

Chinese Standards of the First-mile Data Collection from Automatic Observing Stations

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MOC / CMA

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I. Meteorological Observation in China

1. Subdivides data of discrete categories

- Categories as land Surface data, Vertical soundings, satellite, etc. Each category has a data format standard.

2. Surface observation is the most complex

- **Different number of element:** From 1 single observation element to more than 30 observation elements.
- **Elements are increasing all the time:** There are increasing automatic equipment coming into use.
- **Real time observation data service in manned stations:** About 2427 manned stations in China need to provide real-time observations and services in special cases.
- **Demand for more information:** such as spectral data, image and videos, instrument status, metadata, etc.



Manned stations in china



Equipment layout at manned stations

I. Meteorological Observation in China

1. Why A unified first mile data format is needed

1. Difficulties in the past

- Many instruments manufacturers
- A variety of data format
- Several software
- Several display terminal
- Messy cables

2. Current status

- One interface
- **One data format**
- One software
- One display terminal

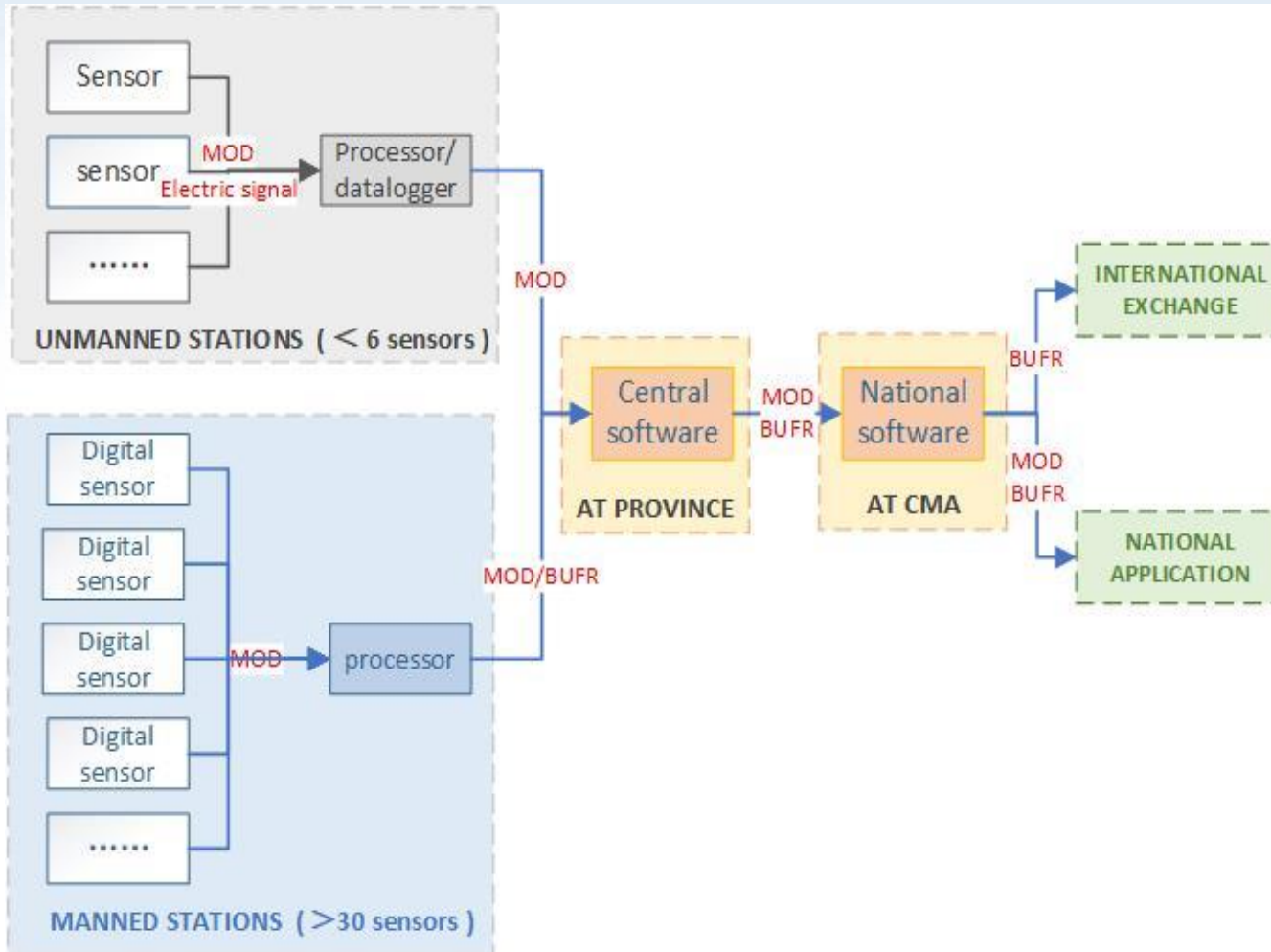
3. Results

- **Flexibility:** Easy to expand variables
- **Compatibility:** Easy to establish an integrated network with instruments from different manufactures



I. Meteorological Observation in China

2. Meteorological data flow in China

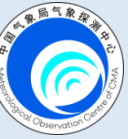


A Unified Data Standard:

the **M**eteorological **O**bservation **D**ata-dictionary (**MOD**).

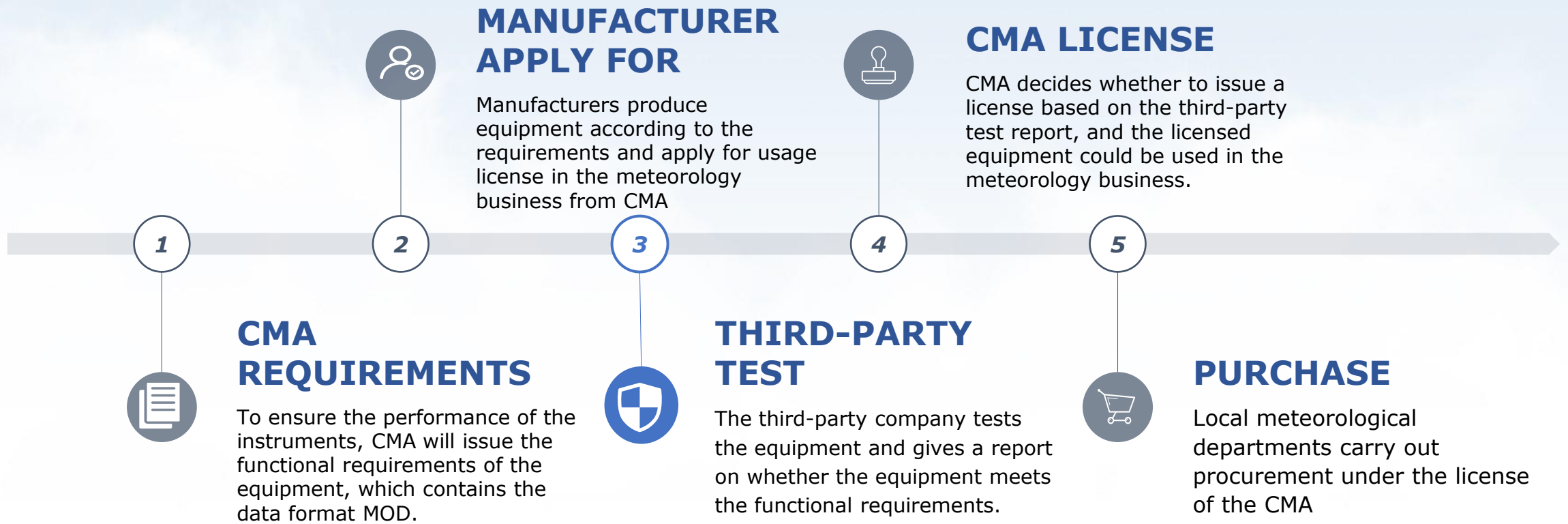
Applications:

- ✓ For all messages transmission from digital sensors to data processor;
- ✓ For all messages transmission from weather stations to Central software;
- ✓ For instrument status and metadata transmission from Central to CMA.



I. Meteorological Observation in China

3. How to make MOD be applied in meteorology business





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II. Standardizations of the First-mile data in China

1. Factors should be considered in coding are:

1. Self-descriptive

Table driven.
Data description.
Data session.

.....



- Different in elements.
- Changing all the time.

Should be flexible and expandable

2. Convenient

Readable.
Simplify.
Only single site message.

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- Manned stations
- Real-time data service.

Should be easy to understand and easy to use

3. Categorized

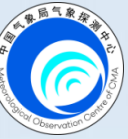
Observation data
Status data.
Metadata.
Spectral data.

.....



- Metadata of station and instruments
- Different type of datasets.

Encoded in different files based on applications



II. Standardizations of the First-mile data in China

2. Similarities and differences between BUFR and MOD

	BUFR	MOD
DIFFERENCE	All sites and all types of observation	subdivides of discrete categories
	no instrument status data	Have instrument status data
	little metadata	Much metadata
	mnemonic not easy to remember	mnemonic easy to remember
	information mixed	Information categorized
	statistics indistinguishable	Statistics distinguishable
SIMILARITY	message structure	
	table driven	
	data descriptor	
	common sequence	

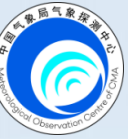


II. Standardizations of the First-mile data in China

3. Layouts of MOD

Section number	Name	Contents
0	Indicator section	"DATADICK", version, station number, device, instrument number, data type ("OB", " ST", " ME")
1	Data section	Time, mnemonic , data, (data flag),(instrument status flag)
2	Check section	The last 4 values of the accumulated ASCII code of all characters from the indicator section to the end of the data section.
3	End section	"ED"

- **Data type:** OBSERVATION tables, INSTRUMENT STATUS tables, METADATA tables.
- **Mnemonic:** flexible, expandable and easy to remember.
- **Data flag:** Data with quality control, it indicates the sampling quality control result.
- **Check section:** make sure the transmission is correct.



II. Standardizations of the First-mile data in China

4. Examples of MOD

- ① **Observation** message of temperature by a temperature **sensor** :

DATADICK,V202201,54511,YTEMP00,N01,OB,20221101080500,TEMPA,7.3,0,TEMPA_mmstd,0.0100,0,z,0,5470,ED

- ② **Observation** message of temperature **in sequence** by a temperature **sensor** :

DATADICK,V202201,54511,YTEMP00,N01,OB,20221101080500,TEMPSEQ1,7.3,0,0.0100,0,z,0,4620,ED

- ③ **Hourly observation** message by **processor**:

DATADICK,V202201,54511,YTEMP00,N01,OB,20220702160000,TEMPA,31.2,0,TEMPA_hhmax,31.5,0,TEMPA_hhmaxt,1546,0,TEMPA_hhmin,30.8,0,TEMPA_hhmint,1503,0,TEMPA_p24tend,1.2,0,TEMPA_p24max,31.5,0,TEMP_p24min,23.3,0,z,0,4012,ED

- ④ **Hourly observation** message **in sequence** by **processor** :

DATADICK,V202201,54511,YTEMP00,N01,OB,20220702160000,TEMPSEQ3,31.2,0,31.5,0,1546,0,30.8,0,1503,0,1.2,0,31.5,0,23.3,0,z,0,5548,ED

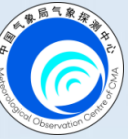
- ⑤ **Instrument status** message of a temperature sensor:

DATADICK,V202201,12345,YTEMP00,N01,ST,20221201080500,z,0,rA,0,rB,0,rC,0,qA,0,qB,0,qC,0,qD,0,qE,0,tF,0,tFA,-40,tFB,0,tFC,0,wA,15.2,wAA,0,xA,DC,xE,12.5,xEA,0,xF,15,xFA,0,7545,ED

- ⑥ **Metadata** message of a temperature sensor:

DATADICK,V202201,12345,YTEMP00,N01,ME,20221201080500,DB,-17.5,EB,V1.0.04,EG,24,EH,20220213,1,3,-30,-29.989,-29.956,0.033,0.028,0,0.015,0.008,0.007,0.028,50,50.013,50.022,0.009,0.0282,EI,Z11010044694014410120711160148060,69363570A123TECKZ789Y456X123W987V654,EL,1163418E401633N,EM,0,EP,DWZ2,FA,1,FF,1,1,2,s,FG,1,HA,0,HB,0,HC,0,HD,0,HE,0,7545,ED

(Orange, indicator section; Red, data section; Black, check section; Green, end section)

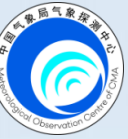


II. Standardization of the First-mile data in China

5. mnemonic

- ❑ All 3 types of mnemonics are composed of category code and element code.
- ❑ Observation mnemonic are based on observation types (see the right table), and statistics are coded differently.
- ❑ Instrument status and metadata are coded by z to a and A to Z respectively, because these two do not have too many elements.
- ❑ Element code are from A to Z.

MNEMONIC	CATEGORY
TEMP	Air Temperature
STEM	Soil Temperature
PRES	Atmospheric Pressure
HUMI	Humidity
WIND	Wind
PREC	Precipitation
EVAP	Evaporation
SDRA	Shortwave Direct Solar Radiation
SSRA	Shortwave Diffuse Sky Radiation
SGRA	shortwave Global Radiation)
SRRA	shortwave Reflected Radiation)
LSRA	longwave Sky Radiation
LERA	longwave Earth Radiation
UVRA	Ultraviolet Radiation
ACRA	photosynthetically active radiation
NERA	net radiation
SUND	Sunshine Duration
CLOD	Clouds
VISI	Visibility
WEAT	Weather
SNOW	Depth of Snow
ACID	Acid Rain
FROS	Frozen Soil
SMOI	Soil Moisture
POWR	power
TIME	time



II. Standardization of the First-mile data in China

6. Examples of observation mnemonic

Category	Mnemonic of observation	Description	Instrument	Mnemonic of instrument
TEMP (Air Temperature)	TEMPA	1.5m air temperature	Platinum resistance temperature measuring instrument	YTEMP00
			Air temperature measuring instrument with forced ventilation	YTEMP01
	TEMPB	Virtual temperature	Ultrasonic wind measuring instrument	YWIND01

Category	Mnemonic of observation	Description	Instrument	Mnemonic of instrument
STEM (Soil Temperature)	-	-	Soil temperature datalogger	YSTEM00
	STEMA	Grass temperature	Grass temperature measuring instrument	YSTEMA0
	STEMB	Soil surface temperature	Platinum resistance surface temperature measuring instrument	YSTEMB0
			Infrared surface temperature measuring instrument	YSTEMB1
	STEMC	5cm soil temperature	Platinum resistance 5cm soil temperature measuring instrument	YSTEMC0
	STEMD	10cm soil temperature	Platinum resistance 10cm soil temperature measuring instrument	YSTEMD0

II. Standardization of the First-mile data in China

7. Examples of observation statistic and observation sequence

mnemonic	statistical period
mm	Minutely Statistic
5mm	5 minute Statistic
hh	Hourly Statistic
dd	Daily Statistic
p0	0 to Present Statistic
p1	Past 1 hours Statistic
p3	Past 3 hours Statistic
p6	Past 6 hours Statistic
p9	Past 9 hours Statistic
p12	Past 12 hours Statistic
p24	Past 24 hours Statistic

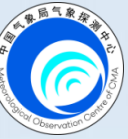


mnemonic	statistical method
max	Maximum Value
maxt	Timeof Maximum Value
min	Minimum Value
mint	Timeof Minimum Value
std	Standard Deviation (N)
mean	Mean Value
medi	Median Value
tend	Tendency
accu	Accumulated value



mnemonic	description
TEMPA_hhmax	Hourly maximum temperature
TEMPA_p0max	maximum temperature from 0 minute to current
TEMPA_p1max	Maximum temperature in the past hour
TEMPA_p24max	Maximum temperature in the past 24 hours
TEMPA_ddmax	daily maximum temperature
TEMPA_hhmaxt	Hour maximum temperature occurrence time
TEMPA_p1maxt	Maximum temperature in the past 1 hour
TEMPA_p24maxt	Maximum temperature in the past 24 hours
TEMPA_ddmaxt	Time of daily maximum temperature
TEMPA_dd	daily average temperature
TEMPA_mmstd	Minute temperature standard deviation
TEMPA_p24tend	24h temperature change

MNEMONIC	CONTENT	DESCRIPTION
TEMPSEQ1	TEMPA,TEMPA_mmstd	the regular data group by the Instrument
TEMPSEQ2	TEMPA,TEMPA_p0max,TEMPA_p0maxt,TEMPA_p0min,TEMPA_p0mint	the regular minutely data group by a processor
TEMPSEQ3	TEMPA,TEMPA_hhmax,TEMPA_hhmaxt,TEMPA_hhmin,TEMPA_hhmint,TEMPA_p24tend,TEMPA_p24max,TEMPA_p24min	the regular hourly data group by a processor



II. Standardization of the First-mile data in China

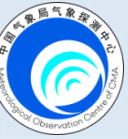
8. Examples of instrument status mnemonic

MNEMONIC	INSRUMENT STATUS CATEGORY
z	The overall status of the device self-check
y	operating status
x	power supply status
w	operating temperature status
v	Heating component status
u	Ventilation component status
t	Communication status
s	Pollution status
r	Sampled data state
q	reserved
.....
a	unique status

Chinese standards of instrument status category

MNEMONIC	VALUE	DESCRIPTION
x	self-check status of power supply part	Detailed description in device status code table
xA	power supply type	AC: indicates AC power supply DC: indicates DC power supply
xB	external power supply voltage	Voltage value of the external power supply, expressed in volts (V). Take 1 decimal place and store the original value.
xC	battery voltage	The value of the current battery voltage, expressed in volts (V), is one decimal place and stored as the original value
xD	Equipment supply voltage	The working voltage of the supply device is expressed in volts (V). The original value is stored as one decimal place
xE	Main board voltage	Voltage value of the main board, in volts (V). Take 1 decimal place and store the original value
xF	working current	The unit is milliamperes (mA), stored in integer
xG	battery status	Battery life status (1-100 number, 100 indicates the highest health status)

subcategory of power supply status



II. Standardization of the First-mile data in China

9. Examples of metadata mnemonic

MNEMONIC	METADATA CATEGORY
A	Observed variable
B	Purpose of observation
C	Station/platform
D	Environment
E	Instruments and methods of observation
F	Sampling
G	Data processing and reporting
H	Data quality
I	Ownership and data policy
J	contact

standards of metadata category (based on WIGOS Metadata)

MNEMONIC	VALUE	DESCRIPTION
EB	software version	measurement/observing method
EC	Hardware version	instrument specifications
EG	Instrument control schedule	instrument control schedule. The verification cycle required by the observation business
EH	instrument control result	The latest equipment verification point and verification value
EI	Device unique identification number	instrument model and serial number
EL	Geospatial location	Geospatial position, latitude and longitude of the instrument
EM	Maintenance Activity	Maintenance start time, maintenance end time, maintenance content description
EP	Use license	The number of the licensed device

subcategory of Instruments and observation methods

Metadata MNEMONIC is based on 《WIGOS Metadata Standard (2019 edition)》.

Metadata does not change frequently, so this message does not need to be uploaded every day.



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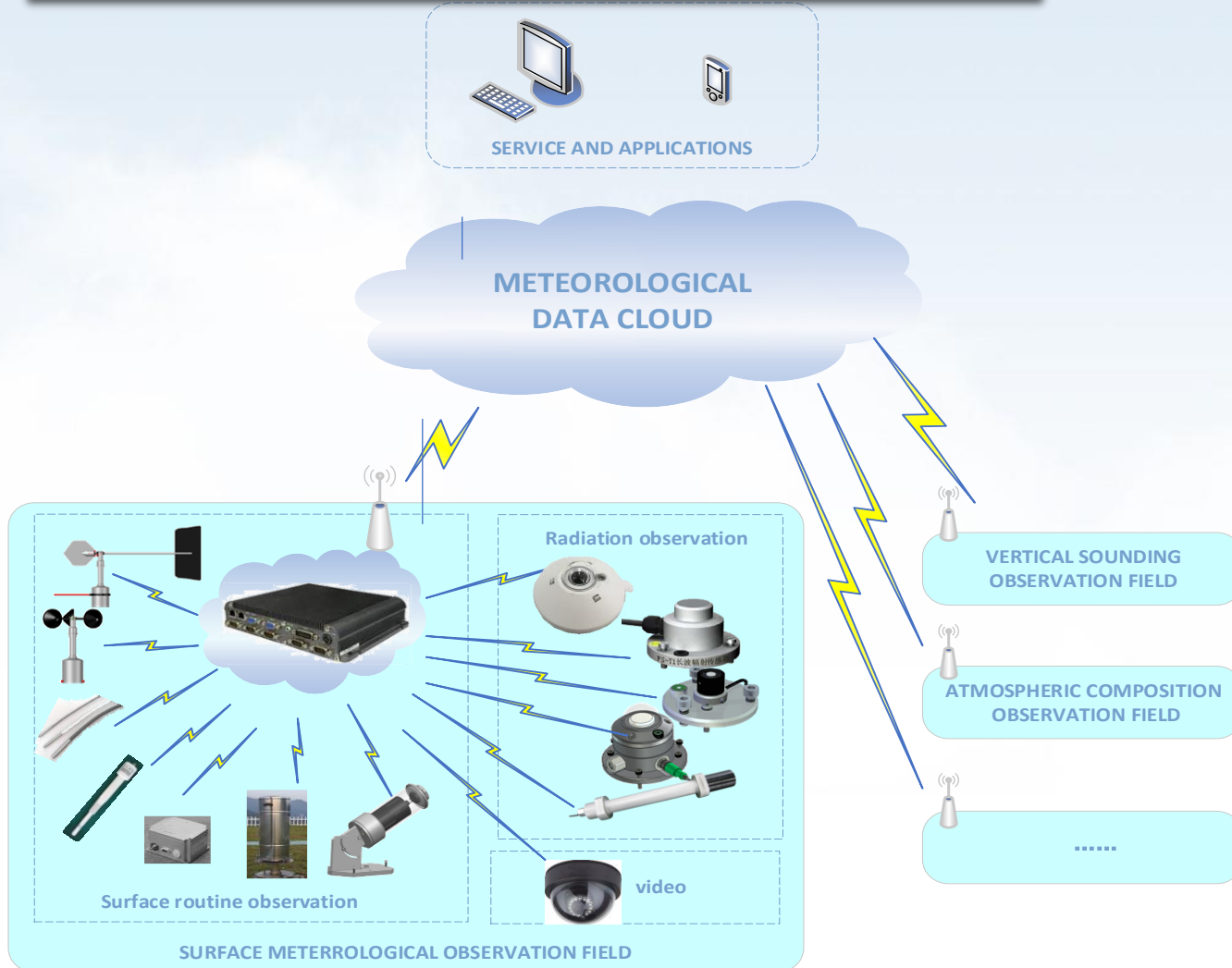
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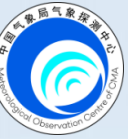
Application in meteorological observation

III. Application in meteorological observation

Structure of AWS in CHINA



- ❑ **Wireless LAN** is used to transfer device data to the processor which makes it convenient to expand equipment.(wired connection is still in use at the previously installed sites)
- ❑ Wireless also supports **remote device upgrades**, which is conducive to device software and data format updating.
- ❑ The integrated processor has three functions as **management center**, **internet gateway** and **data Processing**, which calculates statistics and converts data formats.



Thanks for your attention!

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