

The Network Centric Test System

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Topics

- **Why use a network?**
- **Common tasks using instruments with PCs**
- **Common networking terms and devices**
- **Test system network topologies**
- **Summary**

Why Would I Want a Network Centric Test System vs. GPIB?

Cost—an order of magnitude different for the connections:

- **GPIB:** **Interface: \$500+** **Cables: \$50 - \$100**
- **Ethernet:** **Interface: \$0 - \$50** **Cables: \$ 2 - \$6**
- **For the cost of a GPIB cable, it is possible to outfit a test station with Ethernet**

Speed (for large data blocks):

- **GPIB <1 MB/sec**
- **Ethernet 1-60+ MB/sec**

Latency:

- **GPIB 0.2-2 mS**
- **LAN 0.1-5 mS**

Configuration and use flexibility

- **Cable lengths from .5 meter to 100's of meters—readily available**
- **Worldwide access through the Internet if needed**
- **System support and collaboration through the web**



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Common Tasks encountered using instruments with PCs

- Physically and logically attach an instrument to a computer
 - Find 'How To' information
 - View instrument screen on PC
 - Change instrument settings (programmatically or graphically), move data to Excel, Matlab, ADS, VB, C#...
 - Work with one or more people to solve measurement or system problems
 - Work with Agilent personnel to solve instrument setup, configuration, measurement problems or receive training.
- Topology selection. Load and configure appropriate software.
 - Remote Help: Instrument help on PC screen
 - Remote Monitoring: see & save screen
 - Remote Front Panel: GUI front panel on PC
 - Remote Control: alter settings, get/send data in PC-standard formats.
 - Remote Collaboration: more than one person monitoring or controlling the instrument(s) or system.
 - Remote Support: across firewalls, change configuration of instrument, update instrument firmware, licenses, etc.



Common Networking Terms

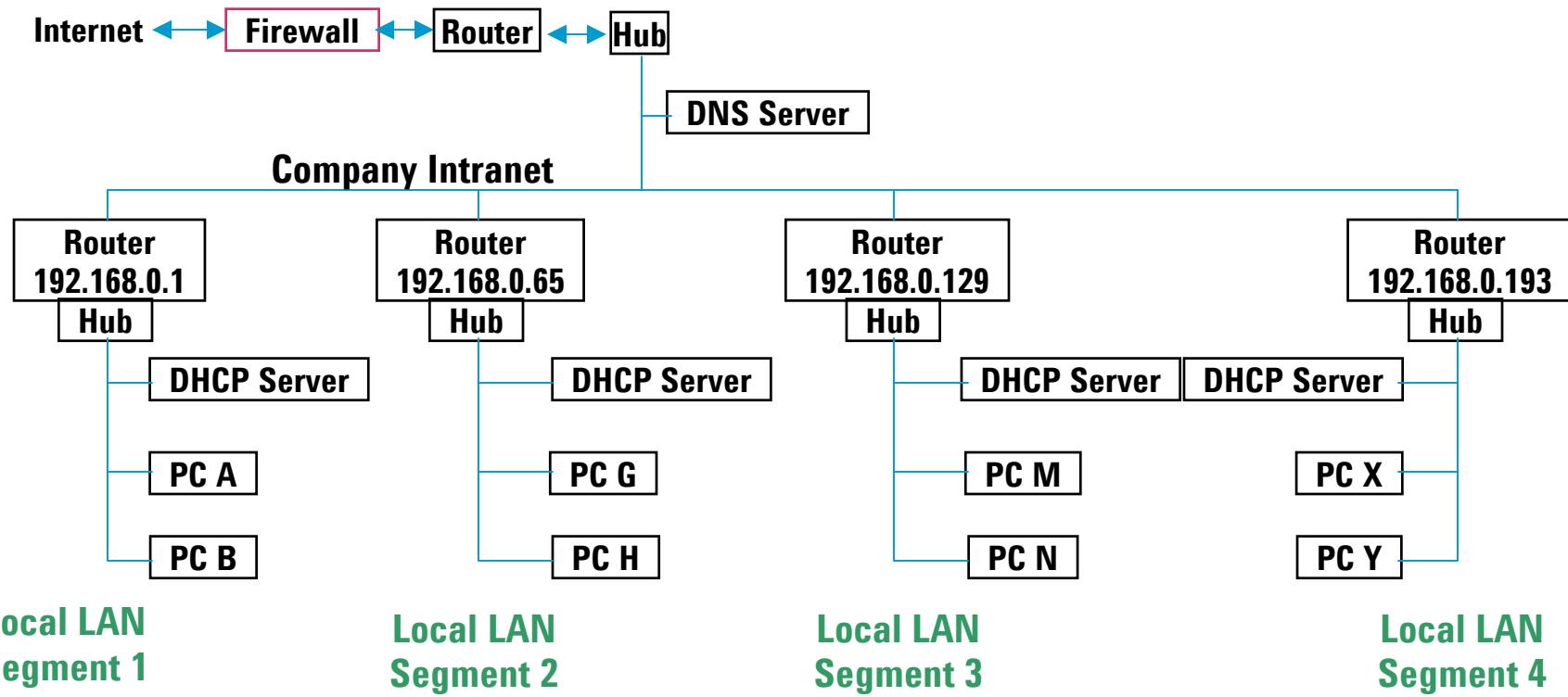
DHCP	Dynamic Host Configuration Protocol —a method of automatically obtaining an IP address for a LAN connected device (computer, router, instrument, etc.)
DNS	Domain Name Service : maps names to IP addresses.
IP	Internet Protocol : requires an address to communicate.
Intranet	Typically, a network within an organization—local in scope to the organization. It may have protected access to the Internet.
Internet	A publicly accessible wide area network (WAN).
LAN	Local Area Network : a network that is restricted in scope or access. Often used as a label to distinguish ports on routers and firewalls.
WAN	Wide Area Network : a network such as the internet which has broader or public access. Often used as a label to distinguish ports on routers and firewalls.
VPN	Virtual Private Network : a protocol for secure communication across the public Internet—messages are encrypted, communicating parties are validated as authorized.



Common Networking Devices

Hub	A multi-port device which transmits on all other ports any packet received by any port.
Switching Hub	An intelligent hub that looks at the traffic on each port to determine which addresses are present. It uses this information to switch received packets to the appropriate port instead of blindly sending incoming packets to all ports.
Router	A two port device used to separate a network into localized segments. The WAN port is connected to the larger network and the LAN port is connected to the local segment. This device only allows WAN traffic destined for the local segment through AND forwards packets from the local segment to the WAN when the destination address is outside of the local segment address range—also called a gateway.
Firewall	A two port security device used to examine incoming and outgoing traffic between the Internet and an internal network to prevent unauthorized access. Commonly located in a router or computer which acts as the Internet or WAN gateway.

A Typical Network in a Company or Organization

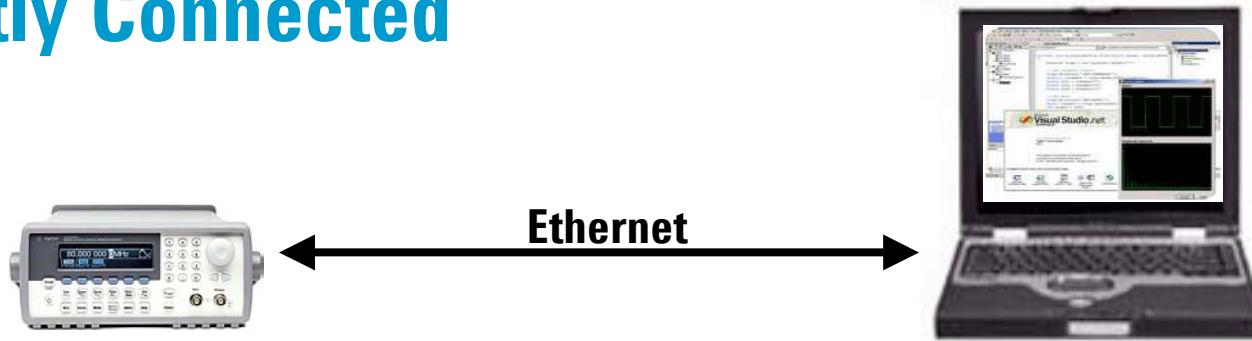


The number of LAN segments and the size of the segments depends on the size of the organization. A small company may collapse this to only one segment (1 router).

The DHCP server often resides in the router (a common practice).

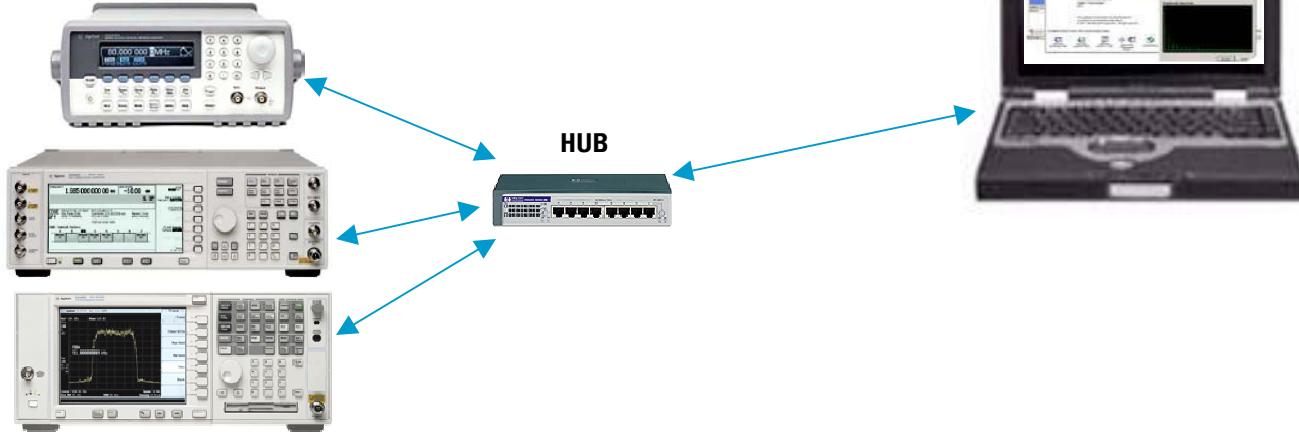


Directly Connected



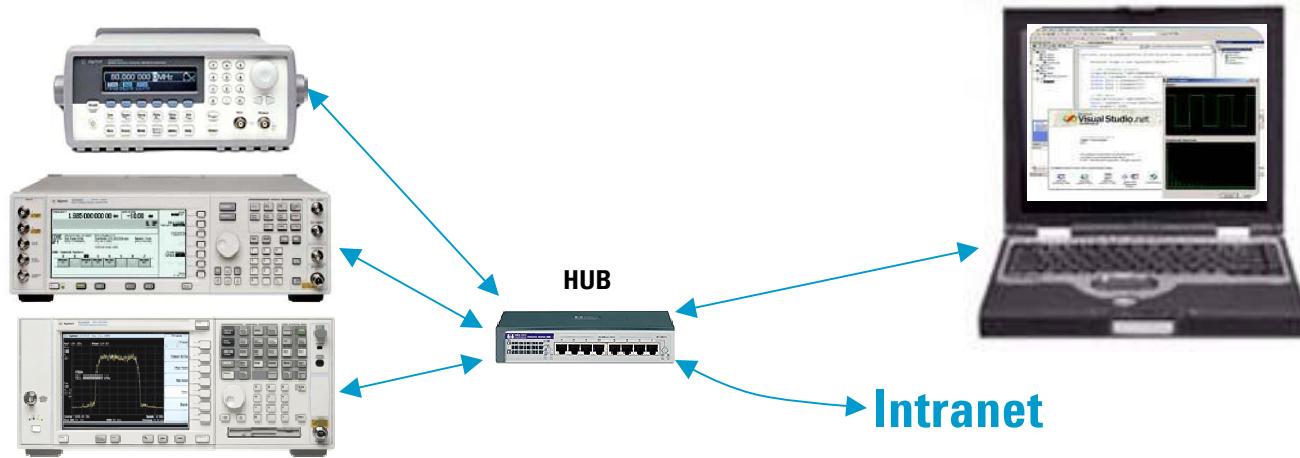
- **Single instrument connected to PC**
 - May need a crossover cable
- **Instrument accessible only from connected PC**
 - Excellent measurement integrity and security
 - No remote access or collaboration
- **Works well for field portable usage**

Directly Connected through a Hub



- **Multiple instruments connected to PC**
- **Instruments accessible only from connected PC**
 - **Excellent measurement integrity and security**
 - **No remote access or collaboration**
- **Works well for field usage or self contained systems**

Connected through a Hub to the Intranet

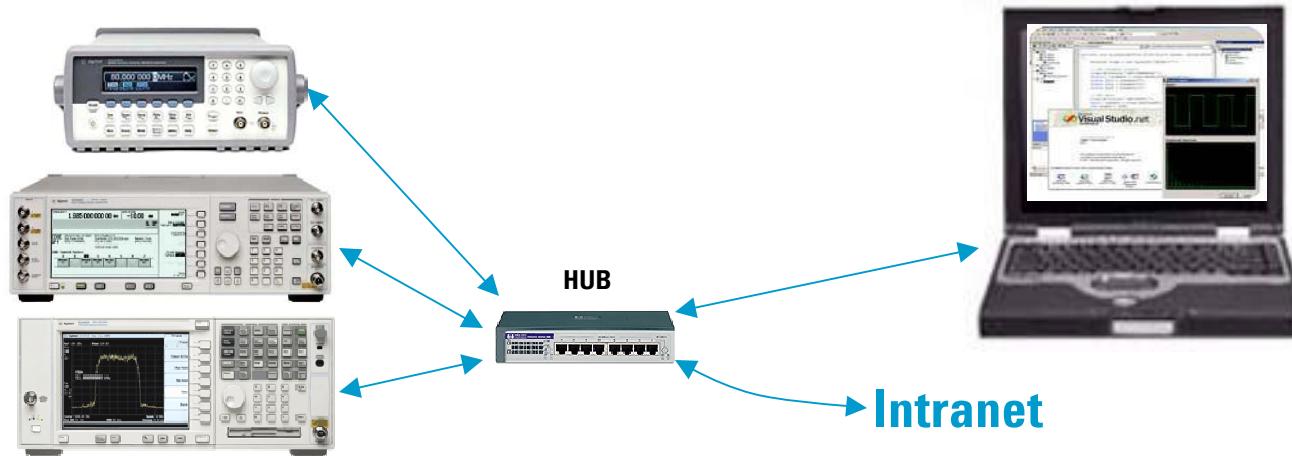


- Multiple instruments connected to PC and intranet
 - Consumes IP address on intranet for each instrument
- Instruments accessible from any PC on network
 - Enables remote viewing, control and collaboration
 - Measurement integrity can be compromised by multiple user access—relies on access control provided by instrument.
- Intranet traffic competes with test system traffic
 - Degraded network performance and measurement throughput
- Small to large systems easily implemented



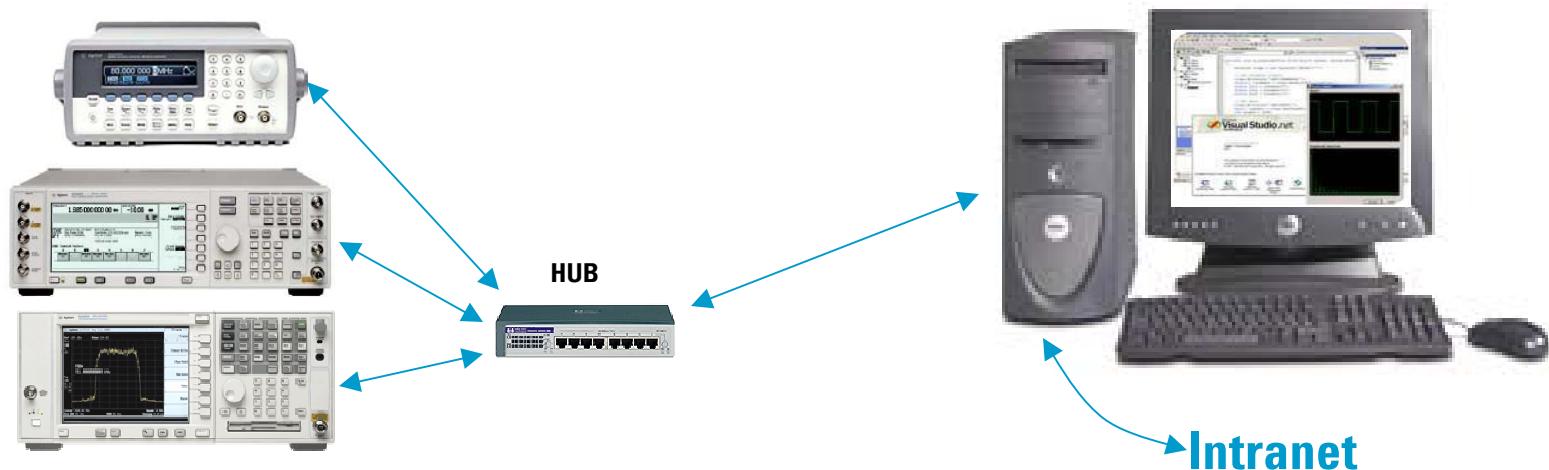
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Connected through a Switching Hub to the Intranet



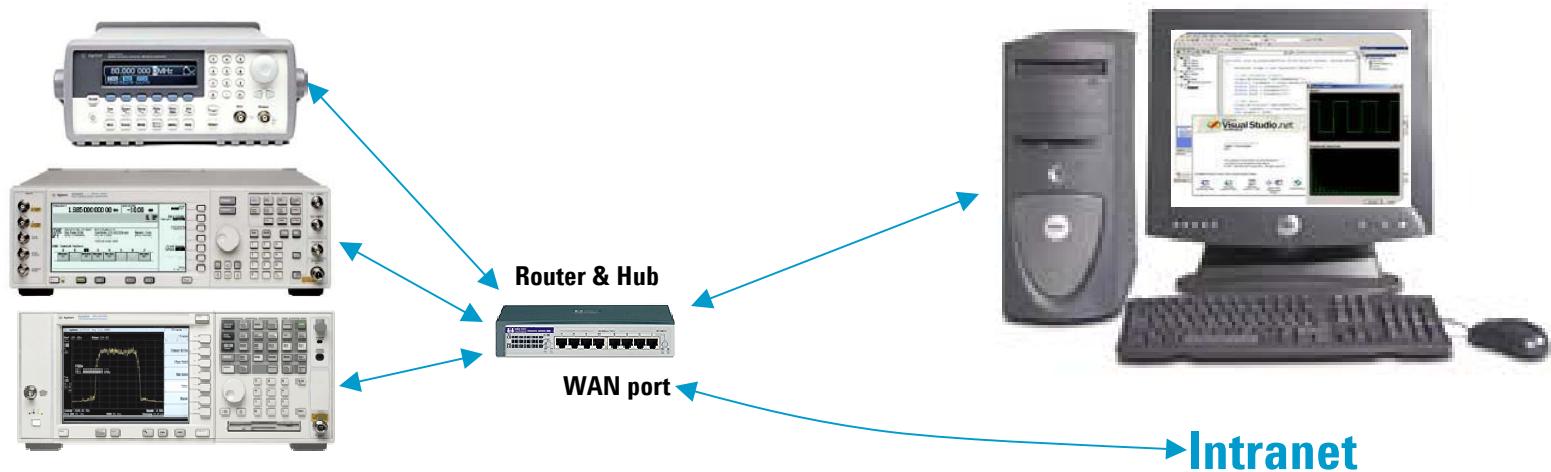
- Multiple instruments connected to PC and intranet
 - Consumes IP address on intranet for each instrument
- Instruments accessible from any PC on network
 - Enables remote viewing, control and collaboration
 - Measurement integrity may be compromised by accidental interference
- Network traffic isolated from test system traffic.
- Small to large systems easily implemented

Connected through PC to the Intranet (2nd LAN)



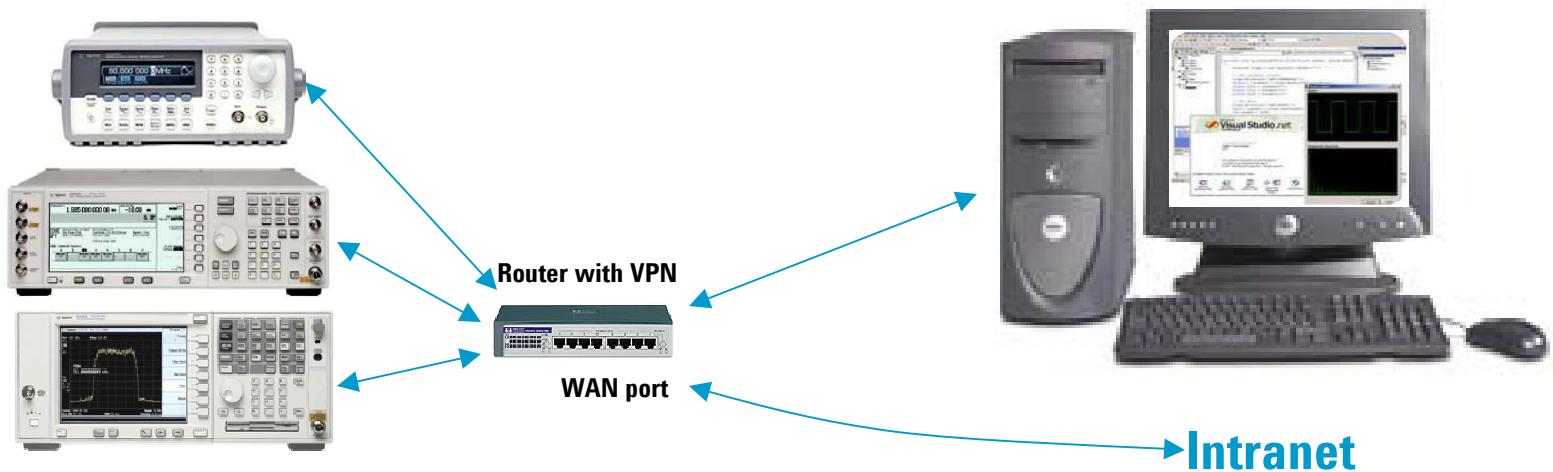
- Multiple instruments connected to PC by private LAN
 - Instruments typically in 192.168.xxx.xxx private local address range
- Network instrument access limited by routing software in PC.
 - Enables remote viewing, control and collaboration—if allowed by local PC
 - Better measurement integrity because of access control
- Network traffic isolated from test system traffic.
- Need to have two LAN ports on PC—configuration becomes more complicated

Connected through Router & Hub to the Intranet



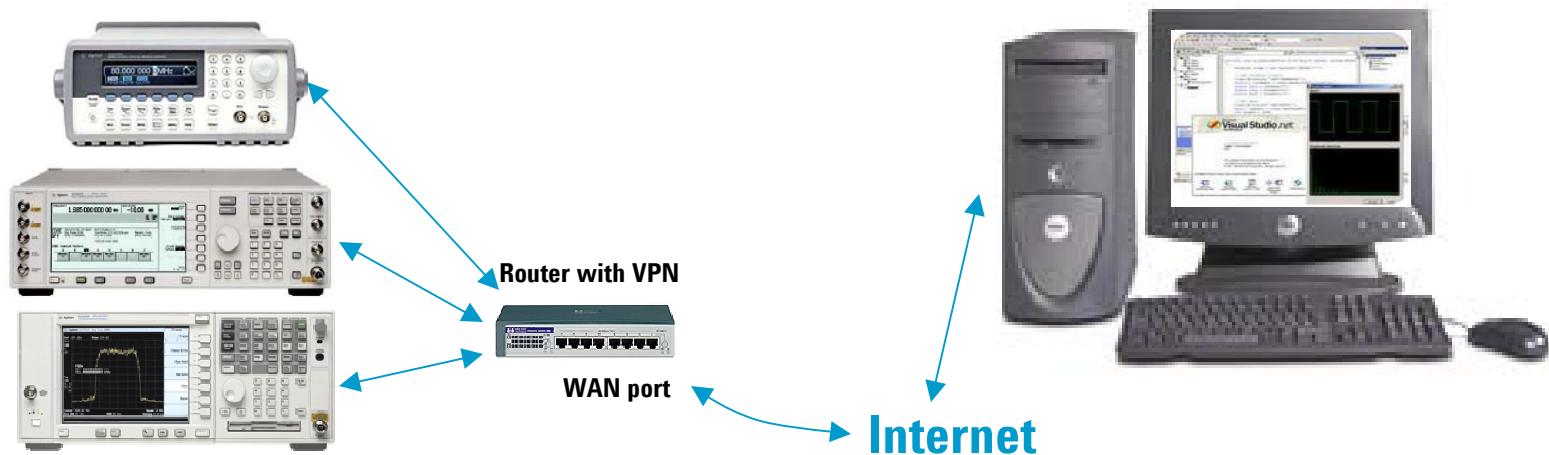
- **Multiple instruments connected to PC**
- **Network instrument access limited by router configuration**
 - **Enables remote viewing, control and collaboration—if allowed by router**
 - **Better measurement integrity because of access control**
 - **Network traffic isolated from test system traffic.**
 - **Trade router configuration for dual LAN configuration in PC**

Connected through Router with VPN to the Intranet



- Multiple instruments connected to PC through hub portion of router
- Network access limited by router and VPN configuration.
 - Enables remote viewing, control and collaboration—if allowed by router and VPN security
 - Best security and measurement integrity because of access control and encryption
- Network traffic isolated from test system traffic.
- VPN client required to connect to test system from the intranet

Instruments Remote from PC—Internet Connection



- Multiple instruments connected to internet through router
- Network access limited by router and VPN configuration.
 - Enables remote viewing, control and collaboration—as allowed by router and VPN security
 - Security and measurement integrity improved because of access control and encryption
- Internet traffic competes with test system traffic for bandwidth
 - Trades long distance connectivity for high throughput
- VPN client required to connect to test system from the internet

Summary

Several network topologies are available to meet varying system needs.

Choosing one is a balance among several requirements.

- Access from outside the test system
- Measurement throughput
- Measurement integrity
- Security needs

Summary Table

Topology	Security Integrity	Help	Remote Monitor	Remote Front Panel	Remote Control	Remote Collaboration	Remote Support
Direct	Best	Y					
Direct Hub	Best	Y					
Intranet Hub	Poor	Y	Y	Y	Y	Y	F
Intranet Switch Hub	Poor	Y	Y	Y	Y	Y	F
Intranet 2 nd LAN	Good	Y	RC	RC	RC	RC	F
Intranet Router	Good	Y	RC	RC	RC	RC	F
Intranet Router VPN	Better	Y	RC	RC	RC	RC	F
Internet Router VPN	Better	Y	Y	Y	Y	Y	Y

RC: Router Configuration Dependent

F: Firewall access needed

