TECHNICAL DESCRIPTION

IT NETWORK SYSTEMS ADMINISTRATION

world**skills**
international

WorldSkills International, by a resolution of the Technical Committee and in accordance with the Constitution, the Standing Orders and the Competition Rules, has adopted the following minimum requirements for this skill for the WorldSkills Competition.

The Technical Description consists of the following:

Effective 11.10.11

John Shiel
Chair Technical Committee

Stefan Praschl
Vice Chair Technical Committee

1. INTRODUCTION

1.1 Name and description of skill

1.1.1 The name of the skill is

IT Network Systems Administration

1.1.2 Description of skill

IT Network Systems Administrators require a wide range of IT skills. This is a fast-moving skill with continuously rising skill levels.

Skills include the ability to:
- Install a complex, custom IT solution with workstations, users, servers and networking equipment
- Use a variety of operating systems and server software
- Implement business IT systems with servers, workstations and network devices
- Tackle business-to-business communication solutions, accessing the Internet and other business networks safely and efficiently
- Install and configure wireless network devices, switches, routers, data protection devices
- Ensure security of stored information and give access to relevant users
- Provide system level documentation and diagrams
- Install, maintain and troubleshoot VOIP devices and software
- Install and configure IPv4, basic IPv6 services and tunnelling
- Install, configure and maintain virtualised environments

1.2 Scope of application

1.2.1 Every Expert and Competitor must know this Technical Description.

1.2.2 In the event of any conflict within the different languages of the Technical Descriptions, the English version takes precedence.

1.3 Associated documents

1.3.1 As this Technical Description contains only skill-specific information it must be used in association with the following:
- WSI - Competition Rules
- WSI - Online resources as indicated in this document
- Host Country - Health and Safety regulations

2. COMPETENCY AND SCOPE OF WORK

The Competition is a demonstration and assessment of the competencies associated with this skill. The Test Project consists of practical work only.

2.1 Competency specification

PC Hardware
Competitors shall be able to:
- Install computer operating systems according to user and manufacturer specifications.
- Determine hardware requirements to install and run an operating system (OS).
- Install an operating system.

- Configure an operating system to meet customer requirements.
- Install software drivers for all required hardware.
- Install software applications.
- Upgrade computer software to customer requirements.
- Partition and format a hard drive.
- Install updated software drivers to improve system performance.
- Install updated drivers to repair problems or improve performance.
- Create backups of important data.
- Install virtualisation software for servers

Windows Operating Systems
Competitors shall be able to:
- Use various operating systems for common operational tasks.
- Identify the names, locations, purposes, and contents of major system files.
- Demonstrate the ability to use command-line functions and utilities to manage the operating system, including the proper syntax and switches.
- Identify basic concepts and procedures for creating, viewing, and managing disks, directories and files.
- Manage various operating systems by installing, configuring and upgrading to ensure continued functioning for clients.
- Identify the procedures for installing operating systems and bringing the operating system to a basic operational level.
- Identify the basic system boot sequences and boot methods, including the steps to create an emergency boot disk.
- Identify procedures for installing/adding a device, including loading, adding, and configuring device drivers, and required software.
- Identify procedures necessary to optimize the operating system and major operating system subsystems.
- Perform installations, configurations and upgrades to operating systems.
- Recognise and interpret the meaning of common error codes and start-up messages from the boot sequence.
- Identify steps to correct boot sequence problems.
- Recognise when to use common diagnostic utilities and tools.
- Recognise common operational and usability problems and determine how to resolve them.
- Configure PCs with an IP address, subnet mask, and default gateway.

Cisco Internetworking Devices
Competitors shall be able to:
- Login to a router using both the console and telnet.
- Configure user mode, privileged mode, and telnet passwords.
- Configure the router with a name and a login banner.
- Configure Ethernet interfaces and WAN interfaces with an IP address, a subnet mask, and an interface description.
- Verify proper router configuration using show commands and debug commands.
- Configure network clients to connect to a network.
- Connect client computers to a network using appropriate cables.
- Test connectivity using ping, trace route, and telnet.
- Configure routers to provide routing services using routing protocols.
- Manage the Cisco IOS file system.
- Configure a router to load the IOS software from: flash memory, TFTP server, or ROM.
- Backup and upgrade IOS software.
- Perform password recovery.
- Create a backup of the configuration file on: a TFTP sever.
- Manage access lists on a Cisco router to increase communication security.
- Configure standard access lists to filter IP traffic.
- Verify selected access list operations on the router.

IT Network Systems Administration

- Configure extended access lists to filter IP traffic.
- Monitor selected access list operations on the router.
- Test network functionality.
- Configure VLSM addressing
- Monitor network traffic using packet capturing software.
- Monitor network devices using the Simple Network Management Protocol (SNMP).
- Locate network problems using Ping, Traceroute, and Telnet.
- Identify the basic parameters to configure a wireless network.
- Configure wireless infrastructure components.
- Configure STP on a Cisco switch.
- Configure VTP on a Cisco switch
- Configure switches to provide high speed LAN communications.
- Configure a Cisco switch for maximum performance in a network.
- Configure and verify VLAN operation on a Cisco switch.
- Configure inter-VLAN routing on a Cisco router.
- Configure NAT and PAT on a Cisco router.
- Configure Frame Relay sub-interfaces.
- Configure Frame Relay on a Cisco router.

Windows Server
Competitors shall be able to:
- Manage local, roaming, and mandatory user profiles.
- Implement user, group and computer accounts in an Active Directory environment.
- Configure access to shared folders.
- Install and configure Terminal Services for remote administration.
- Install and configure Terminal Services to serve applications to thin clients.
- Configure file system permissions.
- Create policies to control user desktop settings and security.
- Manage application of policies.
- Deploy software using policies.
- Configure and manage a web server.
- Configure web-site authentication.
- Perform system recovery for a server.
- Manage backup procedures.
- Recover from server hardware failure.
- Configure DNS Server service
- Configure RAID (redundant array of independent disks).
- Manage network attached storage remotely.
- Implement virtualization software.
- Perform system recovery within a virtual computing environment.
- Manage audit settings and audit logs.
- Configure DHCP.
- Verify DHCP reservation configuration.
- Install Operating System images.
- Configure a network policy server.

Network Security
Competitors shall be able to
- Configure IPSec and L2TP.
- Configure VMWare virtual interface mapping.
- Configure a Radius server or TACACS+.
- Configure AAA authentication.
- Configure PEAP authentication.
- Configure a VPN server.
- Configure a secure wireless network.

Linux

Competitors shall be able to:

- Install a major Linux distribution to specifications.
- Install and configure Linux services such as Apache, MySQL, etc
- Partition according to pre-installation plans.
- Configure file systems.
- Manage packages after installing the operating systems.
- Select appropriate networking configuration and protocols.
- Select appropriate parameters for Linux installation.
- Configure peripherals as necessary.
- Manage storage devices for proper user security access.
- Mount and un-mount varied file systems.
- Create and modify files and directories.
- Execute content and directory searches.
- Create linked files.
- Modify file and directory permissions and ownership.
- Identify and modify default permissions for files and directories.
- Access and write data to recordable media.
- Manage Linux services/processes for efficient use of resources.
- Manage run-levels and system initialization.
- Control processes by identifying, executing, killing and managing.
- Repair packages and scripts.
- Monitor and troubleshoot network activity.
- Manage print jobs and print queues.
- Perform remote management.
- Manage basic shell scripts by creating, modifying and using.
- Manage user and group accounts by creating, modifying and deleting.
- Manage and access mail queues.
- Schedule jobs to execute in the future using daemons.
- Configure client network services and settings.
- Configure basic server network services.
- Implement basic routing and sub-netting.
- Configure the system and perform basic make file changes to support compiling applications and drivers.
- Configure files that are used to mount drives or partitions.
- Implement DNS.
- Configure a Network Interface Card.
- Configure Linux printing.
- Apply basic printer permissions.
- Configure log files.
- Configure the X Window system.
- Set up environment variables.
- Manage server/workstation security parameters to maintain operating system and data integrity.
- Configure security environment files.
- Given security requirements, implement appropriate encryption configuration.
- Use appropriate access level for login.
- Set process and special permissions.
- Given security requirements, implement basic IP tables/chains.
- Implement security auditing for files and authentication.
- Set up user-level security.
- Configure removable system hardware.
- Configure RAID (Redundant Array of Independent Disks)

2.2 Theoretical knowledge

2.2.1 Theoretical knowledge is required but not tested explicitly.

2.2.2 Knowledge of rules and regulations is not examined.

2.3 Practical work

- Install, manage and configure virtual services
- Install and configure VOIP in a Small Medium Enterprise
- Identify and rectify hardware and software problems.
- Conduct routine procedures on computer equipment, such as:
  o Plan and implement backup procedures.
  o Install and configure virus detection and removal.
  o Design and carry out appropriate system tests for checking system efficiency, reliability and data integrity.

- Install and configure operating systems as required.
- Install software packages to run locally on a personal computer.
- Install software packages to run remotely on a personal computer.
- Install and configure a network, including peer to peer and client/server.
  o Install and configure a network interface card.
  o Connect correct cabling for a LAN.
  o Install and configure a network operating system (NOS).
  o Install and configure appropriate network protocols and client part of NOS.
  o Install and configure network specific devices and services such as email, anti-spam, and anti-virus.

- Administer a LAN / WAN (including advanced user / software / security and hardware configurations)
- Troubleshoot a network including monitoring network performance.
- Create and maintain documentation and diagrams as required.
- Use software diagnostic tools.
- Perform network design and implementation.
- Configure interoperability between Windows, Linux and Cisco devices
- Perform switch, router, firewall and wireless (IEEE) configuration. Implement network security including accounting and authentication. Integrate server and services into a network configuration.

Simulations and scenarios
It is anticipated that competition scenarios may include the assembly of various pieces of hardware to create working pieces of equipment and the installation of software onto this equipment.

3.   THE TEST PROJECT

3.1   Format / structure of the Test Project

The format of the Test Project is modular, with 1 module on each day of the Competition as shown in the following table:

Period	Module	Tasks
Island A	Linux Environments	Installation, configuration and upgrading
Island B	Windows Environments	Installation, configuration and upgrading
Island C	Networking and Unified Communication	Installation, configuration and upgrading
Island D	Integration and Network Security	Installation, configuration and upgrading

3.2   Test Project design requirements

Each Test Project module must be:
- At a level that a Competitor can comfortably complete
- Cisco skills tested must come from current CCNA, CCNA Security and CCNA Voice certification skill set
- Windows server administration skills tested must come from MCITP: Enterprise Administrator on current Microsoft server software skill set
- Linux skills tested must come from current RHCE or equivalent skill set
- Designed using a standard cover sheet for each section on the WorldSkills International template available on the website
- Self-explanatory requiring minimal translation (Competitor instructions containing a minimum of text)
- Be accompanied by a marking scheme that will be finalised at the Competition in accordance with the technical description
- All Operating Systems used in the Competition are to be English language versions. Only those Operating Systems & hardware supported in every participating country in the previous Competition may be used
- A variety of techniques may be used for the practical tests: Full day projects, round robin projects and a variety of methods for collection of evidence utilized: For example: Print-outs, screenshots, etc
- New software or services must be voted on using the Discussion Forum

3.3   Test Project development
The Test Project MUST be submitted using the templates provided by WorldSkills International (http://www.worldskills.org/competitionpreparation). Use the Word template for text documents and DWG template for drawings.

3.3.1   Who develops the Test Project / modules
The Test Project / modules are developed by:

The Test Project modules are developed by some Experts. That is those wishing to contribute.

3.3.2   How and where is the Test Project / modules developed

The Test Project modules are developed independently by an Expert or by a group of Experts.

Once at the Competition site, each Expert should perform as a member of a team in the preparation of the 30% change to that module.

Four closed groups will be created to be in charge of the development of each of the 4 day's modules.

Each person allocated to a team will continue in that development team until the task is completed. Experts will be given an opportunity to select their choice of team. However, in cases where the teams are unbalanced, the Chief Expert may recommend and decide that an Expert should join another team.

Test Project Module team leaders
The team leader should be an Expert with previous experience from a WorldSkills competition (whenever possible) and be nominated by the Chief Expert after consultation with the Deputy Chief Expert and Jury President.

It is the responsibility of the team leader to ensure that each module conforms to the Technical Description, complete with proof of testing and a marking scheme.

Module team leaders must work together to ensure that tasks are not repeated throughout the Competition.

- 12 months before the Competition, the Chief Expert. Deputy Chief Expert and Jury President will begin the process by contacting the available Experts from the different countries/regions for input into the process.
- They will – in consultation – prepare an up-to-date hardware and software request list for the Country/Region hosting the Competition.
- This list will be forwarded to the Host Country/Region not less than 6 months before the start of the Competition.
- 6 months before the Competition, the Experts under the guidance of the Chief Expert will begin design of the competition outlines and collection of activities suitable for inclusion in the competition. (This collection of activities/ outlines will be available for selection for / inclusion in the final project).
- Any submitted activities / outlines must be accompanied by a suitable marking scheme.
- The current Jury President will have unrestricted access to this process and database of outlines and activities.

3.3.3   When is the Test Project developed
The Test Project is developed as shown in the following timeline:

Time	Activity
12 months prior to the Competition	SMT contacts the registered Experts to invited them to contribute to the TP development process
6 months prior to the Competition	Experts begin to design the outlines and collection of activities suitable for the TP modules
3 months prior to the Competition	Proposed Test Project modules are developed. Test Project modules are selected by vote of the Experts on the forum. The selected Test Project modules are circulated on the WSI website by the Technical Director
2 months prior to the Competition	A list of possible 30% change for each module is submitted on the forum by Experts.
At the Competition	Experts agree on 30% change to the TP modules

Each Test Project will have a detailed physical topology image followed by a detailed logical topology image.

IT Network Systems Administration

All Experts must send proposed Test Projects to the Chief Expert 3 months before the current Competition. The Chief Expert will publish these Test Project proposals in the Discussion Forum. It is the responsibility of all Experts to access and download the projects submitted. These projects will be voted on by all Experts who contributed a Test Project for that day.

3.4   Test Project marking scheme
Each Test Project must be accompanied by a marking scheme proposal based on the assessment criteria defined in Section 5.

3.4.1   The marking scheme proposal is developed by the person(s) developing the Test Project. The detailed and final marking scheme is developed and agreed by all Experts at the Competition.

3.4.2   Marking schemes should be entered into the CIS prior to the Competition.

3.5   Test Project validation

The Test Project modules will be validated by a Test Group appointed by the Chief Expert as described below.

The amended Test Project modules (30% change) will be passed onto a Test Group who will check each of the selected projects on four complete Competitor workstations. It must be demonstrated that the Test Project/modules can be completed within the material, equipment and knowledge constraints.

The Test Group must check the 30% change / addition and the marking scheme and provide further changes back to the Module Group until agreement is reached and the project is in accordance with 3.2 Test Project design requirements above.

The hardware and software list is correct and is provided for use.

3.6   Test Project selection
The Test Project is selected as follows:

By vote of Experts on the Discussion Forum as per the Competition Rules.

Two months before the Competition a list of possible 30% changes for each module will be submitted on the Discussion Forum. The 30% changes for the Competition will be chosen from the submitted list on the Discussion Forum.

3.7   Test Project circulation
The Test Project is circulated via WorldSkills International website as follows:

The four selected Test Projects modules are sent to the WorldSkills International Secretariat by the Chief Expert at least 3 months before the Competition for publication on the WSI website for download by all participating Members.

3.8   Test Project coordination (preparation for Competition)
Coordination of the Test Project will be undertaken by:

- The Chief Expert and Deputy Chief Expert.

- The Chief Expert assigns at least three (3) Experts (if possible) to each of four Module Groups. Each Module Group is responsible for one Test Project module.

- Each Module Group will be allocated a team leader. The Module Group leader will work closely with the Chief Expert and the Deputy Chief Expert to allow for the completion of the module. The team leader will be responsible for the completion of each module in line with this document and ensure the modules are true and correct.

- The Module Group must add or change a minimum of 30%, produce a marking scheme, and pass the module to the Test Group for validation (see 3.5 Test Project validation).

- Each person allocated to a team will continue in that development team until a replacement from their home country/region is found or the task is completed.

3.9 Test Project change at the Competition

The Module Group must add or change a minimum of 30% and produce a marking scheme for the module for that day and pass the project to the Test Group for validation (see 3.5 Test Project validation).

Acceptable changes to the modules include the following:
- Topology
- Functionality
- Operating System
- Software and hardware used

On C-1 completed Test Projects with the included 30% change will be given to all Experts and Interpreters. Test Projects may be shared between Experts and Competitors at this time. Summary marking schemes will also be given to Experts to share with Competitors.

3.10 Material or manufacturer specifications

Not applicable

4. SKILL MANAGEMENT AND COMMUNICATION

4.1 Discussion Forum
Prior to the Competition, all discussion, communication, collaboration and decision making regarding the skill must take place on the skill-specific Discussion Forum (http://www.worldskills.org/forums). All skill-related decisions and communication are only valid if they take place on the forum. The Chief Expert (or an Expert nominated by the Chief Expert) will be moderator for this forum. Refer to Competition Rules for the timeline of communication and competition development requirements.

4.2 Competitor information
All information for registered Competitors is available from the Competitor Centre (http://www.worldskills.org/competitorcentre).

This information includes:
- Competition Rules
- Technical Descriptions
- Test Projects
- Other Competition-related information

4.3 Test Projects
Circulated Test Projects will be available from worldskills.org (http://www.worldskills.org/testprojects) and the Competitor Centre (http://www.worldskills.org/competitorcentre).

4.4 **Day-to-day management**
The day-to-day management is defined in the Skill Management Plan that is created by the Skill Management Team led by the Chief Expert. The Skill Management Team comprises the Jury President, Chief Expert and Deputy Chief Expert. The Skill Management Plan is progressively developed in the six months prior to the Competition and finalised at the Competition by agreement of the Experts. The Skill Management Plan can be viewed in the Expert Centre (http://www.worldskills.org/expertcentre).

5. ASSESSMENT

This section describes how the Experts will assess the Test Project / modules. It also specifies the assessment specifications and procedures and requirements for marking.

5.1 **Assessment criteria**
This section defines the assessment criteria and the number of marks (subjective and objective) awarded. The total number of marks for all assessment criteria must be 100.

Section	Criterion	Marks		
		Subjective **(if applicable)**	**Objective**	**Total**
A	Linux Environments	0	25	25
B	Windows Environments	0	25	25
C	Networking and Unified Communication	0	25	25
D	Integration and Network Security	0	25	25
	Total =	0	100	**100**

5.2 **Subjective marking**

Not applicable

5.3 **Skill assessment specification**

The Module Groups of Experts for each day will decide on the marking criteria.

The following is not a definitive list but is an example of possible aspects which will be assessed:
- RAID 1 mirrors exist
- 5 SCSI Hard disk detected
- Second hard disk contains two partitions
- Both 10GB in size, formatted and ready to use no DNS timeout
- Backup includes drive D
- Backup includes system state
- Backup includes /usr/local or files representing it
- Backup schedule show one full backup per week and differential on other days
- Above scheduled for 12pm everyday
- Linux install completed
- DNS forwarder set to Linux
- All DNS root hints cleared
- DHCP Range created and correct
- Default gateway 192.168.1.1
- DNS 192.168.1.2
- DHCP Lease time 2 days

- Domain in 2003 Native Mode
- RDWeb installed
- RDWeb only listen / respond on VPN range.
- RRAS setup and set to VPN server. Printouts / Scripts

5.4 Skill assessment procedures

Each module will form an island. With this island organisation the assignment of the Competitor's first day module will be down as follows:
- If the Competitor's compatriot Expert is part of an "island marking team", their Competitor will start the Competition on this island.
- If the Competitor's Expert is part of the QA team and not part of an "island marking teams", their Competitor's starting island will be by ballot draw as soon as the island teams are formed.

The Competitor's work may not be altered in any way to facilitate marking unless included in the marking scheme.

The Experts attending the Competition will be divided into marking groups to mark each specific section of the marking criteria.

Progressive marking for all sections of the Competition
Each module / task / section will be completed on the assigned day so that progressive marking can take place.

Marking scheme
- Each Competitor is provided with an overview of the marking scheme.
- A full marking scheme will only be seen by the Experts. (Reason: The full marking scheme would give the answers to the Competitor.)
- No single aspect is allowed to be more than 10% of the day's marks. That is not more than 2.5 marks.

6. SKILL-SPECIFIC SAFETY REQUIREMENTS

Refer to Host Country Health & Safety documentation for Host Country regulations.

- When Competitors work with a dismantled computer, the power cord must be disconnected from the computer.
- Competitors must use ESD (electrostatic discharge) protection during work on the dismantled computer or component.

7. MATERIALS & EQUIPMENT

7.1 Infrastructure List
The Infrastructure List details all equipment, materials and facilities provided by the Host Country.

The Infrastructure List is online (http://www.worldskills.org/infrastructure/).

The Infrastructure List specifies the items & quantities requested by the Experts for the next Competition. The Competition Organiser will progressively update the Infrastructure List specifying the actual quantity, type, brand/model of the items. Items supplied by the Competition Organiser are shown in a separate column.

At each Competition, the Experts must review and update the Infrastructure List in preparation for the next Competition. Experts must advise the Technical Director of any increases in space and/or equipment.

At each Competition, the Technical Observer must audit the Infrastructure List that was used at that Competition.

The Infrastructure List does not include items that Competitors and/or Experts are required to bring and items that Competitors are not allowed to bring – they are specified below.

7.2 Materials, equipment and tools supplied by Competitors in their toolbox

- Three keyboards and three mice each.
- The keyboards must be supported by the software used in the Competition.

7.3 Materials, equipment and tools supplied by Experts

Experts are not required to supply any materials, equipment or tools.
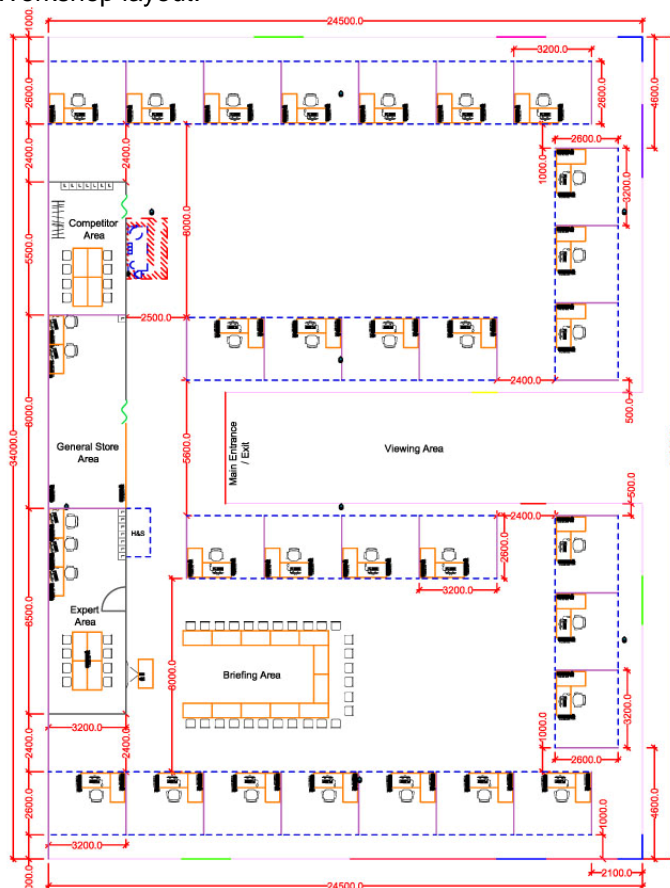
7.4 Materials & equipment prohibited in the skill area

Electronic devices such as cell phones, media players, recorders are not permitted in the skill area.

7.5 Proposed workshop and workstation layouts

Workshop layouts from London are available at:
http://www.worldskills.org/index.php?option=com_halls&Itemid=540

Workshop layout:

8. MARKETING THE SKILL TO VISITORS AND MEDIA

8.1 Maximising visitor and media engagement

The following will be exhibited to the public to generate interest in the skill:
- Video description of trade. For example: "Warriors of the Net"
- Dual displays – public can observe work being done by competitor in detail
- Test Project descriptions
- Competitor profiles
- Career opportunities
- Daily reporting of competition status

8.2 Sustainability

- Workstations will be organised into 4 islands corresponding to the skill sets (Day 1 – 4) being tested. Competitors will be divided into these 4 groups for the purpose of reducing the need for a large number of networking devices.