

Detailed Specification for**Landslide Early Warning Instrumentation & Real Time Monitoring System**

This **field based landslide early warning instrumentation & real time monitoring system** is to be installed and made operational on a turn-key basis at Tangni Landslide area on NH-58 12 km ahead of Pipalkoti in Chamoli District of Uttarakhand and comprises of the following major components:

- A. Instruments for wireless based real time landslide monitoring system**
- B. Site Preparation for Instrumentation**
- C. Field Installation of Instruments**
- D. Maintenance of the real time landslide monitoring system**

(A) Instruments for wireless based real time landslide monitoring system**1. Vibrating Wire Piezometer – 2 No.**

- Type: Vibrating wire type
- Range: 0-0.5 MPa
- Accuracy: ± 0.5 % FS or better
- Operating Temperature: -10 to $+60^{\circ}\text{C}$ or better
- Material: Stainless Steel
- Maximum Overpressure: 150% of range
- Filter type: Standard High/Low Air Entry 50 micron porosity or better
- Environmental Protection: IP68 or better
- Cable: 4-Core shielded from sensor to the top of the borehole
- Other accessories for installation

2. MEMS based In-place Inclinator (IPI) Sensors – 13 Nos.

- Sensor: Biaxial Sensor on wheel pairs
- Measuring Range: $\pm 15^{\circ}$
- Sensor Accuracy: $\pm 0.1\%$ FS or better
- Operating Temperature Range: -10°C to $+60^{\circ}\text{C}$ or better
- Environmental Protection – IP68 or better
- Sub-assemblies:
 - Spacer assembly: 3m gauge length
 - Suspension kit with protective cap

- Placement tubing for placing string of sensors
- Individual 4 or 6 conductors single cable from each sensor in the borehole to the top surface OR a single cable threaded in a daisy chain fashion, connecting each sensor with Wireless Sensor Node.
- Casing: ABS self aligning four grooved access tube around 70 mm O.D. for the borehole depth
- Other accessories for installation

3. Soil Moisture Sensors – 4 Nos.

- To measure water content of the soil.
- Measurement range: 0 to 0.3 m³.m⁻³ or better
- Accuracy: ±0.03 m³.m⁻³ or better
- Temperature range: -10°C to +60°C or better

4. Automatic Rain Gauge – 1 No.

- Tipping bucket type
- Accuracy: ±5% or better
- Resolution: 0.5 mm or better
- Range: 0 to 500 mm/hr or better

5. Wireless Sensor Nodes – 6 Nos.

- Each Wireless Sensor Node must be compatible for connecting IPI Sensor(s) and/or Vibrating Wire Sensor and/or Soil Moisture Sensor(s) together in combination.
- Each Wireless Sensor Node must be able to accommodate minimum 5 sensors.
- Accuracy: ±0.5 % FS or better
- Battery powered with minimum 3 years life
- Environmental Protection: IP68 or better
- Temperature range: -10°C to +60°C or better
- ADC resolution: 12 bits or better
- Hourly data reading from the sensors

6. Coordinator Node/Data Logger/Gateway – 1 No.

- Wireless Transceiver: 2.4 GHz Frequency (or any permissible ISM band with better range capability) for sending and receiving data to and from all the installed Wireless Sensor Nodes with minimum 500 m range
- 3G/4G/LTE or a suitable GSM Module for sending data to Cloud Server over internet by connecting to ISP
- Memory storage: 16Mb/2Mb flash memory or better
- Suitable power supply through Solar System with Battery (described in Point 8)

- Should have facility to download data by laptop and/or USB
- Temperature range: -10°C to +60°C or better
- Facility to connect 1 Rain Gauge Sensor (Wired/Wireless)

7. Web based Monitoring Software – 1 No.

- Web based monitoring software with Database to store sensed data
- Graphic like a map, ground plan or a photograph can be put on the screen and marked with installed sensors. The sensor locations should indicate a pop up box having the corresponding sensor details.
- Capable of downloading both raw data and processed data from all the sensors
- Graphical display facility of sensor data in hourly/daily/weekly/monthly/yearly basis.
- Monitoring software to be password protected
- Multiple users' facility at any time from any internet-connected PC in real time.
- Watchdog function to generate an email and/or text message alarm and/or hooter alarm
- Detailed alarm logging
- Automatic generation of reports in csv, excel or similar data format

8. Solar Panel, Batteries & Accessories – As per requirement for the whole system

- 12V 100W solar panels with weather proof structure
- 12V 10A Charge controller for charging 12V SMF batteries from solar panel
- 12V 65AH sealed maintenance free (SMF) batteries

9. Network Architecture

- There are two types of Wireless Communication Networks acceptable as explained below:

STAR NETWORK: Figure 1 demonstrates a star wireless sensor network that enables Sensor Nodes to send the sensors' readings wirelessly directly to the Coordinator Node/Data Logger/Gateway Node.

OR

MESH NETWORK: Figure 2 demonstrates a multi-hop wireless sensor network that enables Sensor Nodes to send the sensors' readings wirelessly through any other node of the network and finally to the Coordinator Node/Data Logger/Gateway Node. The communication mesh is smart, dynamically re-adapting the communication paths.

- After receiving sensed data, Coordinator Node/Data Logger/Gateway Node will send it to the Cloud Server through ISP. It is same for both Star and Mesh Network Architectures in Figures 1 and 2 respectively.
- Sensor Nodes to Sensor Node communication and Sensor Node to Coordinator Node/Data Logger/Gateway Node communication range must be minimum 500m.

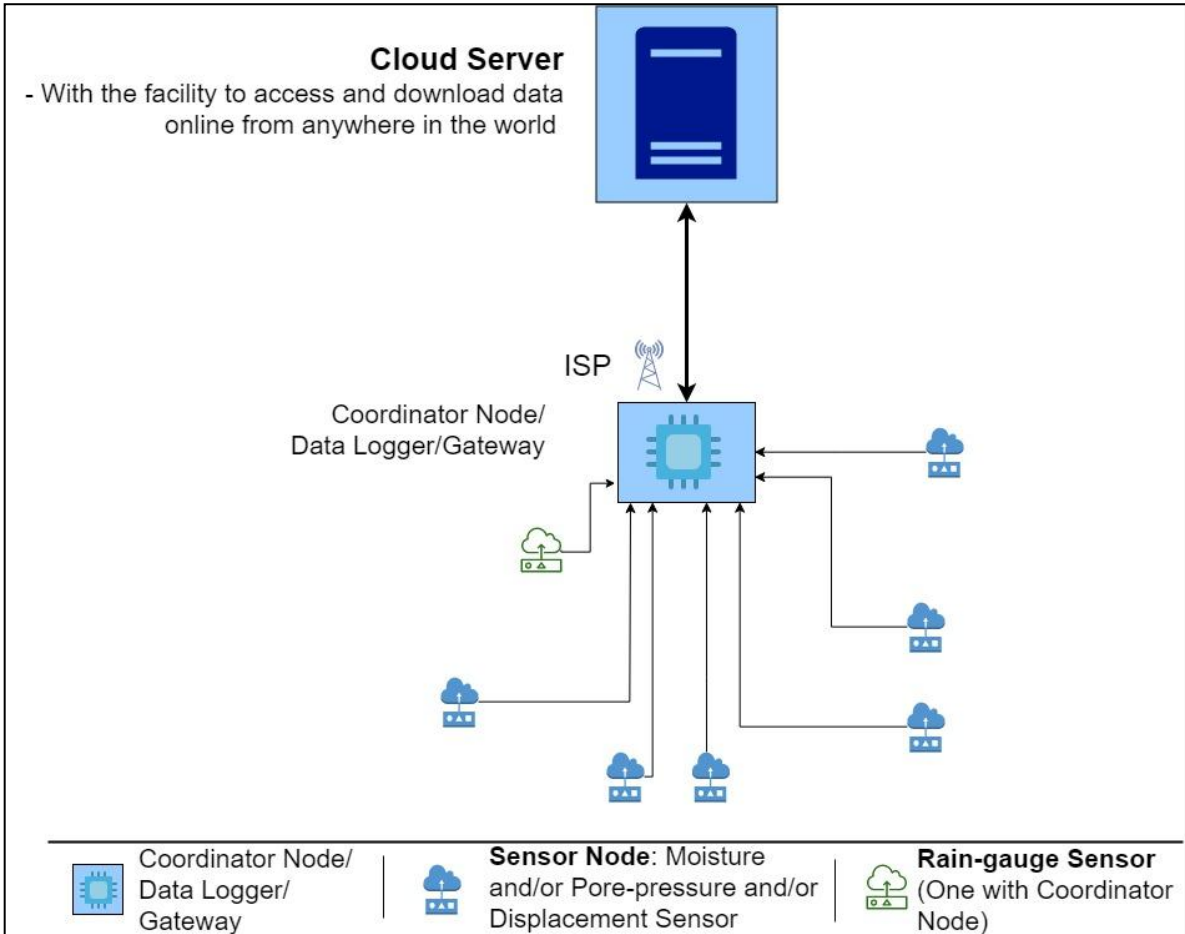


Fig.1. Network Architecture with Star Topology between Coordinator Node and Sensor Nodes

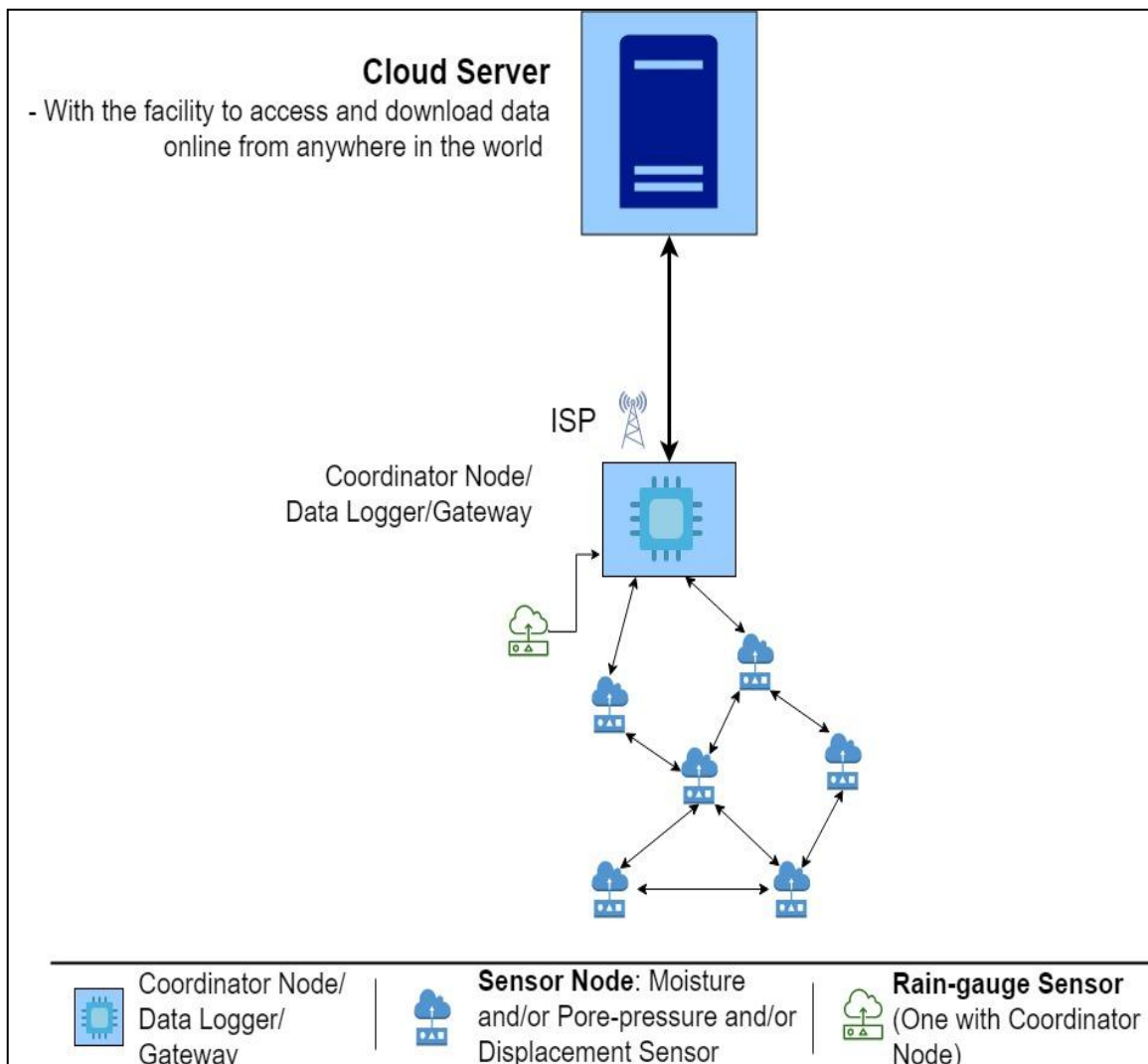


Fig.2. Network Architecture with Mesh Topology (Multi-hop) between Coordinator Node and Sensor Nodes

(B) Site Preparation for Instrumentation

- Total drilling length of about 120m with about 6 Nos. of 100 mm dia boreholes at 6 locations on hill slope with each borehole drilled up to 2m within bedrock.
- Core logging as per standard format and preservation of core samples (soil/debris/rocks) in core boxes are also to be done. The core boxes needs to be delivered at CBRI Roorkee.
- Supply and installation of PORTA Cabin of 3m X 2m X 2m size for control station.

(C) Field Installation of Instruments

- A total of 2 VW piezometers and 13 in-place inclinometer sensors need to be installed at different depths in 6 boreholes.
- A total of 4 soil moisture sensors need to be installed in the pits in top soil at different selected locations on the landslide slope.

- All the sensors need to be integrated with a total of 6 Sensor Nodes at suitable locations on landslide slope for effective communication with the Coordinator Node/Data Logger/Gateway Node.
- Porta Cabin needs to be erected near the landslide body for establishing the Control Room.
- Coordinator Node/Data Logger/Gateway Node with batteries is required to be installed inside the Control Room.
- Automatic rain-gauge station and solar panel with weather proof facility needs to be installed near/at roof top of the control room.
- Installation of laboratory developed sensors along with the procured sensors must be allowed.

(D) Maintenance of the real time landslide monitoring system

The real time landslide monitoring system needs to be installed at Tangni Landslide on NH-58 (12km ahead of Pipalkoti in Chamoli District of Uttarakhand) should include the annual maintenance of the whole system to keep it functional round the clock for 3 years time. Minimum 4 visits annually to the instrumented site and submission of status report of the site is required. Additionally, after the report of non-functioning of any component at any time, it must be addressed within a week's time.

IMPORTANT

Technical Qualification Criteria: The bidder should have carried out at least one similar supply and installation work in recent past (5-6 years).

BoQ				
S.No.	ITEM	QTY.	UNIT PRICE (INR)	TOTAL PRICE (INR)
1	VW piezometers and its accessories	2		
2	MEMS based In Place Inclinometer Sensors and its accessories	13		
3	Soil Moisture Sensors and its accessories	4		
4	Automatic Rain Gauge and its accessories	1		
5	Wireless Sensor Nodes and its accessories	6		
6	Coordinator Node/Data Logger/Gateway and its accessories	1		
7	Web based Monitoring Software with 3 years license	1		
8	Solar Panels, Batteries and other accessories	1 Set		
9	Porta Cabin and its accessories	1		
10	Drilling of HX size boreholes (6 nos), mobilization/demobilization charges, core logging, core boxes, delivery of core boxes at CSIR-CBRI and other related aspects	120 m		
11	Field Installation of all sensors, sensor nodes, Coordinator Node/Data Logger/Gateway, automatic rain gauge, porta cabin and their integration as per network architecture	1		
12	Maintenance of the whole system for 3 years			
Total				