



NS178

Secondary System Requirements for Major Substations (Metering Only)

September 2012



SUMMARY

Network Standard NS178 (Metering) covers the planning and design requirements for metering systems for subtransmission feeders, subtransmission substations and zone substations. **The requirements for control and protection systems that make up the rest of NS178 will be published shortly.**

ISSUE

For issue to all Ausgrid and Accredited Service Providers' staff involved with the design of Ausgrid's major substations.

Ausgrid maintains a copy of this and other Network Standards together with updates and amendments on www.ausgrid.com.au.

Where this standard is issued as a controlled document replacing an earlier edition, remove and destroy the superseded document.

DISCLAIMER

As Ausgrid's standards are subject to ongoing review, the information contained in this document may be amended by Ausgrid at any time.

It is possible that conflict may exist between standard documents. In this event, the most recent standard shall prevail.

This document has been developed using information available from field and other sources and is suitable for most situations encountered in Ausgrid. Particular conditions, projects or localities may require special or different practices. It is the responsibility of the local manager, supervisor, assured quality contractor and the individuals involved to ensure that a safe system of work is employed and that statutory requirements are met.

Ausgrid disclaims any and all liability to any person or persons for any procedure, process or any other thing done or not done, as a result of this Standard.

Note that compliance with this Network Standard does not automatically satisfy the requirements of a Designer Safety Report. The designer must comply with the provisions of the WHS Regulation 2011 (NSW - Part 6.2 Duties of designer of structure and person who commissions construction work) which requires the designer to provide a written safety report to the person who commissioned the design. This report must be provided to Ausgrid in all instances, including where the design was commissioned by or on behalf of a person who proposes to connect premises to Ausgrid's network, and will form part of the Designer Safety Report which must also be presented to Ausgrid. Further information is provided in Network Standard (NS) 212 *Integrated Support Requirements for Ausgrid Network Assets*.

INTERPRETATION

In the event that any user of this Standard considers that any of its provisions is uncertain, ambiguous or otherwise in need of interpretation, the user should request Ausgrid to clarify the provision. Ausgrid's interpretation shall then apply as though it was included in the Standard, and is final and binding. No correspondence will be entered into with any person disputing the meaning of the provision published in the Standard or the accuracy of Ausgrid's interpretation.

Network Standard
NS178
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Major Substations (Metering Only)
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4 Metering Systems

4.0 Explanatory Note to this Interim Publication

Network Standard NS178 (Metering) covers the planning and design requirements for metering systems for subtransmission feeders, subtransmission substations and zone substations. **The requirements for control and protection systems that make up the rest of NS178 will be published shortly.**

4.1 Guiding Principles – Metering Points Categories

The following definitions replace the term Bulk Supply Point (BSP) and seek to provide greater clarity for metering points within and bordering the Ausgrid transmission and distribution Network. Ausgrid must ensure that metering installations in a zone substation (ZS), subtransmission switching station (STSS) or subtransmission substation (STS) are installed to ensure compliance with the National Electricity Rules (NER).

4.1.1 Wholesale Metering Point (WMP)

Across the Ausgrid network, any present or potential future connection point that is mutually defined by AEMO (Australian Energy Market Operator) and Ausgrid as a junction between Transmission and Distribution will require National Electricity Rules (NER) compliant Wholesale Metering. This point is known as a Wholesale Metering Point (WMP). Such a connection point will be identified by the allocation of a Transmission Node Identifier (TNI) and the metering associated with the TNI will be located at the Transmission Node. WMPs will be installed at a minimum of a Type 2 metering installation, see table in Clause 4.3.

It is vital that these WMPs are metered in accordance with the NER as the data from these meters allows for settlement of the NEM. This metering data also allows AEMO to calculate EnergyAustralia Retail's liability to generators for electricity traded in the spot market. Failure to meet these NER requirements may result in financial penalties and/or place Ausgrid's Network Operators licence in jeopardy.

NOTE: WMP's may be used as a Network Boundary Point (NBP) in addition to their use as a WMP. In this case they will still be referred to as a WMP and must meet the requirements of a WMP.

4.1.2 Network Boundary Point (NBP)

Across the Ausgrid network, any present or potential future connection point that has been identified by Ausgrid as a connection point to another LNSP or TNSP will be deemed a Network Boundary Point (NBP). An NBP requires metering equivalent to NER compliant metering. It should be noted that the majority of these NBP will be located in TransGrid Substations. Connections to generators may also be considered as a NBP, however these will be classified as a Generator Metering Point (GMP) as defined below. NBPs are generally Type 2 metering installations where installed in Ausgrid substations.

Where WMP or NBP metering is required in TransGrid substations, the Ausgrid Responsible Person (RP) will consult with TransGrid to ensure that the relevant metering requirements are achieved.

4.1.3 Zone Metering Point (ZMP)

A metering point at any zone substation that is not deemed to be a WMP or NBP will be classified as a Zone Metering Point (ZMP). ZMP are not required to comply with the requirements of the NER. However, in the event that one of these ZMP may become a WMP in the future, these points are to be installed as a minimum Type 2 WMP installation.

At the discretion of the Ausgrid Responsible Person (RP) installation of metering panels for check meters may not be required where there is no immediate requirement for a check metering installation. In this case, space must be allocated adjacent to the metering panels for the installation of future check metering panels should they be required.

Some metering points that are not required to be WMP or NBP but are installed for statistical metering purposes may also be referred to as a ZMP. Although these may not be located on the transformers at a Zone Substation, they are generally installed to the same requirements and therefore still referred to as a ZMP. These may include metering points that were WMP in the past or may become WMP in the future.

4.1.4 Customer Metering Point (CMP)

A Customer Metering Point is a metering point on any direct connection from an Ausgrid Substation to a customer's installation. NER compliant metering must be installed and the metering installation is to be located on the customer's premises, not at the Ausgrid Substation. Further information regarding the metering requirements for these installations can be found in Ausgrid's metering policy document ES3 - Metering Installations.

4.1.5 Generator Metering Point (GMP)

A Generator Metering Point is a metering point on any direct connection from a Generator Installation to the Ausgrid Network. NER compliant metering must be installed, and the metering installation is to be located on the generator's premises, not at the Ausgrid Substation. Further information regarding the metering requirements for these installations can be found in ES3 - Metering Installations and the Ausgrid Standard Generator Connection Agreement suite of documents.

4.1.6 Power Quality Metering Point (PQMP)

A Power Quality Metering Point (PQMP) is a metering point where a meter is to be installed for the purpose of obtaining Network Power Quality data. Any Ausgrid zone substation (ZS), subtransmission switching station (STSS) or subtransmission substation (STS) may contain one or more PQMP(s). New substations of these types or major refurbishments at such substations shall include power quality metering equipment.

The Senior Engineer from Ratings and Supply Quality (RSQ) shall advise on power quality metering requirements such as the location of the PQMP(s) in consultation with the Ausgrid Responsible Person (RP).

4.1.7 Identification of Likely WMP, NBP or ZMP.

Ausgrid will identify the category of metering required as a part of any substation specification. The Ausgrid Responsible Person (RP) must be informed of any new or altered construction work at the development brief phase of the project so that the metering requirements can be determined and incorporated into the Engineering Requirements document. In general the following points are likely to be identified as a WMP, NBP or ZMP. Three phase currents and voltages for metering purposes are required at each metering point.

- 132kV Feeder – typically at a Sub-transmission Substation.
- 132kV/66kV Transformer – typically at the LV (66kV) side.
- 132kV/33kV Transformer – typically at the LV (33kV) side.
- 132kV/11kV Transformer – typically at the LV (11kV) side.
- Any connection point at a boundary to any external network (Endeavour Energy, Essential Energy and TransGrid).

4.1.8 Identification of Likely PQMP

The Senior Engineer – Ratings & Supply Quality will identify points that require PQMP metering and inform the Ausgrid Responsible Person (RP). The Senior Engineer – RSQ

shall be consulted during the RP's consideration of likely NBP, WMP or ZMP metering points during the development brief (DB) phase of substation construction or upgrade projects. The PQMP requirements shall be incorporated into the design document for the project. In general, three phase voltages and/or currents are likely to be required for the following points to be utilised by PQMP metering:

- Transformer Secondaries;
 - The voltage on each bus or bus section for split bus bars
 - The summated current when transformers are in parallel or several transformer tails are present.
- one 132kV bus voltage and one 132kV feeder current – typically at a Sub-transmission Substation. This is to be determined on a case by case basis;
- feeders to major customers;
- network boundary points (NBP).

4.2 Definition of Compliance to National Electricity Rules

The following details the requirements to achieve compliance to the NERs. These details apply to NER Version 49 (April 2012). The requirements specified below should be checked against the current version of the NER.

Some components of specific metering requirements are governed by the annual GWh energy throughput at a connection point. For the purpose of this document the following definitions will apply for the type of HV metering installation:

TYPE 1 Greater than 1000GWh PA;

TYPE 2 Between 100GWh PA and 1000GWh PA;

TYPE 3 Below 100GWh PA.

All WMP and NBP will be classified at a minimum of a Type 2 metering installation. A ZMP must have the equipment provided to be classified as a Type 2 metering installation, however check metering may be omitted from the original installation at the discretion of the Ausgrid RP.

4.3 Type Specific Requirements

Item	Metering Requirements WMP or NBP Type 1	Metering Requirements WMP or NBP Type 2	Metering Requirements ZMP	Metering Requirements PQMP
Revenue CT Details	<p>Accuracy - Class 0.2S.</p> <p>Measurement uncertainty less than $\pm 0.05\%$.</p> <p>On each phase of feeders and TX secondaries.</p> <p>Secondary output to be 1A and 15VA.</p> <p>CT secondary wiring remains exclusively for the purpose of electricity metering and cannot be shared with other devices.</p>	<p>Accuracy - Class 0.5S.</p> <p>Measurement uncertainty less than $\pm 0.1\%$.</p> <p>On each phase of feeders and TX secondaries.</p> <p>Secondary output to be 1A and 15VA.</p> <p>CT secondary wiring remains exclusively for the purpose of electricity metering and cannot be shared with other devices.</p>	<p>Accuracy - Class 0.5S.</p> <p>Measurement uncertainty less than $\pm 0.1\%$.</p> <p>On each phase of feeders and TX secondaries.</p> <p>Secondary output to be 1A and 15VA.</p> <p>CT secondary wiring remains exclusively for the purpose of electricity metering and cannot be shared with other devices.</p>	

Item	Metering Requirements WMP or NBP Type 1	Metering Requirements WMP or NBP Type 2	Metering Requirements ZMP	Metering Requirements PQMP
Check CT Details	<p>Accuracy - Class 0.2S.</p> <p>Measurement uncertainty less than $\pm 0.05\%$.</p> <p>On each phase of feeders and TX secondaries.</p> <p>Secondary output to be 1A and 15VA.</p> <p>Check Current Transformer secondary wiring on a Type 1 installation remains exclusive for the purpose of electricity metering and cannot be shared with other devices.</p>	<p>Accuracy - Class 0.5S.</p> <p>Measurement uncertainty less than $\pm 0.1\%$.</p> <p>On each phase of feeders and TX secondaries.</p> <p>Secondary output to be 1A and 15VA.</p> <p>Check CT secondary wiring on a Type 2 installation can be shared with other devices (e.g. a power quality meter or Voltage Regulation equipment), subject to the arrangement not affecting the performance of the check metering (ie. shorting out one part of the circuit will not affect the check metering and the combined load of the meter and other instrumentation must be within the burden range of the CT).</p>	<p>Accuracy - Class 0.5S.</p> <p>Measurement uncertainty less than $\pm 0.1\%$.</p> <p>On each phase of feeders and TX secondaries.</p> <p>Secondary output to be 1A and 15VA.</p> <p>CTs to be terminated and shorted in marshalling box if not used for other purposes.</p>	<p>Accuracy - Class 0.5S.</p> <p>Measurement uncertainty less than $\pm 0.1\%$.</p> <p>On each phase of feeders and TX secondaries where a PQMP has been nominated</p> <p>Secondary output to be 1A and 15VA</p> <p>Note that the CTs used for a PQMP may be shared with other equipment such as Type 2 Check Metering.</p>
VT Details	<p>Accuracy - Class 0.2.</p> <p>Measurement uncertainty less than $\pm 0.05\%$.</p> <p>On Primary and Secondary side of TX.</p> <p>Secondary output to be 110V (phase to phase) or $110/\sqrt{3}$ (phase to neutral) and 25VA per phase (minimum VA available for metering).</p>	<p>Accuracy - Class 0.5.</p> <p>Measurement uncertainty less than $\pm 0.1\%$.</p> <p>On Primary and Secondary side of TX.</p> <p>Secondary output to be 110V (phase to phase) or $110/\sqrt{3}$ (phase to neutral) and 25VA per phase (minimum VA available for metering).</p>	<p>Accuracy - Class 0.5.</p> <p>Measurement uncertainty less than $\pm 0.1\%$.</p> <p>On Primary and Secondary side of TX.</p> <p>Secondary output to be 110V (phase to phase) or $110/\sqrt{3}$ (phase to neutral) and 25VA per phase (minimum VA available for metering).</p>	<p>Accuracy - Class 0.5.</p> <p>Measurement uncertainty less than $\pm 0.1\%$.</p> <p>At the nominated PQMP location. VT's used for a PQMP must be of the magnetic type and not capacitive VT's.</p> <p>Secondary output to be 110V (phase to phase) or $110/\sqrt{3}$ (phase to neutral) and 25VA per phase (minimum VA available for metering).</p>
Meter Details	<p>Accuracy - Class 0.2 (Wh)</p> <p>Class 0.5 (VARh).</p> <p>One revenue and one check meter per metering point.</p> <p>Location of metering points to be determined by the Network RP.</p>	<p>Accuracy - Class 0.5 (Wh)</p> <p>Class 1.0 (VARh).</p> <p>One revenue and one check meter per metering point.</p> <p>Location of metering points to be determined by the Network RP.</p> <p>Adequate panel space to</p>	<p>Accuracy - Class 0.5 (Wh) Class 1.0 (VARh).</p> <p>One revenue meter per metering point.</p> <p>Metering points to be located on the secondary side of each transformer.</p> <p>Adequate panel space to</p>	<p>Class A compliance with IEC61000-4-30.(Edition 2)</p> <p>One meter per metering point. (*)</p> <p>Metering point(s) to be located as nominated by the Senior Engineer – Ratings & Supply Quality.</p>

Item	Metering Requirements WMP or NBP Type 1	Metering Requirements WMP or NBP Type 2	Metering Requirements ZMP	Metering Requirements PQMP
	Adequate panel space to incorporate two meters, (one revenue and one check), associated communication equipment and links etc. for each metering point. These panels shall be clearly labelled with the metering point details (eg. TX1, Fdr 957) and which is 'Revenue' and 'Check'. Refer to clause 7.5.	incorporate two meters, (one revenue and one check), associated communication equipment and links etc. for each metering point. These panels shall be clearly labelled with the metering point details (eg. TX1, Fdr 957) and which is 'Revenue' and 'Check'. Refer to clause 7.5.	incorporate one revenue meter, associated communication equipment and links etc. for each metering point. These panels shall be clearly labelled 'Revenue' and include the metering point details (eg. TX1). Refer to clause 7.5. Adequate panel space shall also be provided in the control room for future check metering panels.	Adequate panel space to incorporate one power quality meter, associated communication equipment and links etc. for each PQ metering point (*). A shelf shall be provided in the rear of the metering panel to support each PQ meter. These panels shall be clearly labelled 'Power Quality Metering' and include the metering point details (eg. TX1). Refer to clause 7.5.
Communications Details	No specific details at this time. GSM/NextG modem to be installed by Metering Provider at the meter panel.	No specific details at this time. GSM/NextG modem to be installed by Metering Provider at the meter panel.	No specific details at this time. GSM/NextG modem to be installed by Metering Provider at the meter panel.	Either: RJ45 Ethernet connection to be provided at the PQ meter panel and cabled (Cat 5E) back to a local Cisco Grid Connected Switch. OR: a 100 Base FX fibre interface to a Cisco Grid Connected switch anywhere in the substation OR: a 100 Base FX fibre interface to the MPLS/PINC communications cabinet only where there is no Cisco switch. If MPLS/PINC is not available, wireless communication methods(e.g. NextG modem) shall be used.

(*) Depending on the PQ meter up to two metering points can be supported by one meter.

4.3.1 Common Requirements and Definitions

The following requirements are common to all categories of metering installations.

- (a) **Access to Test** – It is **MANDATORY** that the installation of CTs and VTs is carried out in such a way that primary injection testing of an individual instrument transformer is practically achievable. Practically achievable means that electrical access can be

achieved through normal operational switching without the isolation of alternative electricity supply and physical access means the capability of convenient connection of injection cabling to the primary side of the instrument transformer and adequate space for test instruments directly adjacent to the device under test. This also includes access to the secondary side of the instrument transformers as close as practically allowable to the secondary terminals whilst maintaining safety clearances. This is typically achieved with a marshalling box and/or test links adjacent to the instrument transformers. This testing requirement **MUST** be taken into consideration when purchasing switchgear (eg. GIS switchgear) and during the design process.

A set of voltage transformer secondary test points must be located between each VT and its fuse. The test points themselves must be suitable for in-service connection of test cables with either spade type lugs or 4mm 'banana' plugs.

NOTE: It is Ausgrid's obligation under the NERs that these instrument transformers are tested at least every 10 years. Failure to do so would constitute a breach of the NERs.

- (b) **Auxiliary Supply** – A 110V ac supply with a failsafe backup supply must be provided at each metering panel. The revenue and check supplies must not be supplied from the same circuit. Each supply must be separately fused.
- (c) **CT Requirements** - Metering Class CTs must comply with the current version of AS 60044.1, design type tested and with traceable individual accuracy test results for the quoted accuracy class. CTs must be installed with the primary polarity facing toward the source of generation.
- (d) **Revenue CT** - The Revenue CT is reserved exclusively for electricity metering. Apart from the electricity meter, no other device may be in series with the secondary circuit. This also applies to Check CTs on Type 1 Metering Points.
- (e) **Revenue Metering** – A metering installation which is the primary source of metering data.
- (f) **Secondary Wiring Security** - Secondary wiring must be installed in a secure manner, with unbroken conductors between instrument transformer secondary terminals and marshalling box (if applicable) and electricity meter panel. Provision is required to allow the marshalling box and electricity meter panel to be sealed or locked.

Check CT secondary wiring on a Type 2 installation may be shared with other devices, subject to the arrangement not affecting the performance of the check metering (ie. shorting out one part of the circuit will not affect the check metering and the combined load of the meter and other instrumentation must be within the burden range of the CT).

- (g) **Secondary Wiring Cross Section** - Secondary conductors must be selected to minimise the contribution of burden due to voltage drop and to achieve overall error performance as specified by the Metering Provider. All secondary cables used for metering purposes must be screened and the screen earthed at either end of the cable. The minimum specific requirements for each individual main and check circuit are as follows:
 - 6mm² for current transformer secondary wiring up to 750m
 - 6mm² for voltage transformer secondary wiring up to 200m and 16 mm² for voltage transformer secondary wiring up to 750m.
- (h) **VT Requirements** - Metering Class VTs must comply with the current versions of AS 60044.2 if single phase or AS1243 - 1982 if three phase, design type tested and with traceable individual accuracy test results for the quoted accuracy class. All VT's for use with a PQMP must be of the magnetic type.
- (i) **VT Secondary** – VT secondary wiring can be shared with other devices, including Check Metering and/or Power Quality Metering subject to individually fused circuits for each device and subject to the arrangement not affecting the performance of the Main

or Check metering. The VT fuses for each circuit are to be located as close as practicable to the VT's.

4.3.2 Testing Requirements for Instrument Transformers

All instrument transformers that are to be used for any metering purpose, must comply with Chapter 7 of the National Electricity Rules and AEMO Metrology Procedure.

All instrument transformers must have a valid pattern approval issued under the authority of the National Measurement Institute or, until relevant pattern approvals exist, a valid type test certificate.

Note: all instrument transformer designs MUST have a valid type test certificate that meets the full type test requirements of the appropriate Australian Standard even once the National Measurement Institute pattern approval exemption is lifted.

Each individual instrument transformer MUST be supplied with routine test results to the appropriate Australian Standard with traceability to National Standards and a statement of the Estimated Uncertainty of Measurement.

All reference/calibration equipment used for the purpose of meeting the routine and type testing obligations identified within this clause, must be certified to ensure full traceability to test certificates issued by either:

- (a) A NATA accredited body; or
- (b) A laboratory recognised under the International Laboratory Accreditation Corporation (ILAC) mutual recognition agreement. Further details of ILAC laboratories can be found at <http://www.ilac.org/>.

Copies of the test reports for all WMPs and CMPs must be forwarded to:

- Engineer – Bulk Supply Point Metering
Ausgrid
Homebush Business Village
Units 39-42, 11-21 Underwood Road
Homebush NSW 2140
- or fax to (02) 8719 3022, Attn: Engineer – Bulk Supply Point Metering
- or email to – bsp@ausgrid.com.au

at least two weeks prior to the instrument transformers being installed.

4.3.3 Additional Testing Requirements for Current Transformers

All routine test reports for current transformers must include the test points as identified in AS 60044.1 – 2007, Table 12 - Limits of Current Errors and phase displacement for measuring current transformers for special application. In addition to these test points identified in AS60044.1, test points of 10% and 50% must also be included in the routine test report for each individual current transformer. All test points for current transformers must be tested at both 25% and 100% rated burden for each individual current transformer.

4.4 Marshalling Box Details

The marshalling box shall be installed as close as practicable to the instrument transformers. This box shall be of adequate size to allow termination of all cables from the CTs, VTs and those going to the metering panel and should also be capable of accommodating the following equipment for each secondary circuit.

- Three black HRC fuseholders (GEC Safeclip FS20CF or equivalent) and one white HRC fuseholder (GEC Safeclip LK3A or equivalent).
- Slide test links (Phoenix URTK/S or equivalent) to be connected in series, on the load side of the above fuseholders.

- All CT secondary wiring to terminate in slide test links (Phoenix URTK/S or equivalent).

4.5 Meter Panel Details

The meter panel layout and design should use the following drawings as an example:

- Schematic drawing No. 225643.
- Layout drawing No. 225644.

The meter panel(s) shall be located as separate panel(s) within the control room of the substation. A separate panel shall be supplied and clearly identified for revenue and check metering for WMP and NBP. Meter panels for all metering points in one substation shall be located adjacent to each other where possible. This will allow for simplification in the communications and auxiliary supply installation. Every two PQMPs will require a half meter panel.

Where ZMP panels have been installed without space for Check Meters, spare panel bays must be left in the control room adjacent to the existing meter panels for future installation of Check Meter panels so that the full requirements of a Type 2 WMP installation can be met.

Secondary VT conductors are to be terminated in fuse links and in series with slide test links (Phoenix URTK/S or equivalent). Secondary CT conductors are to be terminated in slide test links (Phoenix URTK/S or equivalent).

The meter panel drawing indicates communications requirements for remote meter reading and includes requirements for PSTN, MPLS and wireless communication technologies.

4.6 Accommodation of Transducers

The location and requirement of transducers is specified by Ausgrid. Typically, transducers are co-located at WMPs or NBPs. In this circumstance, for Type 2 and Type 3 installations where check CTs are installed, CT secondary wiring can be connected to kW / kVAR transducers. Such metering points will be to the specification level of the Check Metering of a Type 2 installation.

4.7 Accommodation of metering CTs

If a 2nd set of suitably sized CTs for check metering cannot be provided within switchgear chambers, as may be the case with compact GIS switchgear at 132kV, for example, the first preference is for a separate metering core over the cable rather than using interposing CTs on the protection CTs. Physical access to the CT is required for the purposes of testing, ie: a large enough window to get a 50mm diameter test cable through beside the feeder cable. Suitable access to the cable basement (or wherever the CT's are located) is required to allow manual handling of heavy test equipment. Interposing CTs on a protection CT secondary circuit is only acceptable if the first preference is not feasible. All sheathed HV cables must be terminated in a manner that does not affect the accuracy of the CT.

4.8 Accommodation of Power Quality Meters

Power Quality Meters shall be installed whenever a new Ausgrid zone substation (ZS), subtransmission switching station (STSS) or subtransmission substation (STS) is established or undergoes a major refurbishment and the Senior Engineer – Ratings & Supply Quality nominates a PQMP. The power quality meters must be of accuracy 'Class A' according to AS/NZS 61000.4.30 and the measurements are to be taken in accordance with AS/NZS 61000.4.7.

Voltages shall be monitored with at least Class 0.5 magnetic VTs. Currents shall be monitored with at least Class 0.5 CTs.

If possible, communication to the power quality server shall be established via MPLS (PINC), otherwise via the wireless communication methods. e.g. NextG modem.



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