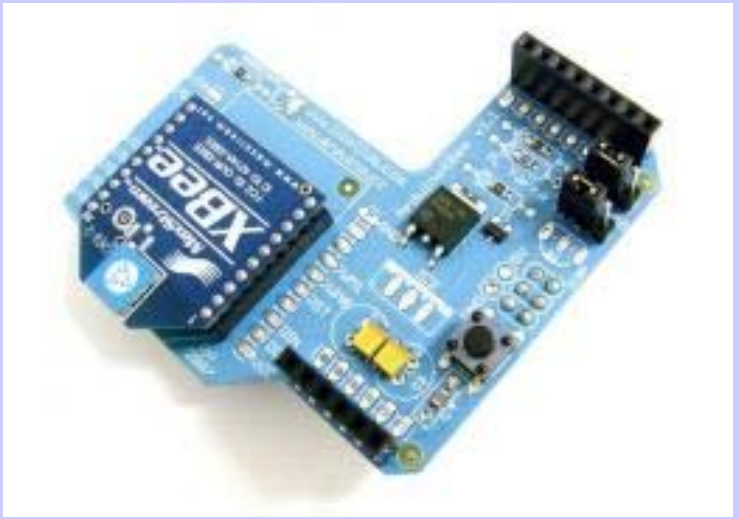


ZigBee

Wi-Fi

Arduino + XBee

Arduino



XBee Shield

Arduino is an open-source single-board computer. The Arduino project began in 2005 to make a simple device for education and hobby.

Field Servers

(1)試作１号機

(2)固定カメラ内蔵

(3)可動カメラ内蔵

(4)固定カメラ内蔵（超小型タイプ）

(5)地表面撮影用デジタルカメラ内蔵

(6)全方位カメラ内蔵

(7)固定カメラ
＋熱画像カメラ

(8)２眼カメラ内蔵

(9)固定カメラ８台
＋赤外カメラ

(10)デジタル一眼レフ
カメラ内蔵
＋ソーラパネル

(11)可動雲台
＋デジタル一眼
レフカメ
＋赤外カメラ
＋プロジェクタ

(12) 可動カメラ
＋超小型 PC
＋３G モデム

(13) 固定カメラ
＋害虫カウンタ

(14) 固定カメラ+青色 LED 照明
＋陶器製筐体

(15)デジタル一眼
レフカメラ
＋高出力 Wi-Fi
＋3 色 LED 発光球

(16)固定カメラ
＋高電圧給電

(17)太陽電池
＋風力発電

(18)固定カメラ
＋ソーラパネル

(19)固定カメラ
＋ソーラパネル

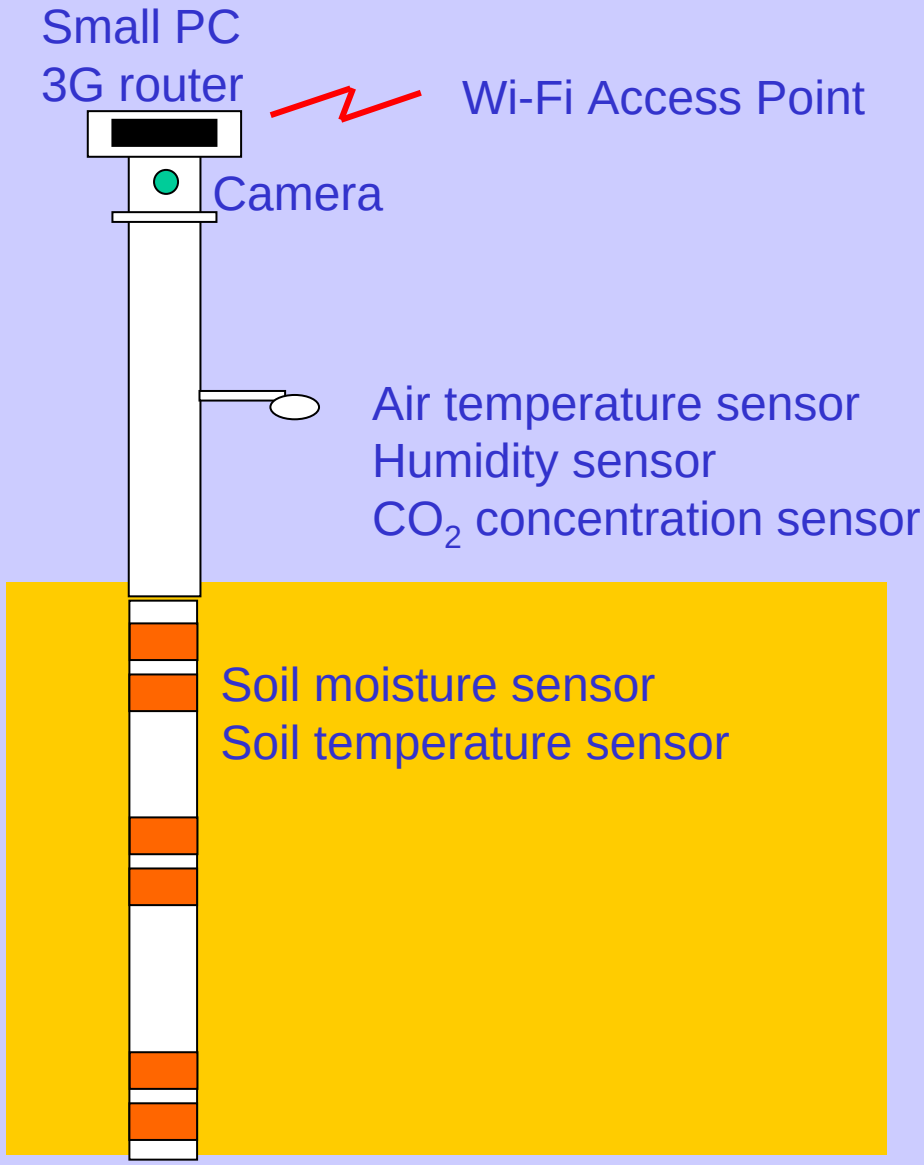
(20) 赤外線／可視光カメラ
＋円形ソーラパネル

(21)可動カメラ
＋円形ソーラ
パネル２段

(22)可動カメラ
＋ソーラパネ
ル３段

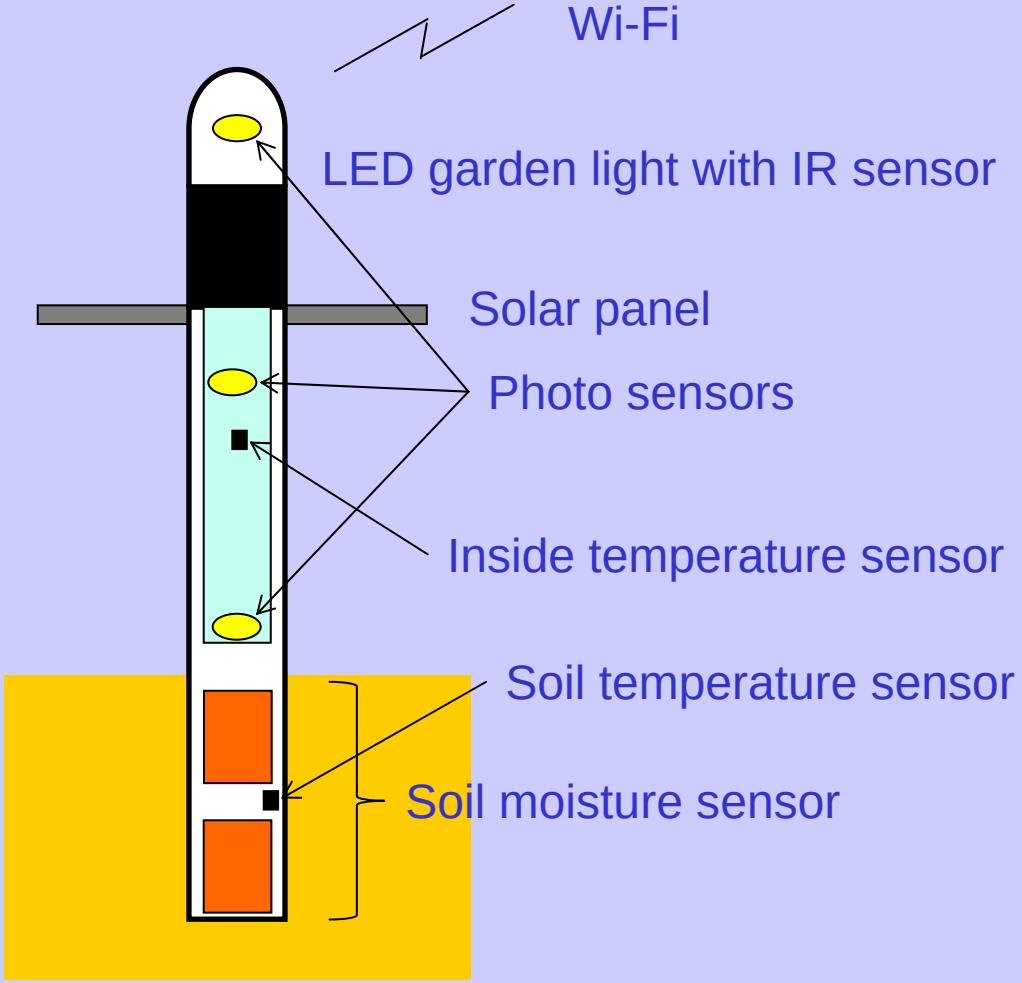
(23)カメラなし（センサのみ）
＋小型ソーラパネル

The Newest Field Server with A Wi-Fi/3G-router

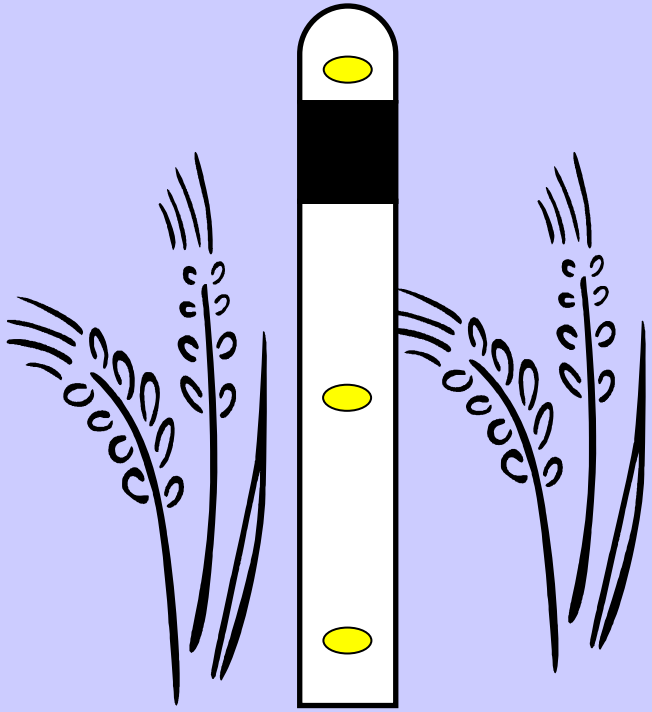


All-In-One

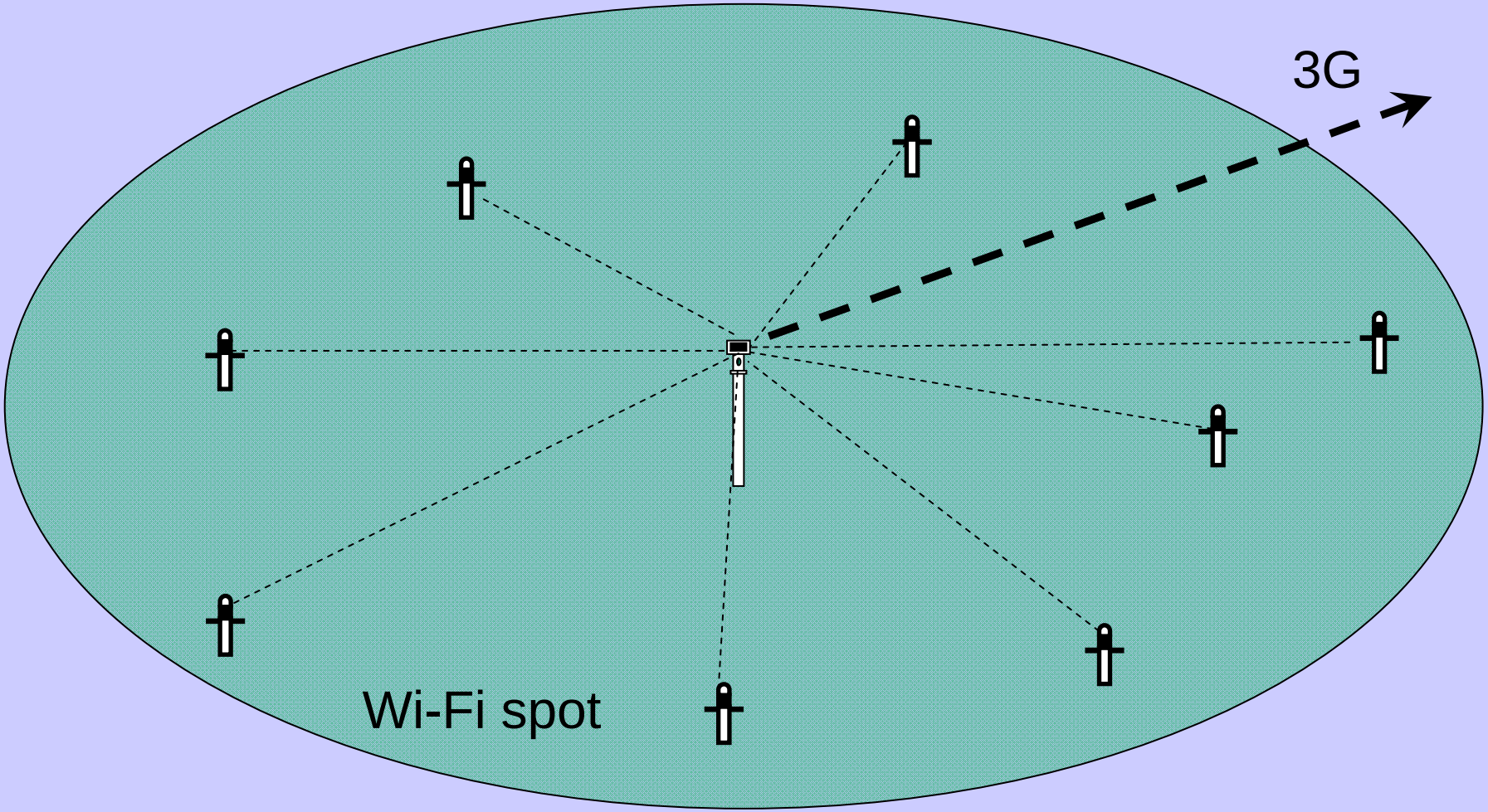
Open-FS (Open Field Server)



Sensing LAI As Extinction Coefficient by 3 layered Photo Sensors



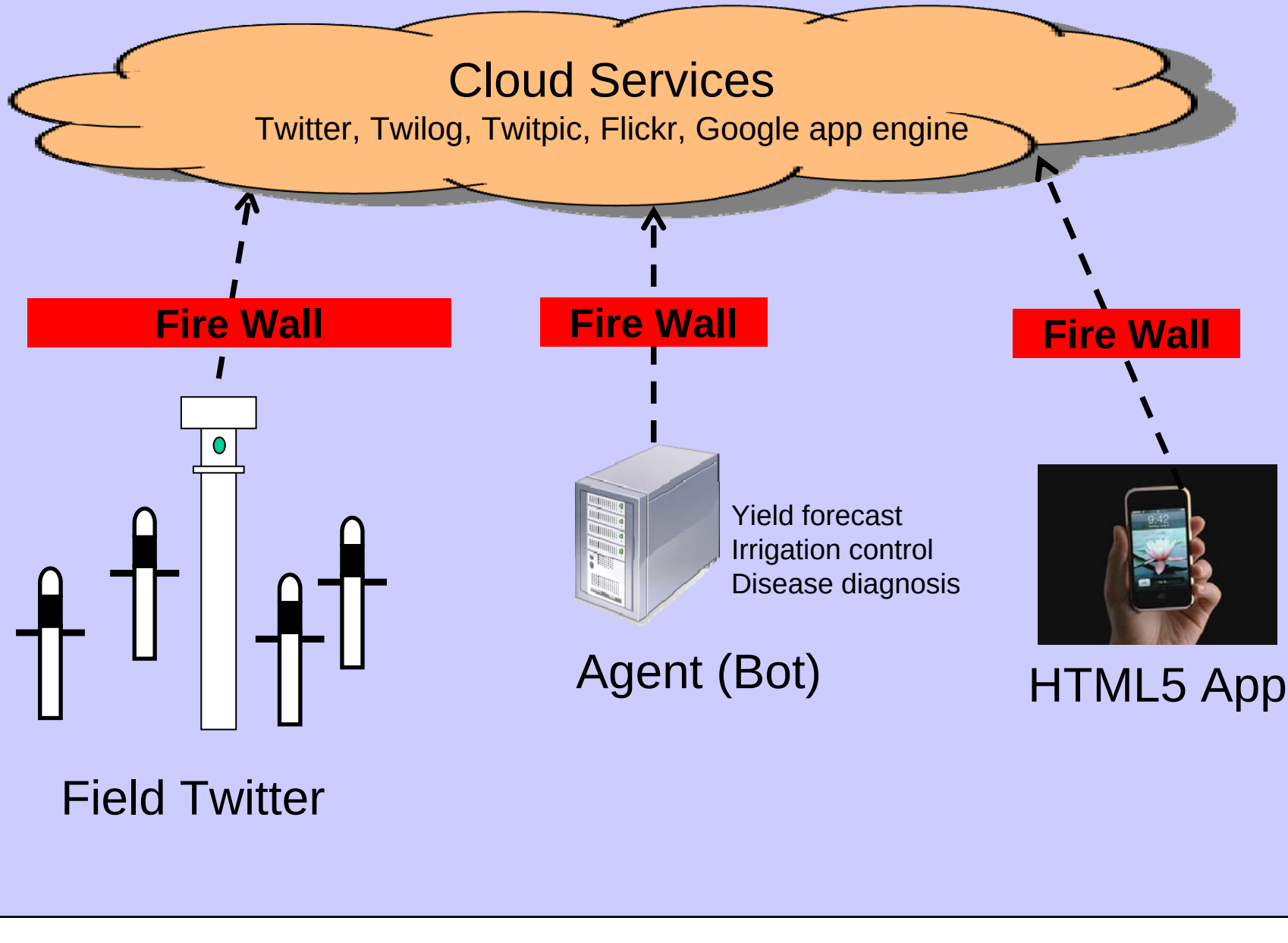
Field Servers share 3G connection.



With Cloud Computing
“Sensor Cloud”

“Field Twitter” by using Open-FS

Ambient Sensor Cloud System

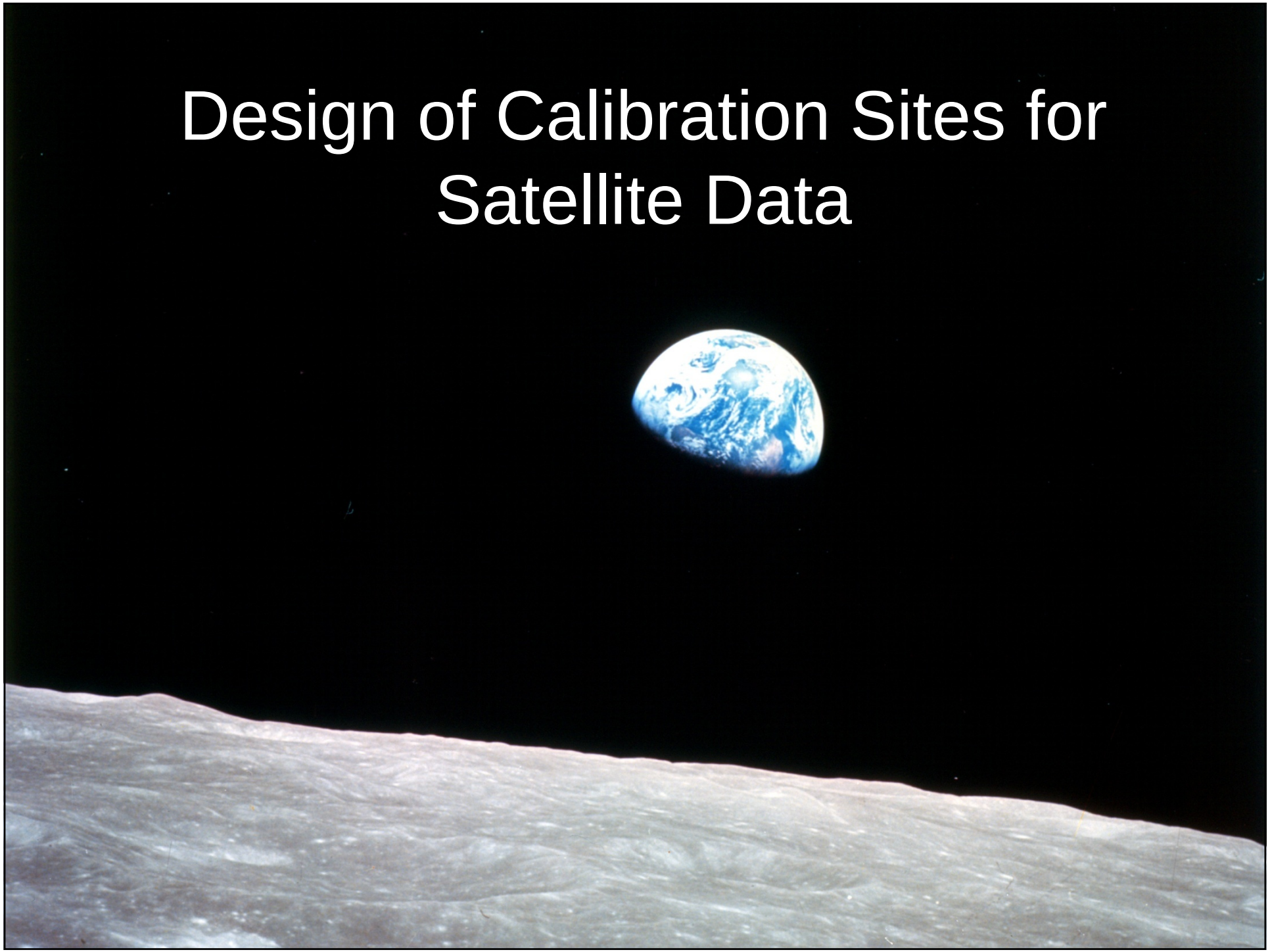


Data Integration

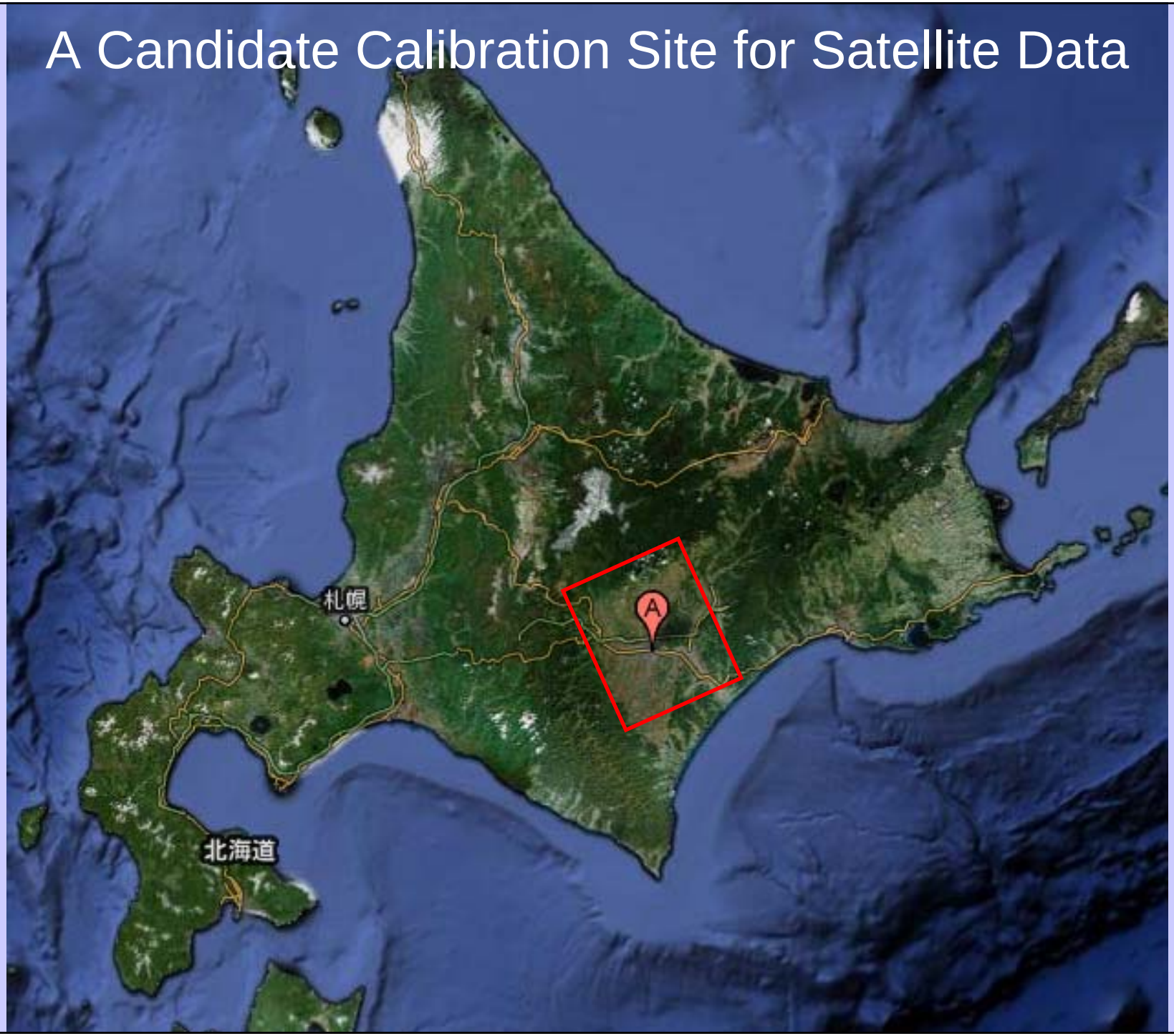
Points of Attention for Data-Integration

1. Accuracy of sensor data
   Especially for “ambient air temperature”
2. Meta-data about accuracy rating of sensor data

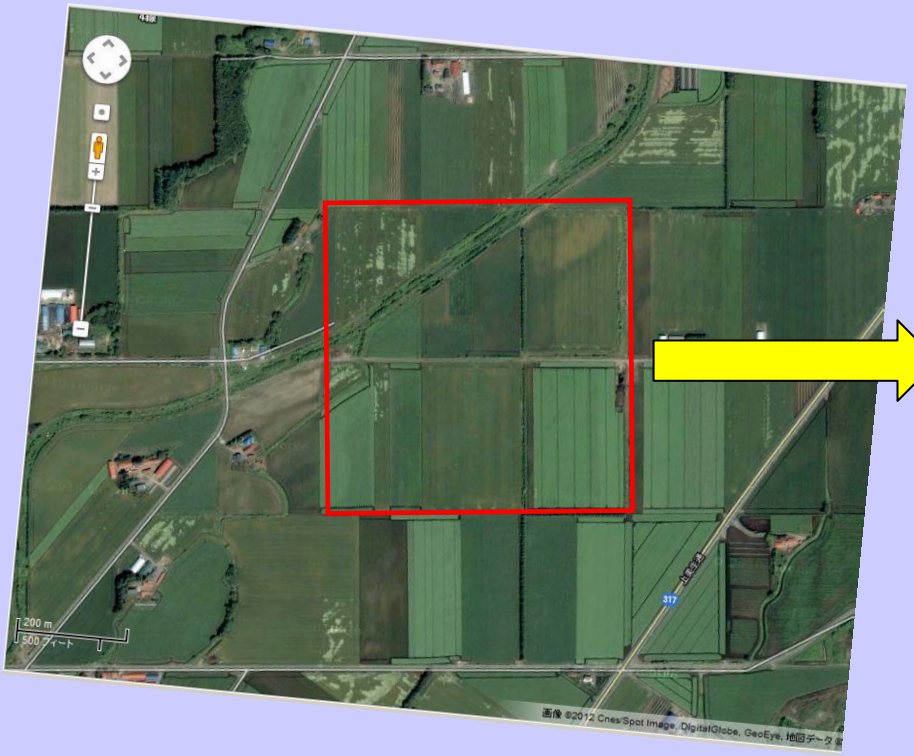
Design of Calibration Sites for Satellite Data

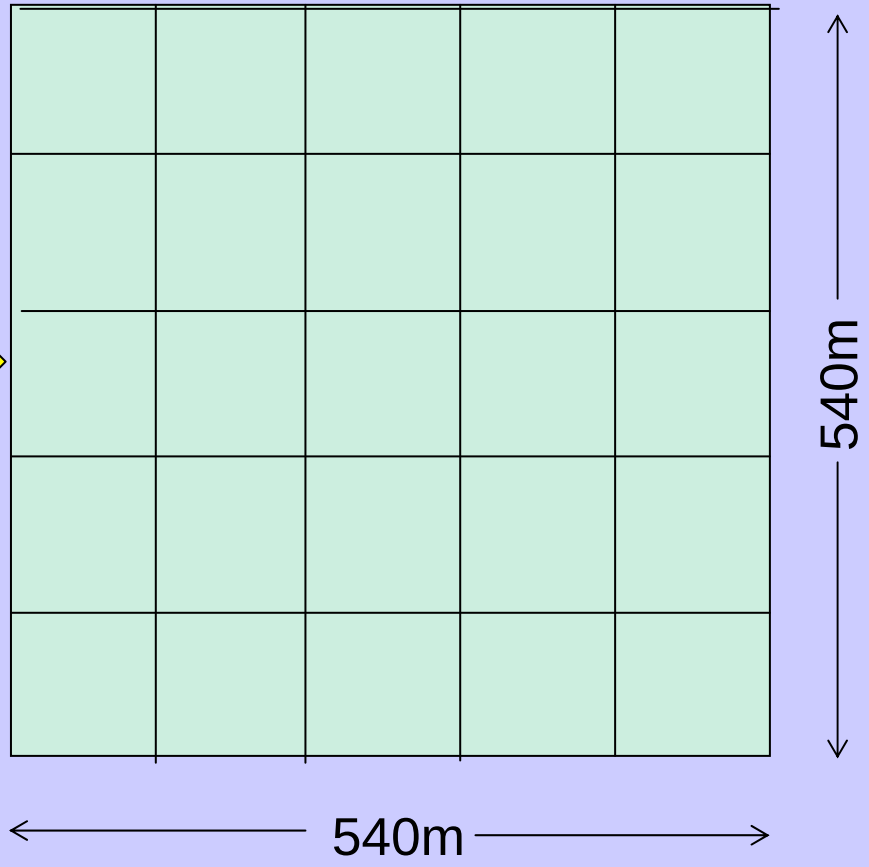


A Candidate Calibration Site for Satellite Data



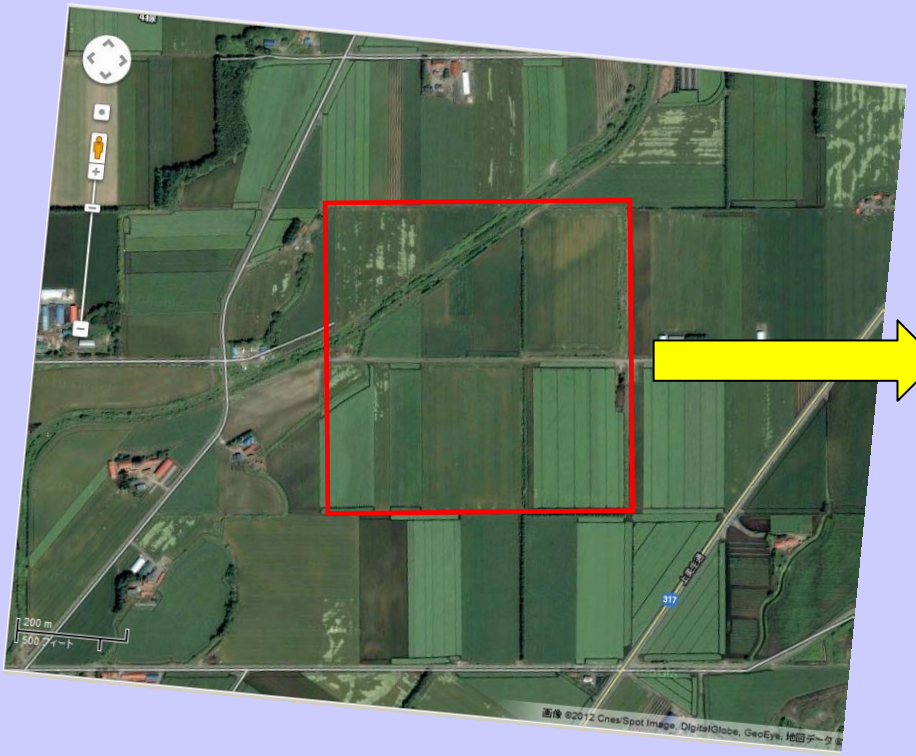
A Typical Field in Tokachi Sub-prefecture

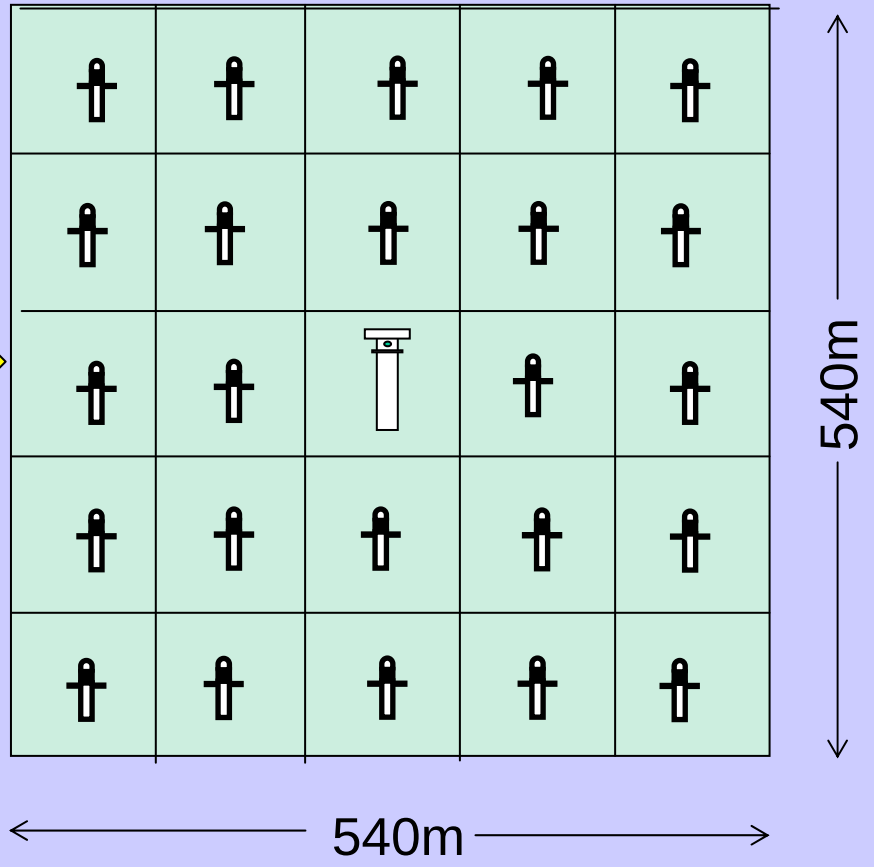




A Sensor Network Model to Get Ground Truth Data

16,000USD (=500X24+4000)



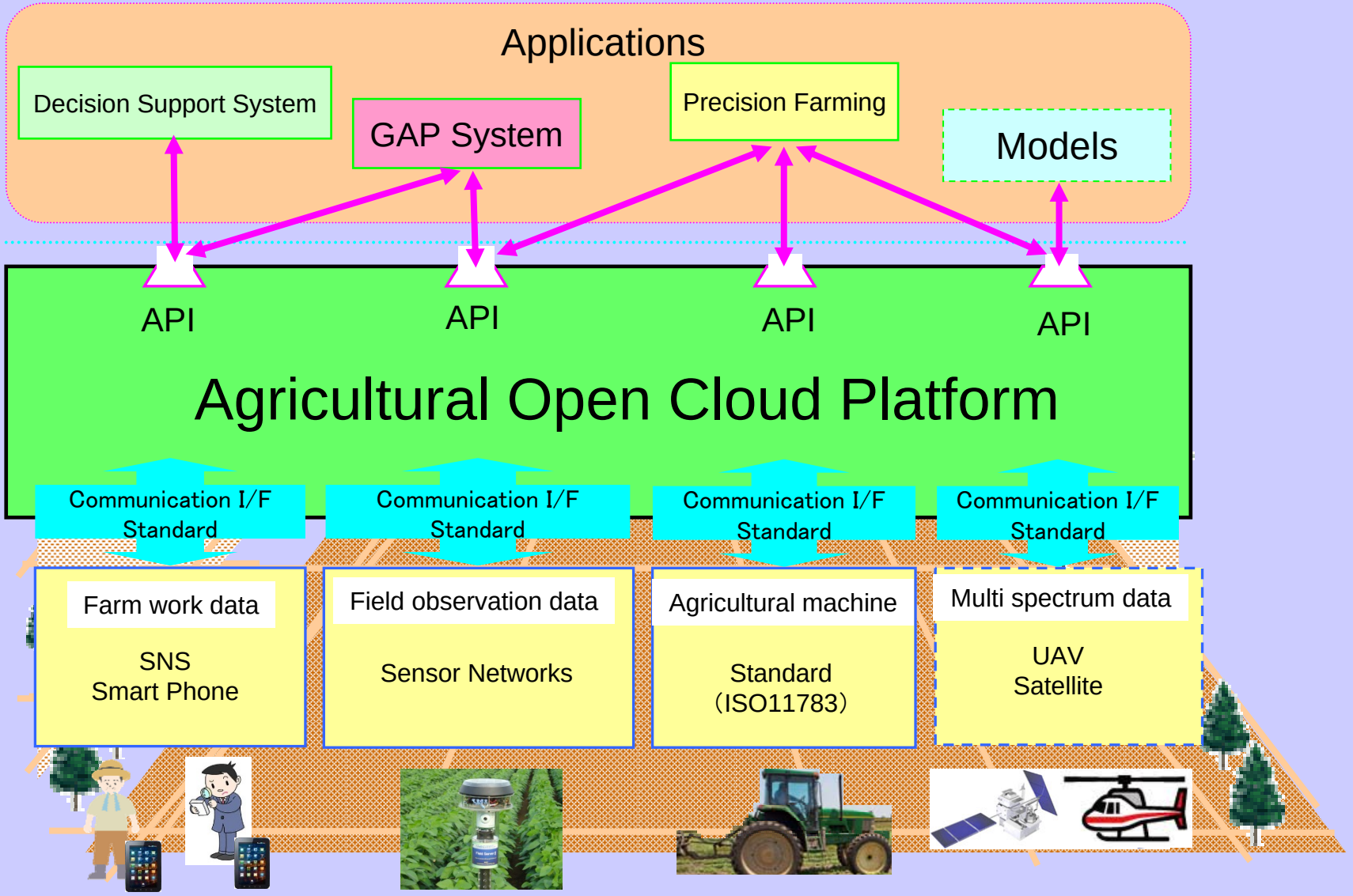


“Big-data” Agriculture.

Variable rate fertilization

Harvester equipped with yield sensor

Standardization of Agricultural Open Cloud Platform



Conclusions

1. Open-FS and Field Twitter were developed.
2. An ambient sensor cloud system was developed.
3. A design of practical calibration site for satellite data is proposed.
4. A concept of agricultural open cloud platform is proposed.
5. Integrated satellite and ground observation data will be big-data, which can innovate agriculture.