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## 1. Overview

As a result of the dramatic growth of the Internet and other Internet Protocol (“IP”)-based networks, support for IP-related technologies is now a strategic element in the design, development and use of telecommunication networks. The “net result” is a significant and wide-ranging impact on the ITU’s core activities in standardization, radiocommunication and development. As a direct consequence, there continues to be rapid expansion in the scope of ITU IP-related activities since the adoption of Resolution 101 on “Internet Protocol (IP)-based networks” (Minneapolis, 1998)<sup>1</sup> and the activities described in last year’s Council Document C99/51.<sup>2</sup>

This Report provides an overview of the activities that the ITU has undertaken in regard to IP-based networks since Council 1999. The Report is structured along ITU organizational lines and contains numerous references to source materials available on the Union’s web site.<sup>3</sup>

Several trends provide examples of the impact IP-based networks have on ITU activities. The first is that demand for bandwidth and capacity is driving continuous innovation in access and transport networks. Examples include leveraging of copper wire “last-mile” networks through digital subscriber line (“DSL”) technologies, re-architecting of cable networks to support IP services and new advances in optical networking techniques. As a result, ITU-T Study Groups 9<sup>4</sup> and 15,<sup>5</sup> involved in directly related standardization, have witnessed renewed interest and participation.

Another trend is the ever-increasing popularity of wireless networks and mobile data services. Most analysts forecast that cellular systems will rapidly merge with handheld computers to become a (if not the) strategic IP services platform.<sup>6</sup> Supporting this prediction, one of the world’s first mobile Internet operators has grown to more than 7 million subscribers in less than 18 months — thereby becoming the world’s second largest Internet service provider.<sup>7</sup> Directly related, ITU’s 3<sup>rd</sup> generation mobile initiative, IMT-2000,<sup>8</sup> lays an important cornerstone of the emerging “mobile information society” — supporting minimum data speeds of 384 kbps to 2 Mbps, depending on the environment. IMT-2000 systems, standardized in a suite of interdependent ITU-R and ITU-T Recommendations, recently moved one step closer to reality in May 2000 when crucial spectrum was allocated<sup>9</sup> at ITU’s World Radiocommunication Conference. The initial deployment of IMT-2000 systems is expected shortly before Council 2001.

A third important trend to emerge is the “unification” and interoperability of IP-based and PSTN<sup>10</sup> network services and applications. For example, in a joint standards project with the Internet Engineering Task Force, ITU-T Study Group 16 recently approved Recommendation H.248:<sup>11</sup> a significant “convergence” standard defining the control of gateway devices that can exchange voice, video, facsimile and data traffic between PSTN and IP networks.

At the same time, technical convergence is bringing new challenges to policy-makers and regulators — particularly in developing countries. One example of how the ITU-D is responding is through the organization of an African Internet and Telecom Summit<sup>12</sup> in the Gambia in June 2000, in cooperation with the Commonwealth Telecommunication Organization.<sup>13</sup> The objective is to bring together representatives from all Sub-Saharan African countries to focus on the key challenges and opportunities the Internet poses for telecommunication policy-makers and operators in the region.

In other ITU policy-related initiatives, the ITU’s Strategies and Policy Unit,<sup>14</sup> under the aegis of the “New Initiatives”<sup>15</sup> programme approved at last Council, has organized several topical “Strategic Planning Workshops”.<sup>16</sup> Focusing on themes of high interest to regulators, policy-makers and the broader ITU membership, themes have included “Electronic Signatures and Certification Authorities,”<sup>17</sup> “IP Telephony,”<sup>18</sup> and “Fixed/Mobile Interconnect”.<sup>19</sup>

Finally, another trend has become clearer during the preparation of this Report. As support for IP-based networks becomes further integrated into the global telecommunications framework, it is increasingly difficult to report on the “Internet” and “IP-based” network activities as distinctly

separate from the ITU's other "telecommunications" activities. For example, most of the ITU-T's standardization activities now have either explicit or tangential relationship with IP networks.<sup>20</sup> Similarly, ITU's global 3<sup>rd</sup> generation mobile initiative, IMT-2000, is claimed by most analysts to be equally important for mobile Internet access as voice. Likewise, services based on IP telephony, standardized in ITU-T Recommendations,<sup>21</sup> are very likely to become a common feature of the general telecommunications landscape — if for no better reason than for the benefits of voice and data integration. For these reasons, the boundaries between the telecommunications world and IP-based networks will increasingly only be shades of grey.

## 2. Telecommunication Standardization Sector

### 2.1. Background

Since 1998, ITU-T Study Group 13 has acted as the lead study group "to provide a focal point in ITU-T for IP-related studies, including the interrelationship between IP and telecommunication networks and their convergence". In this role, Study Group 13 maintains an "ITU IP Project Description", describing the status of ITU-T IP-related activities and specific study "Questions". This document<sup>22</sup> along with the report of SG 13's last meeting in February/March 2000<sup>23</sup> are essential reading to have a full understanding of the scope of ITU-T's technical standardization activities related to IP networks.

### 2.2. Related Meetings

Apart from scheduled Study Group and management meetings, the following ITU-T IP-related meetings took place since last Council:

- 31 August – 9 September 1999 (Geneva): SG13 IP Experts meeting;<sup>24</sup>
- 7 November 1999 (Washington, D.C.): Meeting between ITU-T Study Group Chairman and Internet Engineering Task Force ("IETF") Area Directors;
- 25 – 27 January 2000 (Geneva): IP-Telecoms Interworking Workshop related to Numbering, Naming, Addressing and Routing.<sup>25</sup>

Furthermore, ITU-T Study Group 13 (see Section 2.4.9) plans to host an "IP Networking" workshop in the January/February 2001 time frame.

### 2.3. Strategic Direction of ITU-T IP-Related Studies

In general, all ITU-T Study Groups have refocused their activities on IP-related standardization. At its October 1999 meeting, the Telecommunication Standardization Advisory Group ("TSAG") endorsed the following focus areas for future ITU-T IP-related studies:<sup>26</sup>

- **Differentiated QoS<sup>27</sup> IP Services:** IP services (to end-users, or service-provider to service-provider) will become differentiated by QoS characteristics. The classes of service required for various applications and related quantified parameters should be defined.
- **Support for Differentiated QoS IP Services:** The QoS requirements for differentiated services, and how they may be implemented by using various classes of service provided by the underlying network facilities should be defined.
- **Service Interworking:** In any situation of network change it is always necessary to ensure that the new services interwork with the old. A leading example is interworking PSTN supplementary services with an IP network offering many or no such services. The ITU-T

should identify the key interworking situations and develop or adopt interworking specifications.

- **Supplementary Services for IP network-based Voice Services:** Many supplementary services have been defined and standardized for the PSTN. The ITU-T should continue to define a similar set of services for VOIP<sup>28</sup> networks. The provision of emergency services is an important aspect of this work.
- **Provision of IP-based Virtual Private Networks (“VPNs”):** Partitioning of network resources in order to support VPNs can be performed at various protocol layers. The ITU-T should undertake to define schemes based upon partitioning at layer 1 (“L1”) and/or layer 2 (“L2”).
- **Support for Multicast:** Multicast services can consume large amounts of network resources unless carried out in an efficient manner. Telecoms networks can play an important role in supporting such services through the use of native multicast facilities available at lower layers (e.g., over ATM and wireless). The definition and specification for usage of transport-based multicast services will provide an efficient basis for IP multicast services.
- **Naming and Addressing:** Present work in this area, for example, ICANN, VOIP country code and inter domain translations, largely reflects necessary ad-hoc evolution of existing arrangements. An activity to establish a long term vision of a global entity (e.g., person, legal entity, device, equipment) naming scheme for all communications needs would provide an objective against which short term changes and arrangements can be judged.
- **Support for Charging and Settlements:** Proposals on the information to be collected for the purpose of charging end-users and co-operating service providers and suggestions on potential collection points could be usefully shared with the IETF in the joint development of solutions. The ITU-T has substantial experience in charging and in the settlement process.
- **Integrated Management of Telecom and IP-based networks:** Currently the remote management of IP-based and traditional telecom networks is based on different standards paradigms (IETF vs. ITU-T TMN<sup>29</sup>). However, integrated management is needed and should focus on the creation of an integrated set of management architecture, requirements, information and protocols.
- **Routing Principles:** If L1 and L2 facilities are used to support IP services, such as VPN and QoS, appropriate L1 and L2 routing principles should be defined. Also dynamic routing at L1, L2, and L3 should be studied. The implications of end-to-end routing across multiple service providers must be considered in both cases.
- **Network Control:** Existing IETF RFCs<sup>30</sup> do not support full interworking between the control features of router implementations. The ITU-T should undertake activities to encourage and assist the IETF in addressing this problem.
- **IP Signalling Network:** The ITU-T should consider developing recommendations concerning appropriate network facilities for the carriage of IP control protocol information.
- **IP Traffic Management and Policy:** An approach to implementing IP differentiated services at layer 3 depends upon network-based traffic “shaping” and “policing”. The ITU-T should undertake the development of such algorithms and mechanism, possibly in conjunction with the IETF.
- **IP Network Reliability, Integrity and Availability:** The ITU-T should consider developing recommendations covering the reliability, integrity and availability of IP networks and of services supported by IP networks. The requirements imposed by emergency service requirements are an important aspect of this work.

- **Network Aspects of Future Wireless Systems:** It is assumed that IP networks will be the infrastructure of future mobile wireless services. The ITU-T should undertake to standardize as many relevant aspects of this infrastructure as possible. Initial considerations should be focussed on the development of IMT-2000.
- **LANs/WANs:**<sup>31</sup> TCP/IP over Ethernet is becoming a dominant enterprise network technology. Public network services, based on IP networks, to provide LAN/WAN facilities need to be defined and appropriate mechanisms to be developed.
- **Optical Transport Network (“OTN”):** The evolution of optical transmission technology towards an all-optical network (i.e., the Optical Transport Network (“OTN”)) needs to be addressed by the ITU-T with high priority. The OTN, providing multiplexing, routing and transmission functionality and characterized by Wavelength-Division Multiplexing (“WDM”) techniques and the integration of some lower layer functions, together with network and equipment management support, will provide the key future transport infrastructure of networks optimised for IP type traffic.
- **Network Evolution:** The presumed evolution of communications towards all-IP solutions, combined with huge historical and on-going investment in other technologies dictates that certain network architectures and mechanisms must support an evolutionary approach to replacing and/or upgrading network equipment.

The upcoming World Telecommunication Standardization Assembly (“WTSA”)<sup>32</sup> is expected to result in further review of ITU-T strategies, work priorities and structure vis-à-vis IP networks.

## 2.4. Specific Study Group Activities

Some notable IP-related ITU-T Study Group (“SG”) activities during the last year include, *inter alia*:

### 2.4.1. ITU-T Study Group 2

Study Group 2,<sup>33</sup> in January 2000, hosted an “IP-Telecoms Interworking Workshop” focusing on Numbering, Naming, Addressing and Routing (“NNAR”). This workshop included the participation of IETF leadership and resulted in an agreement on fourteen issues to be addressed either by the IETF, the ITU, or jointly by the IETF-ITU. These issues and their disposition are available on the ITU-T web site.<sup>34</sup> Of notable interest are draft proposals that would provide mapping between the Internet Domain Name System (“DNS”) and the PSTN E.164<sup>35</sup> numbering plan. This may imply that the ITU-T may need to play a coordination role for DNS zones that parallel its current top-level E.164 management responsibilities.<sup>36</sup>

Other IP-related work of Study Group 2 includes, *inter alia*:

- Recommendations approved at SG 2’s March 2000 meeting include:
  - E.351: Routing of multimedia connections across TDM, ATM, and IP-based networks;<sup>37</sup>
  - E.651: Reference connections for traffic engineering of IP access networks;<sup>38</sup>
  - E.671: Post-selection delay in PSTN/ISDNs using Internet telephony for a portion of the connection.<sup>39</sup>
- Recommendations determined for approval at the SG 2’s January 2001 meeting include:
  - E.370: Principles when public circuit switched international telecommunication networks interwork with IP-based networks;<sup>40</sup>
  - E.41IP: Framework for the traffic management of IP-based networks.<sup>41</sup>

- Recommendations requiring further development:
  - E.tipi: Naming, numbering and addressing for interworking between E.164 and IP address-based networks;<sup>42</sup>
  - E.te: Traffic engineering and QoS methods for IP, ATM and TDM-based multiservice networks;<sup>43</sup>
  - E.callflows: Call flows showing possible ENUM<sup>44</sup> interactions;<sup>45</sup>
  - Supplement to E.370: Accommodating E.164 number portability within IP-based networks;<sup>46</sup>
  - E.qos-voip: Operational considerations for QoS of voice and facsimile over IP-based networks;<sup>47</sup>
  - E.hfc: Traffic engineering methods for IP access networks based on hybrid fiber/coax system.<sup>48</sup>

An earlier request to SG 2 for an E.164 resource for IP telephony trials directly resulted in the creation of a “Joint Expert’s Group on Numbering for IP Telephony”,<sup>49</sup> also involving ITU-T SG 3 and ITU-D SG 1. Following extended discussions, SG 2, at their March 2000 meeting, agreed to the temporary usage of the UPT<sup>50</sup> E.164 code “878” for IP telephony trials, with further review in 2001.<sup>51</sup>

#### **2.4.2. ITU-T Study Group 3**

In April 2000, Study Group 3<sup>52</sup> adopted a draft recommendation “D.III” on the fair cost sharing of international internet connection between administrations.\*<sup>53</sup> This will be submitted to the WTSA for approval. The draft Recommendation text is:

“Noting the rapid growth of Internet and internet protocol based international services:

It is recommended that administrations\* involved in the provision of international Internet connection negotiate and agree bilateral commercial arrangements applying to direct international internet connections whereby each administration\* will be compensated for the cost that it incurs in carrying traffic that is generated by the other administration\*.”

Note also SG 3’s involvement in the Joint Experts Group referenced in Section 2.4.1.

#### **2.4.3. ITU-T Study Group 4**

Study Group 4<sup>44</sup> is the ITU-T lead Study Group on telecommunication management network (“TMN”) issues. The work plan of Study Group 4 now includes a Question concerning the development of a framework for unified management of integrated circuit-switched and packet-based networks (with an initial focus on IP-based networks).

SG 4’s new Recommendations related to IP-based networks include:

- M.13ip: bringing-into-service and maintenance procedure for leased circuits supporting IP;
- M.23ip: Performance limits for bringing-into-service and maintenance of IP services;
- Q.ip21: Access IP and IP over ATM;
- M.hcp25: Integrated Management of hybrid circuit/packet IP networks.

Activities specifically related to IMT-2000 (see Section 3.1) include:

- M.3210 (IMT-SP): Configuration Management Functional Requirements “Service Provisioning for IMT-2000”;



- M.3210 (IMTSEC): Security Management for IMT-2000;
- M.3210 (IMTACC): Accounting Management requirements and analysis billing and charging for IMT-2000.

#### **2.4.4. ITU-T Study Group 7**

Study Group 7<sup>54</sup> is the ITU-T lead Study Group on open distributed processing, frame relay<sup>55</sup> and communication systems security. In March 2000, it approved a new edition of Recommendation X.509, a reference standard for authentication services using asymmetric cryptography and Public Key Infrastructure (“PKI”) services. X.509 is widely used in digital signature technologies and for E-commerce on IP-based networks.

In March 2000, Study Group 7 also approved Recommendation X.85/Y.1321: IP over Synchronous Digital Hierarchy Networks<sup>56</sup> and new versions of frame relay-related Recommendations offering improved support for IP networks.<sup>57</sup>

Other ongoing IP-related activities of Study Group 7 include, *inter alia*:

- X.126: a new Recommendation on IP/X.121<sup>58</sup> numbering plan interworking/mapping;<sup>59</sup>
- Amendments to X.501<sup>60</sup> and X.519<sup>61</sup> supporting TCP/IP<sup>62</sup> (both approved in March 2000);<sup>63</sup>
- X.841: Information technology - Security techniques - Security information objects;<sup>64</sup>
- X.842: Information technology - Security techniques - Guidelines on the use and management of trusted third party services;<sup>65</sup>
- X.843: Information technology - Security techniques - Specification of TTP<sup>66</sup> services to support the application of digital signatures.<sup>67</sup>

SG 7's future work plan includes additional improvements in frame relay vis-à-vis interworking with IP-based services.

#### **2.4.5. ITU-T Study Group 8**

Study Group 8<sup>68</sup> previously produced, in partial cooperation with the IETF, three Recommendations concerning facsimile over the Internet, including:

- F.185: Internet facsimile: operations and definition of service;<sup>69</sup>
- T.37:<sup>70</sup> Procedures for the transfer of facsimile data via store-and-forward on the Internet;
- T.38:<sup>71</sup> Procedures for real-time Group 3 facsimile communication between terminals using IP networks.

The SG 8 current work programme related to IP-networks includes:<sup>72</sup>

- T.38 Amendment 2: preparation of Annex D on SIP/SDP<sup>73</sup> and Annex E on H.248/Megaco (see Section 2.4.11);
- T.38 Amendment 3: V.34<sup>74</sup> access to T.38 gateways;
- T.Ifax3: Group 4 facsimile over IP networks;
- Revision of F.185: operations and definition of service between terminals using IP networks.

#### **2.4.6. ITU-T Study Group 9**

Study Group 9<sup>75</sup> previously produced two Recommendations, J.83<sup>76</sup> and J.112,<sup>77</sup> related to the provisioning of IP-based services over cable networks using cable modems. Since then, additional

IP-related work has continued in this domain. For example, at SG 9's February 2000 meeting, Recommendation J.120 (previously "J.web"), defining a transmission protocol and configuration for distribution of sound and television programs (webcasting) over IP networks, including the Internet, was approved.<sup>78</sup>

Other related standardization activities in SG 9 includes the new "IPCablecom" project. IPCablecom will specify an architecture and set of integrated protocol interfaces to enable the efficient delivery of time-critical IP-based interactive services over cable television networks. The first three Recommendations: J.arch on the architecture framework, J.acr on audio/video codecs<sup>79</sup> and J.ncs on network-based call signalling, have just been "determined", starting their approval process. In total, 14 Recommendations from the IPCablecom project are planned.

#### **2.4.7. ITU-T Study Group 11**

ITU-T Study Group 11<sup>80</sup> is active in signalling for broadband, narrow-band and multimedia services, Intelligent Networks ("IN") and common transport protocols. As the ITU-T lead Study Group on mobility, SG 11 has played a major role in IMT-2000 signalling issues, in collaboration with ITU-R Task Group 8/1 (now "Working Party 8F", see Section 3.1). Support for IP networks and number portability are also SG 11 priority items.

SG 11's IMT-2000 related activities include:

- IMT-2000 Network Architecture;
- IMT-2000 Radio Access Signalling requirements;
- IMT-2000 Access Signalling requirements and Protocols;
- IMT-2000 Network Signalling requirements and Protocols;
- User Identity Module ("UIM") Signalling requirements and Protocols;
- Universal Personal Telecommunications ("UPT") and Mobility Signalling requirements and Protocols.

Specifically, IMT-2000 related approved and future Recommendations (with completed or projected completion dates) are listed below:

- Q.1701: Framework for IMT-2000 Networks (03/99);<sup>81</sup>
- Q.1711: Network Functional Model for IMT-2000 (03/99);<sup>82</sup>
- Q.1721: Information Flows for IMT-2000 Cset-1 (06/00);
- Q.1731: Radio Technology Independent Requirements for IMT-2000 Layer 2 Radio Interface (06/00);
- Q.1751: Internetwork Signalling Requirements for IMT-2000 Capability Set 1 (06/00);
- Q.1521: Requirements on underlying networks and signalling protocols to support UPT (06/00);
- Q.1531: UPT security requirements for service Set 1 (06/00);
- Q.1542: UPT stage 2 for Service Set 1 on CS2 – Procedures for UPT functional modelling and information flows (06/00);
- Supplement 30 to ITU-T Recommendation Q.1701: Specifications of International Mobile Telecommunications-2000 (IMT-2000) (06/00);

- Technical Report Q.FSU: IMT-2000 Functionality and Signalling Requirements for UIM (Supplement – 12/00);
- Technical Report Q.FSR: General requirements for the IMT-2000 radio interface architecture (Supplement – 12/00).

In addition, IP-related signalling Recommendations include:

- Q.2111: Signalling protocol in a multilink and connectionless environment (12/99);<sup>83</sup>
- Q.1901: Bearer independent call control (06/00).<sup>84</sup>

#### **2.4.8. ITU-T Study Group 12**

ITU-T Study Group 12<sup>85</sup> is responsible for studies concerning end-to-end transmission performance of network end terminals. SG 12 has provided the following set of Recommendations serving as tools for the calculation, planning and categorization of end-to-end speech transmission performance:

- G.107: The E-model, a computational model for use in transmission planning;<sup>86</sup>
- G.108: Application of the E-model - A planning guide;<sup>87</sup>
- G.109: Definition of categories of speech transmission quality.<sup>88</sup>

Another set of Recommendations provides guidance for the interconnection of one Private Network or one Network based on IP with the PSTN.

- G.175: Transmission planning for private/public network interconnection of voice traffic;<sup>89</sup>
- G.177: Transmission planning for voiceband services over hybrid Internet/PSTN connections.<sup>90</sup>

SG 12 recently determined a draft new Recommendation P.862: Perceptual evaluation of speech quality (“PESQ”),<sup>91</sup> an objective method for end-to-end speech quality assessment of narrowband telephone networks and speech codecs. PESQ provides an objective model for assessing one-way speech quality of telephone networks and transmission systems. It has been specifically developed for end-to-end applications including fixed, mobile and voice over IP networks.

SG 12 also has ongoing work on a new recommendation (G.17x) on the end-to-end performance planning for voiceband services in IP networks.

#### **2.4.9. ITU-T Study Group 13**

Study Group 13<sup>92</sup> is the ITU-T lead Study Group on IP. In this role, SG 13 maintains the “ITU IP Project Description” discussed in Section 2.1. SG 13 has also defined a framework for the “Y” Series of Recommendations, covering ITU-T IP-related standardization activities.<sup>93</sup> The report of SG 13’s last meeting in February/March 2000<sup>94</sup> contains considerable detail on the scope of ITU-T’s IP-related work.<sup>95</sup>

At its March 2000 meeting, SG13 approved Recommendation Y.1310: Transport of IP over ATM in Public Networks.<sup>96</sup>

Study Group 13 has a number of ongoing IP-related standardization projects including, *inter alia*:<sup>97</sup>

- Y.iptc: Traffic control and congestion control in IP networks;
- Y.1231: IP access network architecture;
- Y.1241: IP transfer capability for the support of IP-based services;

- Y.1310.1: IP Virtual Private Networks;
- Y.1310.2: IP-MPLS<sup>98</sup> transfer and control protocols;
- Y.1401: General requirements for interworking with IP-based networks;
- Y.1530: Call processing performance for voice service in hybrid IP networks;<sup>99</sup>
- Y.1540: IP packet transfer and availability performance parameters;
- Y.1541: IP performance objectives and allocations (relates to QoS classes);<sup>100</sup>
- Y.17oam: Operations and Maintenance (“OAM”) and protection switching<sup>101</sup> for IP-based networks.

SG 13 plans to host an “IP Networking” workshop in the January/February 2001 time frame.

#### **2.4.10. ITU-T Study Group 15**

Study Group 15 is active in standardization in the area of transport networks, systems and equipment. It is the lead Study Group on Access Network Transport (“ANT”) and co-coordinates<sup>102</sup> ITU-T activities related to the Optical Transport Network (“OTN”) and Optical Networking technologies. During the last study period, SG 15 revised eight and prepared one new Question reflecting the shift in the telecommunications environment towards networks optimized for the transport of IP-type traffic.

Since then, SG 15 has carried out significant standardization work related to high-speed network access over copper wire loops using Digital Subscriber Line (“DSL”) and optical fiber technologies, Synchronous Digital Hierarchy (“SDH”) and the OTN. These have enabled the deployment and management of optical access networks for delivery of broadband services to both residential and business customers.

For example, to facilitate network access over ordinary telephone subscriber lines, a set of six DSL-related Recommendations (G.990 Series<sup>103</sup>) have provided for multi-Megabit/s access to the Internet, private IP-based networks and other data network architectures. In the area of SDH, new and revised Recommendations have provided for high-capacity network protection and restoration, carriage of 40 Gbps client signals and SDH network management. With regard to optical systems, new Recommendations have been prepared for single channel optical systems with bit rates up to 40 Gbps<sup>104</sup> and for multichannel Dense Wave Division Multiplexing (“DWDM”) optical systems. Significant progress has also been made on a new Network Node Interface (“NNI”) specification for the OTN. Further advances have been made on completing Recommendations dealing with optical submarine cable systems and optical components and sub-systems.

SG 15 has proposed to the WTSA a broad suite of further work related to IP-based networks including, *inter alia*:<sup>105</sup>

- enhancement of several SG 15 Recommendations (e.g., G.983.1<sup>106</sup> and G.983.2<sup>107</sup>) dealing with broadband optical access systems based on Passive Optical Networks (“PON”) to better accommodate IP traffic;
- study the need for enhancements of xDSL Recommendations to optimize the transport of IP and IP-based services;
- study General Switched Telephone Network/Internet Protocol gateway equipment known as “Transport Network Equipment for Interconnecting the GSTN to networks optimized for Internet protocol and ATM Networks” (“TIGIN”);
- work on optical transport of Internet packets (“IP over WDM”, planned as Y.1330<sup>108</sup>).

At its April 2000 meeting, SG 15 determined a new Recommendation G.871 on the “Framework for Optical Transport Network Recommendations” providing an overview of ITU-T Recommendations on different aspects of OTNs, the framework for their development, and a time frame for the development of updated or new Recommendations.<sup>109</sup>

#### **2.4.11. ITU-T Study Group 16**

Study Group 16<sup>110</sup> is the ITU-T lead Study Group on multimedia services and systems. It is responsible for Recommendations that are widely used in IP-based and other (including mixed) network architectures. Examples include standards for IP telephony (e.g., H.323<sup>111</sup> series), modems (e.g., V.90<sup>112</sup>) and audio and video codecs (e.g., G.723.1 and G.729 series,<sup>113</sup> H.260 series<sup>114</sup>).

Study Group 16’s H.323 series of Recommendations is a notably key set of multimedia communication standards for networks that do not provide guaranteed QoS: including IP-based networks, most LANs and the public Internet. The scope is very broad and supports point-to-point and multipoint multimedia conferencing. Other features include call control, multimedia and bandwidth management, as well as interfaces between different network architectures. H.323 itself is part of a larger series of multimedia standards supporting videoconferencing across a range of networks, including H.320<sup>115</sup> for ISDN and H.324<sup>116</sup> for PSTN networks. Furthermore, SG 16 has developed a corresponding set of supplementary services (e.g., signalling protocol, call transfer, call holding, call forwarding, call diversion) for H.323 in the H.450 series of Recommendations.<sup>117</sup>

In a directly related activity, SG 16 recently approved an important PSTN/IP “convergence” standard entitled Recommendation H.248.<sup>118</sup> This standardization project, performed in cooperation with the IETF,<sup>119</sup> defines a protocol to control “gateway devices” that can pass voice, video, facsimile and data traffic between PSTN and IP-based networks. In this architecture, “media gateways” convert media from the format for one type of network (e.g., PSTN) to the format required in another type of network (e.g., IP-based). The gateways are controlled by Media Gateway Controllers (“MGCs”) using the protocols defined in H.248. The standard supports interfaces with conventional PSTN switches and Intelligent Network (“IN”) services with plans to support a range of existing signalling protocols including ISUP<sup>120</sup> (SS7 Signalling Protocol), GSM and others.<sup>121</sup> H.248 is an important ITU-T “convergence” Recommendation unifying traditional PSTN-type services with IP-based applications.

The future IP-related work plan of SG 16 includes, *inter alia*:<sup>122</sup>

- Revision 4 of H.323;
- H.323 Annex H: User/Service mobility in H.323;
- H.323 Annex I: Terminal mobility in H.323;
- New Recommendation G.WSC2: wideband (7 kHz) speech coding at around 16 kbps;
- New Recommendation G.4kbps: speech coding at 4 kbps;
- Revision of the V.90<sup>123</sup> modem recommendation supporting improved upstream rate.

SG 16 is also the lead ITU-T Study Group for the Global Information Infrastructure Project M.3:<sup>124</sup> “Technical Framework for Electronic Commerce”. Under the aegis of this project, in March 2000, ITU signed a Memorandum of Understanding on standards coordination for electronic commerce with the International Electrotechnical Commission (“IEC”), the International Organization for Standardization (“ISO”) and the United Nations Economic Commission for Europe (“UN/ECE”).<sup>125</sup>

Finally, an important new SG 16 initiative is “Multimedia Communication 2004” (“Mediacom 2004”). The goal of Mediacom 2004 is to establish a framework for multimedia standardization for

use both inside and external to the ITU. The project plan is to support a harmonized and coordinated development of multimedia communication standards across all ITU-T and ITU-R Study Groups — as well as in close cooperation with other regional and international standards development organizations.<sup>126</sup>

## **2.5. ITU-T Role in ICANN's Protocol Supporting Organization**

The ITU-T role in the Internet Corporation for Assigned Names and Numbers (“ICANN”) Protocol Supporting Organization is discussed briefly in C2000/27-E and more fully in the related comprehensive version distributed on the Council 2000 area<sup>127</sup> of the ITU web site and on the Council CD-ROM as Comprehensive Version - Part II of C2000/27-E.

## **3. Radiocommunication Sector**

### **3.1. International Mobile Telecommunications (IMT-2000)**

International Mobile Telecommunications-2000 (“IMT-2000”)<sup>128</sup> is an ITU initiative for third generation mobile systems scheduled for deployment in early 2001. IMT-2000 systems will provide access to telecommunications services available on wireline telecommunication networks (e.g., PSTN, ISDN, IP-based) and to services uniquely tailored for mobile users.

IMT-2000 lays an important cornerstone for the emerging “mobile information society” — its feature set includes:

- a limited set of radio transmission technologies (“RTT”) with commonality of design worldwide;
- global roaming capabilities;
- support for minimum high speed mobile data rates of 384 kbps to 2 Mbps, depending on the environment;
- support for packet data services (e.g., IP) with asymmetric and symmetric data bit rates and QoS;
- linkage with terrestrial, satellite-based and fixed wireless access networks.

IMT-2000 systems are standardized in a set of interdependent ITU-R and ITU-T Recommendations. For example, ITU-R Recommendation M.1455<sup>129</sup> defined the key characteristics of IMT-2000 radio interfaces representing the results of an evaluation process and proposals submitted to the ITU-R. Recognizing the need to minimize the number of radio interfaces and maximize commonality while optimizing RTT performance, this process resulted in a draft ITU-R Recommendation M.1457,<sup>130</sup> which documented the detailed specification of IMT-2000 radio interfaces. In May 2000 at the ITU Radiocommunication Assembly in Istanbul, ITU-R M.1457 was approved.<sup>131</sup> For examples of ITU-T work related to IMT-2000, see Sections 2.4.3 and 2.4.7 of this Report.

In March 2000, a new ITU group on IMT-2000, Working Party 8F (“WP8F”),<sup>132</sup> was created to develop ITU work plans for future wireless services and systems. WP8F is the follow-up to ITU-R Task Group 8/1, which previously held key responsibility for the development of IMT-2000.

WP8F now acts as the focal point for ITU’s continuing vision of next generation wireless services and systems. It will act as a forum for user requirements and a catalyst for translating these requirements into technical reality. Included in the work assigned to WP8F are issues such as future spectrum needs, higher data rate capabilities, IP-based service needs for mobile systems like IMT-2000, and the development of next generation systems beyond IMT-2000. Directly related to the

latter, WP8F held a workshop in March 2000 entitled “Beyond IMT-2000”. The minutes and results of this workshop are available on the ITU web site.<sup>133</sup>

In May 2000, the Radiocommunication Assembly approved a new ITU-R Study Group 8 Question entitled “Internet Protocol Applications Over Mobile Systems”.<sup>134</sup> Studies related to this Question include:

- technical and operational characteristics needed to support IP applications over mobile systems;
- special requirements for voice over IP on mobile systems;
- what essential characteristics (e.g., mobility, data rates) should be identified for international standardization.

IMT-2000 recently moved one step closer to reality when crucial spectrum was allocated at ITU’s World Radiocommunication Conference — crossing a critical hurdle towards global roaming with a single low-cost mobile terminal.<sup>135</sup>

Analysts widely predict that 3<sup>rd</sup> generation wireless terminals will merge with handheld computers to become a (if not the) strategic IP application services platform.<sup>136</sup> Supporting this prediction, one of the world’s first mobile Internet operators has grown to more than 7 million subscribers in less than 18 months — thereby becoming the world’s second largest Internet service provider.<sup>137</sup>

## **4. Telecommunication Development Sector**

### **4.1. African Internet and Telecom Summit**

An African Internet and Telecom Summit<sup>138</sup> is being organized in The Gambia, 5-9 June 2000, to bring together representatives from all Sub-Saharan African countries to focus on the key challenges and opportunities the Internet poses for telecommunication policy-makers and operators in the region. This conference is jointly organised by the Commonwealth Telecommunication Organization (“CTO”)<sup>139</sup> and the ITU. It is hosted by Gambia Telecommunications Company Limited.<sup>140</sup> It is intended for senior personnel with responsibility for Internet policy and operation in their countries in Africa – including ministries of communications, regulatory bodies, telecommunications operating companies and Internet service businesses.

### **4.2. Internet Case Studies**

The BDT, in cooperation with ITU’s Strategies and Policy Unit (see Section 5.1), is carrying out a series of case studies of the diffusion of the Internet in countries at different stages of development (also see Section 5.2). The aim of the project is to seek to understand the factors that accelerate or retard the development of the Internet in different environments and, through comparative analysis, to advise policy makers and regulatory agencies on appropriate courses of action. A particular focus is on the spread of the Internet in different sectors of the economy such as health, education and commerce as well as government. Case Studies are currently underway in Bolivia, Egypt, Nepal and Uganda. Further case studies are planned for Gambia, Hungary and Singapore. Internet country case studies are available on the ITU web site.<sup>141</sup>

### **4.3. Policy**

The BDT’s Sector Reform Unit (“SRU”)<sup>142</sup> is responsible for implementing the 1998 World Telecommunication Development Conference (“WTDC-98”) Valetta Action Plan Programme on

Reform, Legislation and Regulation of Telecommunications.<sup>143</sup> The SRU provides assistance to countries in restructuring of their telecom sectors. The Unit also collects and analyzes trends in sector reform and carries out an annual survey on telecommunication regulation.<sup>144</sup>

This year's survey includes a section devoted to the Internet and IP-based networks. The survey information will be analyzed and reported in the third edition of the publication: Trends in Telecommunication Reform: 2000 ("TTR 2000").<sup>145</sup> The theme of TTR 2000 is interconnection, including a chapter devoted to Internet and IP interconnection issues. The report will be published on the occasion of the BDT's first development symposium for regulators in November 2000. Regulators from around the world are expected to participate in this meeting that will include a workshop on the regulatory impact of convergence and a session on strategies for increasing Internet connectivity. Updated information about the symposium will be posted on the BDT's Telecommunications Regulation web site ("T-Reg On-Line"),<sup>146</sup> which the SRU updates regularly. T-Reg On-Line serves as the BDT's regulatory information service for the telecommunication community, providing essential information on telecoms regulation and sector reform. This site also includes an electronic reference library containing documents on the Internet and convergence.<sup>147</sup>

#### **4.4. Capacity Building**

The BDT is taking great efforts to promote an "e-learning" culture among its Members. The Human Resource Development ("HRD") unit uses the Internet to deliver online training and support through the ITU Virtual Training Center ("VTC").<sup>148</sup> Two BDT/HRD projects deliver numerous distance-learning courses and electronic forums through the VTC, namely:

- Center of Excellence ("CoE");<sup>149</sup>
- Global Telecommunications University and Training Center ("GTU/GTTI")<sup>150</sup>.

These two projects have delivered the following electronic forums and distance-learning courses over the Internet:

- Business Planning forum for telecommunications organizations in the Eastern European Countries and CIS countries;
- Course on Regulation of Telecommunications for the Americas Region (currently being translated into English and French for use in Africa);
- Course on Management with Leadership for the Americas Region;
- Course to train trainers on "The Use of Technology and Distance-Learning" prepared by the Instituto Tecnológico de Estudios Superiores de Monterrey ("ITESM"), Mexico, starting in July 2000;
- Course on "Developing training material for distance learning", starting in July 2000 for broadcasters in the Asia/Pacific Region;
- Course on "Preparation for WTO basic telecommunication services negotiations" currently under preparation.

Other courses under consideration include those on IP and Internet-related subjects (e.g., distance learning technology through the Internet, deployment of Internet national nodes, security and use of digital signatures in IP networks).

HRD's promotion of e-learning methods and technology will continue, particularly in regions such as Africa where lack of Internet infrastructure poses special difficulties for distance learning activities.



#### 4.5. Access

WTDC-98 Valetta Action Plan Programme 3 is responsible for promoting Universal Access to Information Communication Technologies (“ICTs”). There are a number of ongoing activities aimed at bringing Internet connectivity to developing countries, particularly in underserved or rural areas.<sup>151</sup> These include:

- providing training through regional seminars and workshops;
- implementation of Community Telecentre Pilot Projects - currently under way in Mali, Benin, Tanzania, Uganda, Mozambique, Bhutan, Viet Nam, India, Honduras and Surinam. Pilot Projects are also planned for Nepal, Malawi, Cape Verde and Bolivia;
- In Argentina, the project, "Argentine Internet for All", funded by the Secretariat of Communications of Argentina (US\$ 23 million), will bring Internet access to isolated and underserved areas. 950 Community Technology Centres (“CTCs”) have already been installed.

#### 4.6. Electronic Commerce for Developing Countries (“EC-DC”)

The need to address the challenges faced by developing countries in the transformation to the digital economy through the development of innovative technological applications was highlighted in the WTDC-98 Valetta Action Plan Programme 2. A special ITU development initiative, Electronic Commerce for Developing Countries (“EC-DC”),<sup>152</sup> funded by both public and private sector organizations, has the following objectives:

- Provide assistance in building the e-commerce infrastructure and integrating it into existing infrastructure and services;
- Enable the transfer of e-commerce and related technologies by building local capacity;
- Raise the level of awareness on e-commerce issues and assist in establishing a favourable environment (policies and strategies) for the development of e-commerce;
- Provide a framework for private sector participation through neutral and non-exclusive agreements.

Since it was launched two years ago, EC-DC has gained the support of several ITU Member States and the private sector. The African micro-business used to first launch the EC-DC project is now planning to expand its E-commerce activities to other African countries. In June 1999, EC-DC, although still in its infancy, was given an award as an innovative project at the Global Bangemann Projects Challenge<sup>153</sup> in Stockholm, Sweden.

Based on the project objectives, the following activities have been accomplished or are currently underway:

- **Infrastructure:** With the support of major ICT companies, BDT is in a first phase launch of EC-DC projects in more than 60 countries and 5 continents. It is planned that 100 countries will be operational before the end of 2001. An E-commerce infrastructure for a 3000-member association of African women entrepreneurs (ASAFE<sup>154</sup>) representing some 20 countries is now in its final phase. Other projects are being undertaken in Brazil (for more than 60,000 businesses), Cameroon (with the operator Camtel), Venezuela, Trinidad and Tobago (for 5 Caribbean States), Iran (for D-8 countries) and several more countries planned for 2000.
- **Capacity building:** Training workshops have been organized in Latin America (Chile, Venezuela), Africa (Cameroon, Mali), Asia (Malaysia) and the Middle East (United Arab

Emirates). A training workshop for 100 countries to be sponsored by industry partners and with the participation of leading ICT companies is scheduled for October 2000 at the ITU.

- **Awareness and Policy:** Presentations to raise awareness and address E-commerce policies and strategies have taken place in Africa (Bamako 2000<sup>155</sup>), Asia (CTO<sup>156</sup> conference in Malaysia), USA (AFCOM<sup>157</sup>), Latin America (Americas TELECOM 2000<sup>158</sup>), Europe (IIR Conference, Geneva<sup>159</sup>) and several other locations. A seminar for the Arab States Region is planned for November 2000 and participation in other international conferences has taken place or is planned for later in 2000.
- **Partnerships:** In November 1998, a Memorandum of Understanding (“MoU”) was signed between the ITU and FUNDANDINA,<sup>160</sup> Venezuela, to establish an EC-DC center and provide free human resources to assist the ITU in EC-DC projects in the Latin American region. In May 1999, ITU signed a Partnership Agreement with the World Trade Center Geneva (“WTC”<sup>161</sup>) and the World Internet Secure Key (“WISeKey”<sup>162</sup>) to extend EC-DC projects in 100 countries. Since then, additional leading ICT companies are participating in EC-DC projects. In September 1999, an EC-DC Trust Fund Agreement was signed with the WTC Geneva and WISeKey SA.<sup>163</sup> To date, industry partners have contributed more than USD 5 million of in-kind contributions to the EC-DC project. Because of the growing interest from additional private sector companies, a meeting is planned at ITU in June 2000 to discuss how other partners can assist the BDT in further enabling E-commerce in developing countries.

## 5. General Secretariat

In 1999, Council endorsed a series of “New Initiatives”<sup>164</sup> for the Union to promote electronic commerce and to facilitate the transition of the telecommunications community in the age of the Internet and the Information Society. These include:

- **Strategic Planning Workshops:** designed to provide a focus on topics of high current interest to regulators, policy-makers and the broader ITU membership;
- **Telecommunication Case Studies:** designed to address, on the basis of specific country/company experiences, some of the most challenging issues facing the telecommunication industry;
- **Internet Policy:** to develop, strengthen and coordinate ITU Internet policy functions.

These are discussed in additional detail below.

### 5.1. Strategic Planning Workshops

Strategic Planning Workshops are coordinated by the ITU’s Strategies and Policy Unit (“SPU”) in the Office of the Secretary-General.<sup>165</sup> Since Council 1999, three workshops have been held or are planned.

#### 5.1.1. *Electronic Signatures and Certification Authorities (“ESCA”)*

One of the key issues under debate in the field of E-commerce is that of electronic signatures and certification authorities. These are technological and administrative frameworks that permit parties to an on-line transaction to obtain legally satisfactory assurances as to the identity and intent of each other, in a fashion similar to existing frameworks for everyday commercial transactions. Most of the current schemes for electronic authentication, digital signatures and certificates are based on a “key” ITU-T Recommendation: X.509<sup>166</sup> (see Section 2.4.4).

As the Internet is inherently global and borderless, an important question is whether electronic signatures will be recognized in all of the countries concerned or affected by a particular transaction. The global nature of e-commerce raises both substantive issues of applicable law and procedural and technical matters as to cross-border recognition of national certificates.

Accordingly, the first Strategic Planning Workshop on “Electronic Signatures and Certification Authorities (“ESCA”)” was organized and held in December 1999 at ITU. Its main objectives included:

- what new technical standards are needed in the area of electronic signatures and certification authorities?
- what approaches can be taken to facilitate the use and recognition of authentication tools across national borders considering the trend of divergent national approaches?
- what steps should be taken by the ITU to address the needs and responsibilities of the telecommunications community, who are providers of the conduit for e-commerce and increasingly the suppliers of authentication services?

Materials related to the workshop are available on the ESCA area<sup>167</sup> of the ITU web site. A report on the results of the meeting is available in Council Document 00/02.

### **5.1.2. IP Telephony (“IPTEL”)**

The Internet and IP-based networks are increasingly used as alternatives to the PSTN. Internet Protocol Telephony Service Providers (“IPTSPs”) can now provide voice and fax services that are close to functional equivalents of those provided by public telecommunication operators (“PTOs”). However, few IPTSPs are licensed by national authorities or generally have universal service obligations. Some countries have specifically banned IP Telephony completely yet IP-based calls can be made to almost any telephone in the world. On the other hand, many PTOs are establishing their own IP Telephony services using IP-based networks as alternatives to circuit-switched facilities.

Recognizing this trend, a second Strategic Planning Workshop on “IP Telephony” (“IPTEL”)<sup>168</sup> is planned for June 2000. Its main objectives include:

- identify decisions administrations may need to take in relation to the development of IP Telephony;
- help raise awareness among national regulators;
- explore different types of IP Telephony;
- produce a common set of definitions for the different types of IP Telephony;
- explore basic principles regarding the relationship between IP Telephony and circuit-switched telephony;
- explore opportunities for international cooperation with regards to frameworks for IP Telephony.

A suggested list of questions to be discussed at the workshop as well as other materials are available on the IPTEL area<sup>169</sup> of the ITU web site.

Because of the proximity of this workshop’s date to Council 2000, results will be described in a separate report to Council.

### **5.1.3. Fixed/Mobile Interconnect (“FMI”)**

In the ITU’s 1999 World Telecommunication Development Report on mobile cellular systems,<sup>170</sup> it was forecast that revenue from mobile services would overtake that from fixed line services around the year 2004. It is also projected that the number of subscribers on mobile networks worldwide will overtake fixed-line users a few years later. One consequence is that for the foreseeable future a significant share of traffic will transit from fixed networks to mobile ones and vice versa.

At TELECOM 99,<sup>171</sup> there was considerable interest in the future of mobile data access to the Internet and other IP-based networks. However, the viability of these new services depends on achieving access rates and transaction costs that are affordable to consumers. Commercial rates for fixed/mobile interconnection range from zero in some countries to up to US one dollar per minute. Even in relatively liberalized economies, it is estimated that interconnect rates are often well above costs. Furthermore, unlike settlements between countries, there is no assumption of symmetry with charges for fixed to mobile frequently being higher than charges for mobile to fixed. In cases where both the fixed and mobile operators belong to the same company, there is a suspicion that substantially above-cost rates are used to gouge customers. In addition, when fixed/mobile interconnect rates are substantially above costs, calls to mobile handsets are sometimes bounced across an international border so that they are treated as an incoming international call; a technique known as “mobile tromboning”.

There is a significant international aspect to this problem in that roaming interconnect agreements (mobile/mobile and mobile/fixed) are often asymmetric. Operators with many potential roamers are often able to negotiate rates that are significantly lower than those that they themselves charge. The combination of asymmetric roaming agreements with the traditional symmetric operation of the accounting rate system can lead to market distortions.

As this is a topic of increasing interest to policy-makers and regulators, a third Strategic Planning Workshop on “Fixed/Mobile Interconnect” (“FMI”) is planned for September 2000. Related materials and objectives are available on the FMI area<sup>172</sup> of the ITU web site.

## **5.2. Case Studies**

Under the aegis of the “New Initiatives” programme, a number of telecommunication country case studies have been commissioned and published on the ITU website. Several of these are particularly relevant to the Internet. For example, as part of the preparations for the IP Telephony workshop (see Section 5.1.2), case studies on IP Telephony in China, Colombia, Peru and Thailand have been carried out. This research is available on the ITU web site<sup>173</sup> and will provide the basis for the next edition of ITU’s flagship Internet report: “Challenges to the Network”.<sup>174</sup>

Related to above, a number of Internet diffusion country case studies have been carried out jointly by the BDT and SPU. These studies seek to understand the factors that may accelerate or retard the development of the Internet in different economies. A particular focus is the diffusion of the Internet in various economic sectors such as health, education, commerce and tourism. This research will provide the basis for the next edition of ITU’s “World Telecommunication Development Report”.<sup>175</sup> The first round of case studies cover Bolivia, Egypt, Nepal and Uganda with others planned. The results of ITU Internet country case studies can also be found on the ITU web site<sup>176</sup> (also see Section 4.2).

## 5.3. Other Related Activities

### 5.3.1. Telecommunication Indicators Reports

ITU's general information dissemination role is increasingly focused on the Internet and IP-based networks. A second edition of ITU's Internet report: "Challenges to the Network: Internet for Development" was released in 1999 with a specially updated edition published at TELECOM 99.<sup>177</sup> In addition, many of the Union's other reports of a market analysis or statistical nature now have Internet components. For example, the report "Trends in Telecom Reform: 1999",<sup>178</sup> produced jointly by BDT and SPU, focused on the regulatory implications of convergence. A chapter in the latter on "Numbering in a Digital World" discussed parallels between evolution in telephony numbering (e.g., number portability) and the evolution of the Internet Domain Name System (see Section 5.3.2). Similarly, the "Americas Telecom Indicators 2000",<sup>179</sup> report, produced jointly by BDT and SPU, contains a chapter on Internet services in the region (also see Section 4.3). In addition, an often-updated set of Internet statistics is now published on the ITU website.<sup>180</sup>

### 5.3.2. Management of Internet Names and Addresses

The ITU Secretariat's role in the Internet Corporation for Assigned Names and Numbers ("ICANN") Governmental Advisory Committee is discussed briefly in C2000/27-E and more fully in the related comprehensive version distributed on the Council 2000 area<sup>181</sup> of the ITU web site and on the Council CD-ROM as Comprehensive Version - Part II of C2000/27-E.

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<sup>1</sup> <http://www.itu.int/net/ip/res102.htm>

<sup>2</sup> <http://www.itu.int/itudoc/gscouncil/c99/docs/docs1/051.html>

<sup>3</sup> <http://www.itu.int>, materials are either public or available to the Union's membership

<sup>4</sup> <http://www.itu.int/ITU-T/com9/index.html>

<sup>5</sup> <http://www.itu.int/ITU-T/com15/index.html>

<sup>6</sup> Wireless handsets have much higher growth rates than personal computers

<sup>7</sup> NTT Docomo. See [http://www.nttdocomo.com/source/i\\_m\\_scr.htm](http://www.nttdocomo.com/source/i_m_scr.htm)

<sup>8</sup> <http://www.itu.int/imt/>

<sup>9</sup> <http://www.itu.int/newsroom/press/releases/2000/12.html>

<sup>10</sup> Public Switched Telephone Network

<sup>11</sup> <http://www.itu.int/itudoc/itu-t/com16/reports/r062.html>

<sup>12</sup> <http://www.itu.int/africainternet2000/>

<sup>13</sup> <http://www.cto.int>

<sup>14</sup> <http://www.itu.int/osg/sec/spu/>

<sup>15</sup> <http://www.itu.int/osg/sec/spu/ni/index.html>

<sup>16</sup> See Council Document C00/02.

<sup>17</sup> See <http://www.itu.int/osg/sec/spu/ni/esca/> and ITU-T Study Group 7 activities in Section 2.4.4

<sup>18</sup> <http://www.itu.int/osg/sec/spu/ni/iptel/>

<sup>19</sup> <http://www.itu.int/osg/sec/spu/ni/fmi/>

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<sup>20</sup> For example, areas that historically would have been considered PSTN-related such as standardization related to signalling or access and transport networks

<sup>21</sup> H.323, see 2.4.11

<sup>22</sup> <http://www.itu.int/ITU-T/com13/ip/index.html>

<sup>23</sup> <http://www.itu.int/itudoc/itu-t/com13/reports/report2/r068.html>

<sup>24</sup> <http://www.itu.int/itudoc/itu-t/com13/reports/report2/r057.html>

<sup>25</sup> <http://www.itu.int/ITU-T/ip-telecoms/attachments.htm>

<sup>26</sup> <http://www.itu.int/itudoc/itu-t/tsag/reports/rep2/r030.html>

<sup>27</sup> Quality of Service

<sup>28</sup> Voice over IP

<sup>29</sup> See Section 2.4.3

<sup>30</sup> Request for Comments – some of which include IETF standards

<sup>31</sup> Local Area Networks/Wide Area Networks

<sup>32</sup> September 27 - October 6, 2000. See <http://www.itu.int/ITU-T/wtsa.htm>

<sup>33</sup> <http://www.itu.int/ITU-T/com2/index.html>

<sup>34</sup> <http://www.itu.int/ITU-T/ip-telecoms/attachments.htm>

<sup>35</sup> International Public Telecommunication Numbering Plan, see <http://www.itu.int/itudoc/itu-t/rec/e/e164.html>

<sup>36</sup> <http://search.ietf.org/internet-drafts/draft-vaudreuil-enum-e164dir-01.txt>

<sup>37</sup> <http://www.itu.int/itudoc/itu-t/com2/reports/r067.html>

<sup>38</sup> <http://www.itu.int/itudoc/itu-t/com2/reports/r070.html>

<sup>39</sup> Ibid.

<sup>40</sup> COM2-R77, see <http://www.itu.int/itudoc/itu-t/com2/reports/>

<sup>41</sup> COM2-R78, see <http://www.itu.int/itudoc/itu-t/com2/reports/>

<sup>42</sup> COM2-R80, see <http://www.itu.int/itudoc/itu-t/com2/reports/>

<sup>43</sup> Ibid.

<sup>44</sup> <http://www.ietf.org/html.charters/enum-charter.html>

<sup>45</sup> COM2-R80, see <http://www.itu.int/itudoc/itu-t/com2/reports/>

<sup>46</sup> Ibid.

<sup>47</sup> <http://www.itu.int/itudoc/itu-t/com2/reports/r081.html>

<sup>48</sup> <http://www.itu.int/itudoc/itu-t/com2/reports/r082.html>

<sup>49</sup> <http://www.itu.int/ITU-T/com2/files/repjpeg.doc>

<sup>50</sup> Universal Personal Telecommunications, see <http://www.itu.int/itudoc/itu-t/rec/e/e168.html>

<sup>51</sup> Extracted from COM2-R73 (WP1/2, Question 1/2 Rapporteur Group) not available online as of May 2000

<sup>52</sup> <http://www.itu.int/ITU-T/com3/index.html>

<sup>53</sup> In this Recommendation, the expression “administration” is used for conciseness to indicate both a telecommunication administration and recognized operating agency.

<sup>54</sup> <http://www.itu.int/ITU-T/com7/index.html>

<sup>55</sup> Fast-packet data transmission technology

<sup>56</sup> See Section 2.4.9 on the “Y” Series of Recommendations

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- <sup>57</sup> <http://www.itu.int/newsroom/press/releases/2000/04.html>
- <sup>58</sup> <http://www.itu.int/itudoc/itu-t/rec/x/x1-199/x-121.html>
- <sup>59</sup> <http://www.itu.int/itudoc/itu-t/com7/workprog/workprog.html>
- <sup>60</sup> <http://www.itu.int/itudoc/itu-t/rec/x/x500up/x501.html>
- <sup>61</sup> <http://www.itu.int/itudoc/itu-t/rec/x/x500up/x519.html>
- <sup>62</sup> Transmission Control Protocol/Internet Protocol, the basic communication protocol used on the Internet and other IP-based networks
- <sup>63</sup> <http://www.itu.int/itudoc/itu-t/com7/workprog/workprog.html>
- <sup>64</sup> <http://www.itu.int/itudoc/itu-t/com7/contr/contr5/238.html>, also see Section 5.1.1
- <sup>65</sup> <http://www.itu.int/itudoc/itu-t/com7/contr/contr5/239.html>, also see Section 5.1.1
- <sup>66</sup> Trusted Third Party: common usage for entity providing authentication services
- <sup>67</sup> <http://www.itu.int/itudoc/itu-t/com7/contr/contr5/240.html>, also see Section 5.1.1
- <sup>68</sup> <http://www.itu.int/ITU-T/com8/index.html>
- <sup>69</sup> <http://www.itu.int/itudoc/itu-t/rec/f/f185.html>
- <sup>70</sup> <http://www.itu.int/itudoc/itu-t/rec/t/t37.html>
- <sup>71</sup> <http://www.itu.int/itudoc/itu-t/rec/t/t38.html>
- <sup>72</sup> <http://www.itu.int/itudoc/itu-t/com8/reports/r013.html>
- <sup>73</sup> Session Initiation Protocol (“SIP”), RFC 2543, see <http://www.isi.edu/in-notes/rfc2543.txt> and Session Description Protocol (“SDP”), RFC 2327, see <http://www.isi.edu/in-notes/rfc2327.txt>
- <sup>74</sup> <http://www.itu.int/itudoc/itu-t/rec/v/v34.html>
- <sup>75</sup> <http://www.itu.int/ITU-T/com9/index.html>
- <sup>76</sup> <http://www.itu.int/itudoc/itu-t/rec/j/j83.html>
- <sup>77</sup> <http://www.itu.int/itudoc/itu-t/rec/j/j112.html>
- <sup>78</sup> <http://www.itu.int/itudoc/itu-t/com9/reports/r024.html>
- <sup>79</sup> Encoder/decoders
- <sup>80</sup> <http://www.itu.int/ITU-T/com11/index.html>
- <sup>81</sup> <http://www.itu.int/itudoc/itu-t/rec/q/q1000up/q1701.html>
- <sup>82</sup> <http://www.itu.int/itudoc/itu-t/rec/q/q1000up/q1711.html>
- <sup>83</sup> <http://www.itu.int/itudoc/itu-t/approved/q/q-2111.html>
- <sup>84</sup> This provides a means for incumbent PSTN operators, using circuit switched technology, to evolve their networks towards voice over IP services with minimal operational impact. See Annex 2 in <http://www.itu.int/itudoc/itu-t/com16/reports/r066.html>.
- <sup>85</sup> <http://www.itu.int/ITU-T/com12/index.html>
- <sup>86</sup> <http://www.itu.int/itudoc/itu-t/rec/g/g100-699/g107.html>
- <sup>87</sup> Not yet published, see <http://www.itu.int/itudoc/itu-t/com12/contr/080.html>
- <sup>88</sup> [http://www.itu.int/itudoc/itu-t/rec/g/g100-699/g\\_109.html](http://www.itu.int/itudoc/itu-t/rec/g/g100-699/g_109.html)
- <sup>89</sup> <http://www.itu.int/itudoc/itu-t/rec/g/g100-699/g175.html>
- <sup>90</sup> [http://www.itu.int/itudoc/itu-t/rec/g/g100-699/g\\_177.html](http://www.itu.int/itudoc/itu-t/rec/g/g100-699/g_177.html)
- <sup>91</sup> Not yet published, see <http://www.itu.int/itudoc/itu-t/com12/dcontr/dc-may00/140.html>
- <sup>92</sup> <http://www.itu.int/ITU-T/com13/index.html>

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- <sup>93</sup> <http://web.itu.ch/ITU-T/com13/ip/y1000.html>
- <sup>94</sup> <http://www.itu.int/itudoc/itu-t/com13/reports/report2/r068.html>
- <sup>95</sup> Also see Section 2.1
- <sup>96</sup> <http://www.itu.int/newsroom/press/releases/2000/01NP.html>
- <sup>97</sup> <http://www.itu.int/itudoc/itu-t/com13/reports/report2/r068.html>
- <sup>98</sup> Multi-Protocol Label Switching
- <sup>99</sup> See Annex 8, <http://www.itu.int/itudoc/itu-t/com13/reports/report2/r077.html>
- <sup>100</sup> See Annex 3, <http://www.itu.int/itudoc/itu-t/com13/reports/report2/r068.html>
- <sup>101</sup> Protection switching in IP-based networks may be useful, for example, to protect small numbers of premium services which rely on high reliability when multiplexed with a large number of unprotected services
- <sup>102</sup> With ITU-T Study Groups 4, 6 and 13
- <sup>103</sup> <http://www.itu.int/itudoc/itu-t/rec/g/g800up/index.html>
- <sup>104</sup> STM-256
- <sup>105</sup> Part 2 of the SG 15 “Report to the World Telecommunication Standardization Assembly (WTSA-2000): Questions Proposed For Study During The Next Study Period 2001-2004”
- <sup>106</sup> <http://www.itu.int/itudoc/itu-t/rec/g/g800up/g983-1.html>
- <sup>107</sup> [http://www.itu.int/itudoc/itu-t/approved/g/g\\_983-2.html](http://www.itu.int/itudoc/itu-t/approved/g/g_983-2.html)
- <sup>108</sup> <http://web.itu.ch/ITU-T/com13/ip/y1000.html>
- <sup>109</sup> TD 087, SG 15 April 2000 meeting, also see Annex A of <http://www.itu.int/itudoc/itu-t/com15/reports/r052.html>
- <sup>110</sup> <http://www.itu.int/ITU-T/com16/index.html>
- <sup>111</sup> <http://www.itu.int/itudoc/itu-t/rec/h/index.html>
- <sup>112</sup> <http://www.itu.int/itudoc/itu-t/rec/v/v90.html>
- <sup>113</sup> <http://www.itu.int/itudoc/itu-t/rec/g/g700-799/index.html>
- <sup>114</sup> <http://www.itu.int/itudoc/itu-t/rec/h/index.html>
- <sup>115</sup> <http://www.itu.int/itudoc/itu-t/rec/h/h320.html>
- <sup>116</sup> <http://www.itu.int/itudoc/itu-t/rec/h/h324.html>
- <sup>117</sup> <http://www.itu.int/itudoc/itu-t/rec/h/index.html>
- <sup>118</sup> H.248 is a more flexible implementation of the H.323 gateway functions first defined in H.246, see <http://www.itu.int/itudoc/itu-t/rec/h/h246.html>
- <sup>119</sup> IETF project name is Megaco, see <http://www.ietf.org/html.charters/megaco-charter.html>
- <sup>120</sup> Integrated User Services Part
- <sup>121</sup> Including Q.1901 (Bearer independent call control or “BICC”) mention in Section 2.4.7, instead of using 64 kbps TDM trunks
- <sup>122</sup> <http://www.itu.int/itudoc/itu-t/com16/workprog/workprog.html>
- <sup>123</sup> <http://www.itu.int/itudoc/itu-t/rec/v/v90.html>
- <sup>124</sup> <http://www.itu.int/ITU-T/com16/projects.html>
- <sup>125</sup> <http://www.itu.int/newsroom/press/releases/2000/03.html>
- <sup>126</sup> <http://www.itu.int/itudoc/itu-t/com16/reports/r061.html>
- <sup>127</sup> <http://www.itu.int/itudoc/gs/council/c00/docs/index.html>
- <sup>128</sup> <http://www.itu.int/imt/>



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- <sup>129</sup> <http://www.itu.int/itudoc/itu-r/ra/ra-2000/pink/sg8/1035.html>
- <sup>130</sup> <http://www.itu.int/itudoc/itu-r/draftpub/m/1045.html>
- <sup>131</sup> <http://www.itu.int/newsroom/press/releases/2000/10.html>
- <sup>132</sup> <http://www.itu.int/itudoc/itu-r/sg8/docs/wp8f/index.html>
- <sup>133</sup> <http://www.itu.int/itudoc/itu-r/sg8/docs/wp8f/1998-00/info/62349.html>
- <sup>134</sup> See Annex 3 at [http://www.itu.int/itudocr/itu-r/ra/ra-2000/pink/sg8/1003e\\_ww9.doc](http://www.itu.int/itudocr/itu-r/ra/ra-2000/pink/sg8/1003e_ww9.doc)
- <sup>135</sup> <http://www.itu.int/newsroom/press/releases/2000/12.html>
- <sup>136</sup> Wireless handsets have much higher growth rates than personal computers
- <sup>137</sup> NTT Docomo. See [http://www.nttdocomo.com/source/i\\_m\\_scr.htm](http://www.nttdocomo.com/source/i_m_scr.htm)
- <sup>138</sup> <http://www.itu.int/africainternet2000/>
- <sup>139</sup> <http://www.cto.int>
- <sup>140</sup> <http://www.gamtel.gm/>
- <sup>141</sup> <http://www.itu.int/ti/casestudies/>
- <sup>142</sup> <http://www.itu.int/treg/>
- <sup>143</sup> <http://www.itu.int/ITU-D/vap.pdf>
- <sup>144</sup> <http://www7.itu.int/treg/Events/Survey/survey.asp>
- <sup>145</sup> Also see Section 5.3.1
- <sup>146</sup> <http://www.itu.int/treg/>
- <sup>147</sup> <http://www.itu.int/treg/RelatedLinks/LinksAndDocs/Internet.asp>
- <sup>148</sup> <http://www.itu.int/VTC/>
- <sup>149</sup> <http://www.itu.int/ITU-D-HRD/cexcellence/index.html>, also see related press release at <http://www.itu.int/newsroom/press/releases/2000/11.html>
- <sup>150</sup> <http://www.itu.int/ITU-D-HRD/gtugtti>
- <sup>151</sup> <http://www.itu.int/ITU-D-UniversalAccess>
- <sup>152</sup> <http://www.itu.int/ECDC/>
- <sup>153</sup> The Stockholm Challenge Award has replaced the Global Bangemann Challenge, see <http://www.challenge.stockholm.se/challenge.html>
- <sup>154</sup> <http://www.asafe.org/>
- <sup>155</sup> <http://www.bamako2000.org/>
- <sup>156</sup> <http://www.cto.int>
- <sup>157</sup> <http://www.afcomnet.com/>
- <sup>158</sup> [http://www.itu.int/AMERICAS2000/flash\\_homepage.html](http://www.itu.int/AMERICAS2000/flash_homepage.html)
- <sup>159</sup> [http://www.isp-conferences.com/telinet\\_vi/index.html](http://www.isp-conferences.com/telinet_vi/index.html)
- <sup>160</sup> <http://www.fundandina.org>
- <sup>161</sup> <http://www.wtc-geneva.ch/>
- <sup>162</sup> <http://www.wisekey.com/>
- <sup>163</sup> <http://www.itu.int/newsarchive/press/releases/1999/99-20.html>
- <sup>164</sup> <http://www.itu.int/osg/sec/spu/index.html>
- <sup>165</sup> Ibid.

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- <sup>166</sup> <http://www.itu.int/itudoc/itu-t/rec/x/x500up/x509.html>
- <sup>167</sup> <http://www.itu.int/osg/sec/spu/ni/esca/index.html>
- <sup>168</sup> <http://www.itu.int/osg/sec/spu/ni/iptel/index.html>
- <sup>169</sup> <http://www.itu.int/osg/sec/spu/ni/iptel/workshop/iptel-questions.doc>
- <sup>170</sup> [http://www.itu.int/ti/publications/wtdr\\_99/wtdr99.htm](http://www.itu.int/ti/publications/wtdr_99/wtdr99.htm)
- <sup>171</sup> <http://www.itu.int/telecom-wt99/homepage.html>
- <sup>172</sup> <http://www.itu.int/osg/sec/spu/ni/fmi/index.html>
- <sup>173</sup> <http://www.itu.int/osg/sec/spu/ni/iptel/>
- <sup>174</sup> <http://www.itu.int/ti/>
- <sup>175</sup> <http://www.itu.int/ti/>
- <sup>176</sup> <http://www.itu.int/ti/casestudies/>
- <sup>177</sup> [http://www.itu.int/ti/publications/INET\\_99/index.htm](http://www.itu.int/ti/publications/INET_99/index.htm)
- <sup>178</sup> <http://www7.itu.int/treg/publications/Trends-en.asp>
- <sup>179</sup> <http://www.itu.int/ti/publications/americas/2000/index.htm>
- <sup>180</sup> <http://www.itu.int/ti/industryoverview/index.htm>
- <sup>181</sup> <http://www.itu.int/itudoc/gc/council/c00/docs/index.html>