MINUTES OF
REVIEW OF ICS NETWORK R&D REPORT
(REPORT ~50% COMPLETE)
(Review held at ANL on Feb. 22, 1999)

Attendees:

Reviewers:
Andrew Johnson, ANL, anj@aps.anl.gov
David Leibfritz, ANL, leibfritz@anl.gov
Bill McDowell, ANL, wpm@aps.anl.gov
Ken Sidorowicz, ANL, kvs@aps.anl.gov

SNS ICWG members:
Bill DeVan, ORNL, devanwr@ornl.gov
Dave Gurd, LANL, gurd@lanl.gov
Steve Lewis, LBNL, SALewis@lbl.gov
John Munro, ORNL, munrojkjr@ornl.gov
John Smith, BNL, jsmith@bnl.gov
Johnny Tang, BNL, jtang@bnl.gov

Bill DeVan presented the current status of the SNS Integrated Control System (ICS) network design. During the course of the presentation the following issues were discussed.

Organizational issues:

It is important that the ICS network design be integrated with the design of other facility networks. You don't want each faction to end up with different hardware. The APS controls group handles management of other APS networks. One benefit of this is that there are substitute personnel available when somebody is sick or on vacation.

The APS software development systems are connected to a facility subnet (i.e. they not on the controls subnets). It is advisable for the development systems to communicate using the same type equipment as the controls channel access subnet. This is another reason to make sure the controls and facility networks use the same hardware.

Reliability issues:

Steve Lewis noted that mean-time-to-repair is a big factor in overall network availability.

[Marty Knott later noted that the network is critical to operations. You can often design an IOC so that the accelerator can still run even if the IOC has to be rebooted. But if the network goes down, the accelerator is down.]

APS network hardware is on a UPS. IOCs are not on a UPS (except for a few, e.g. the timing system IOC). All control room hardware (both servers and OPIs) are on a UPS. Operations doesn't like to be blind under any circumstance.

APS UPSs are sized for 30 minutes, but they expect generator power to take over after ~2 min.

The reviewers strongly recommended redundant connections to IOCs. APS has had dual redundant fiber optic links with automatic switchover since the beginning. They indicated that they had experienced a fiber-optic-link failure rate on the order of one per month. Most failures were due to electronics failures (e.g. on hub ports) rather than fiber-related failures (but they experienced some of those as well). They agreed that the reliability of the electronics had probably improved significantly in the last few years. [John Smith suggested we look at RHIC / AGS experience in this regard.]

The reviewers indicated that completely redundant switches were not required. e.g. For an IOC with redundant fiber links: Both links could be run to the same switch but different switch cards. Redundant power supplies and power sources are a good idea. Redundant switch processor boards are a good idea; you can get them with automatic switch-over capability. And of course on-the-shelf spares is a good idea.

They seemed to agree that physical separation of communications cables probably did not provide enough benefits to warrant the expense. They have not had any conduits accidentally cut. Dedicating cable trays to fiber has prevented damage (e.g. by laying heavy copper cables on top of the fiber).

APS typically implements portable OPIs as portable PCs running X-windows software.

Network Switches:

You need to have remote access to network switch console ports. This access needs to be independent of the network connection to the switch. We will want access to the switch when the network connection is down (e.g. so we can diagnose why the connection is down).

See fig. 1 for the planned APS network upgrade.

Maintenance/Support Issues:

APS control system maintenance personnel can connect to the controls network via dial-in modems. They don't go through an internet service provider.

APS uses "Spectrum" network management software because it came free with the Cabletron hardware they were using. They plan to change to Cisco software.

The reviewers indicated that is was OK to wait to spec network management tools because the market is so volatile now.

The APS controls group manages the non-controls networks also. They have a total of 3 people to support the network needs of the control system and users and to provide network management support. They have 8 people for all computer and network support (excluding Macintoshes and some experiments).

An implementation plan for the SNS ICS network was shown. This plan included support being provided from the ORNL Computer, Information, and Network Division (CIND). The reviewers noted that SNS controls will require dedicated, responsive 24-hour support. If we use lab support personnel, the personnel should be dedicated to SNS. During the later years of the project, a staff of one full-time SNS ICS network support person plus one "contract" (e.g. CIND) person might be workable. Once operation starts then both persons should probably work directly for SNS.

APS uses a custom board in each IOC to perform several support-related functions. This board implements the fiber-optic-to-RS-232 conversion required for communications between a terminal server and the IOC processor console port. The board also monitors communications to the console port for a particular character string. If it sees the specific string, then it actuates a relay that in turn initiates a hard reset of the IOC. They noted that there are rare occasions where you need to actually cycle AC power, but that is rare enough that you don't necessarily have to provide for doing it remotely.

Steve Lewis reported on the Weiner (sp?) VME crates that include a CANbus interface for crate management. The reviewers thought it sounded like a good idea if you could afford it.

APS periodically checks IOC fans as part of their scheduled maintenance.

APS is in the process of adding a temperature sensor to each relay rack to monitor rack temperature.

Ken Sidorowicz told the group about plans for implementation of network sniffers at APS. The Cisco 4003 switch they are using has provisions for port mirroring. If there are problems with communications to a particular IOC, they set up the sniffer's port to mirror that IOC port. Cost of sniffers is around $20K-$30K. They have 12 to 15 sniffers; most are semi-permanently installed (i.e. they don't routinely move them around). Portable versions are also available. APS uses Network Associates Co. sniffers, which consist of a dedicate PC. If you had a goal of being able to troubleshoot from home, then a sniffer on each switch would be desirable. John Smith suggested running one port from each switch to a central switch so you could use just one sniffer.

Cable Plant Issues:

The reviewers suggested putting extra fiber optic network jacks in each IOC cabinet. These will get used for portable OPIs, etc.

For terminal servers, they solve the 50 ft. distance limitation problem by using fiber optic links. They use Xyplex "Maxserver 1640" terminal servers with on-board fiber-to-RS-232 converters. At the IOC end, they use the custom board discussed above to convert back to RS-232.

They are in the process of installing cable jacks in tunnels. These were not originally provided. They find that they are having to communicate info via radios that would otherwise be available via OPIs.

They tried a wireless solution but found it didn't work well. The links would be lost for seconds at a time. It was a few years ago, it was a Cabletron product, and it used spread spectrum. It seemed to work OK if you had line-of-sight between the antenna and the terminal. They speculated that the large amount of metal in the area was a factor.

The reviewers said to make sure communications closets are air conditioned, have adequate power capacity for future expansion, and offer redundant power circuits.

[John Smith suggested SNS should have a broadband cable network for CCTV.]

Recommended that there be at least 2 each cat 5 connections in each office.

Regarding Cable Implementation:

Marty Knott said regarding cabling and raceway design: "If you want it done right, then you better do it yourself". At a minimum, there must be oversight of cable and raceway design and construction. For APS, each major subsystem designed their own raceway systems. This was OK because in general (a) there wasn't very much overlap between subsystems, and (b) you often don't want to share your cable tray with anybody else anyway. In the end, APS over-designed their tray system due to both digitization of signals and extensive use of fiber optics. They contracted out their fiber optic installation and termination (i.e. used Davis Bacon labor). However they struggled some with picking the right contractor and making sure they were properly trained. SNS might want to have a "cable tzar" or overseer from each lab. This person would make sure the cable raceways for their lab's equipment meet their requirements. Controls cabling would need to be included in the overseers' responsibilities.

Non-Davis-Bacon labor was used to install control room equipment. Same for installation of beam diagnostics. Bill McDowell said he could provide a copy of the APS document that defined what was Davis-Bacon and what wasn't.

Cost Estimate:

A quick cost estimate was generated for ICS network hardware:

Qty.	Desc.	Unit Cost (k$)	Total Cost (k$)
13	Network switch, 100 Mbit ports, Cisco 4003	15	190
2	Central network switch, Gbit, Cisco 6509	100	200
1	PVgateway, Sun Ultra 10	10	10
-	Network management stations and software	20	20
1	Router, Cisco 8540	90	90
12	Terminal server	5	60
2*	Network sniffers	25	50
	Total		625

*More may be required depending on how implemented. For now say one permanent and one portable.

Bill McDowell indicated that the control system will always need the latest network technology because the latest control equipment (workstations, etc.) will demand it.

The reviewers noted you can incrementally upgrade network hardware as long as the core (i.e. routers and central switches) can handle it. So, if you have limited resources, it's best to put your dollars into the core.

Other Related Issues:

The reviewers liked the concept of integrating conventional facilities with the ICS. APS has two separate conventional facilities systems they are now in the process of integrating: a Siemans SCADA system, and a Johnson Controls HVAC control system.

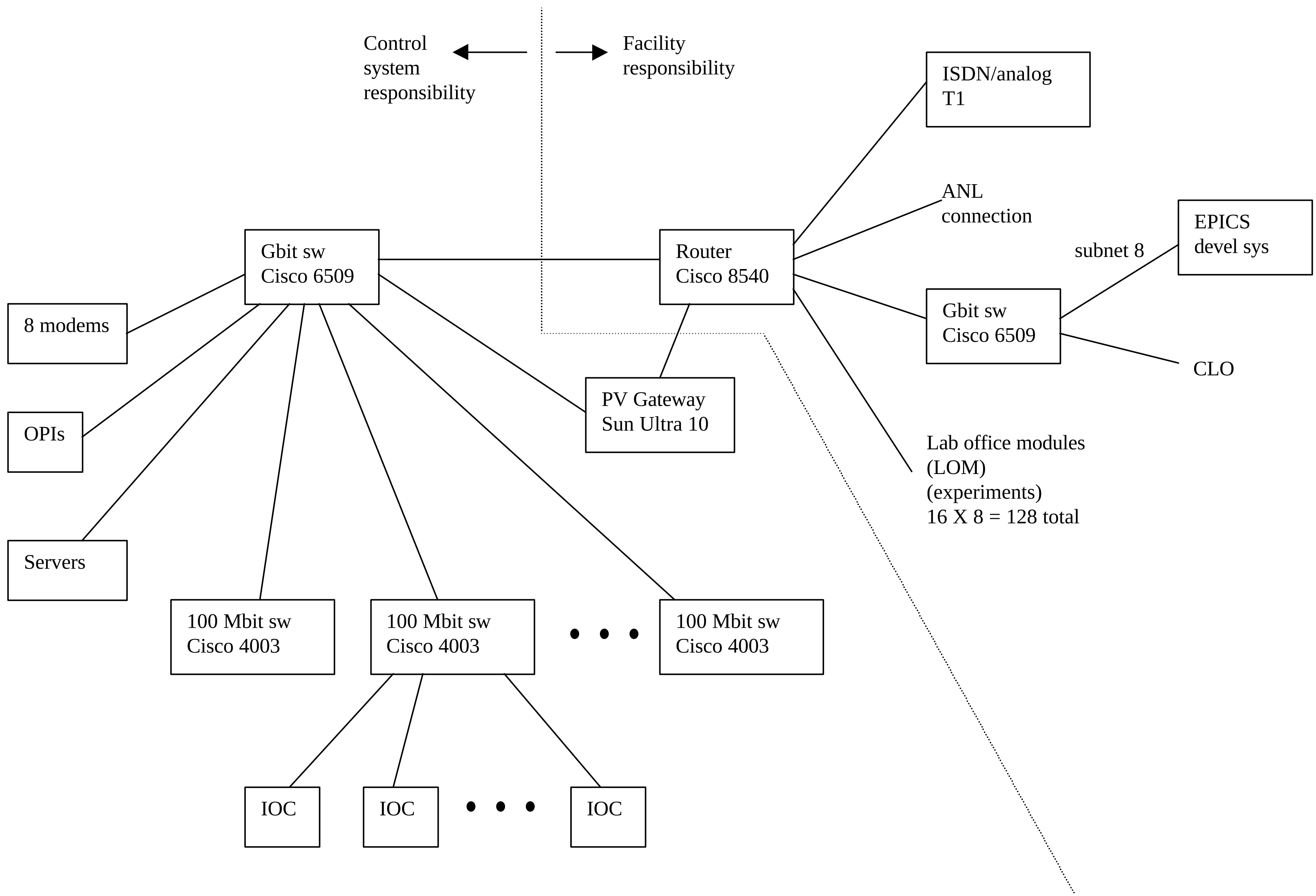

FIG. 1 – NETWORK UPGRADE PLAN FOR APS