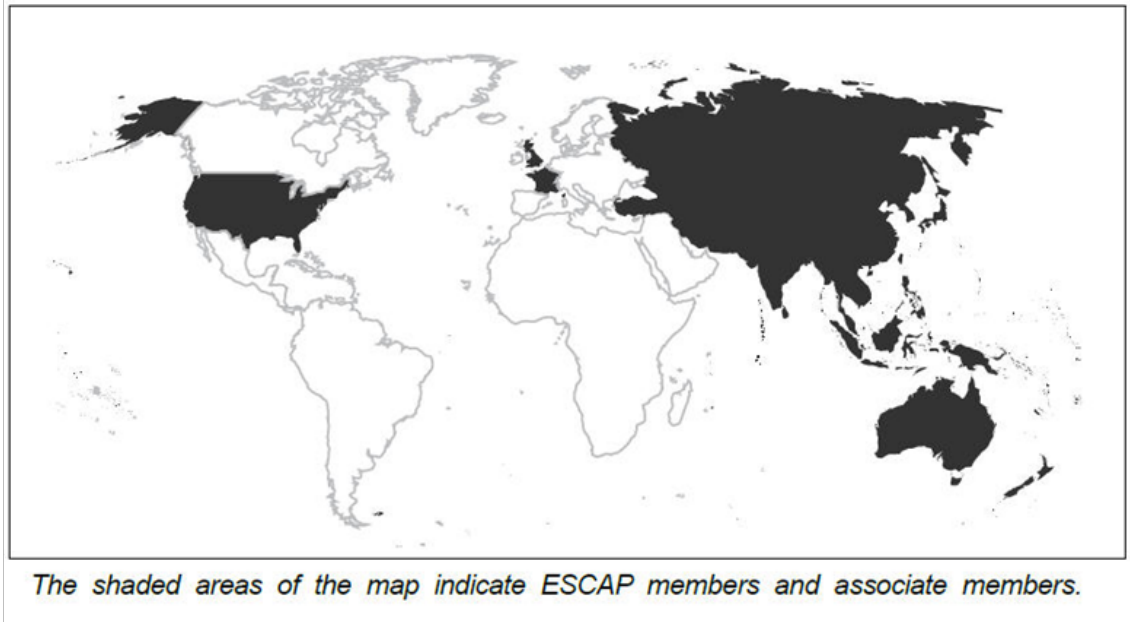




Bridging Transport, ICT and Energy Infrastructure Gaps for Seamless Regional Connectivity

Second United Nations Conference on Landlocked Developing Countries
Vienna, 3-5 November 2014

Side Event: Linking Landlocked Developing Countries to Regional Infrastructure Networks
5 November 2014



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The first photograph depicts a telecom tower powered by solar panels, located along the Dochula pass, in Bhutan. It epitomizes the cross-sectoral infrastructure synergies that can be created for sustainable and inclusive development. Photo credit: Rémi Lang.

The second picture was taken near Khorgos, Kazakhstan, near the border point with China. It illustrates the continuous progress achieved by LLDCs in land transport, in the face of a particularly challenging geographic and topographic environment. Photo credit: Fedor Kormilitsyn.

Bridging Transport, ICT and Energy Infrastructure Gaps for Seamless Regional Connectivity

BRIDGING TRANSPORT, ICT AND ENERGY INFRASTRUCTURE GAPS FOR SEAMLESS REGIONAL CONNECTIVITY

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Foreword



Bridging Transport, ICT and Energy Infrastructure Gaps for Seamless Regional Connectivity, is a contribution by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) to deliberations at the Second United Nations Conference on Landlocked Developing Countries (LLDCs) in Vienna, Austria, from 3 to 5 November 2014. It follows the region's final review of the Almaty Programme of Action, as embodied in the 2013 Vientiane Consensus, which clearly recognized that improving connecting infrastructures and bridging infrastructure gaps would be critical for the Asian LLDCs, and that greater policy attention as well as international support is required.

Overall, the Asian LLDCs have performed relatively well during the decade of implementation of the Almaty Programme of Action (APoA). The infrastructure improvements that took place in some LLDCs demonstrate that there is no absolute inevitability in landlockedness, and that with large-scale investments and prioritization in policy planning, landlocked countries can match, if not outperform the achievements of their neighbouring sea-accessing countries.

The report also shows that, in many respects, regional connectivity remains an unfinished agenda. Bridging infrastructure gaps remains a complex and expensive medium- to long-term challenge for LLDCs and one that will continue to require strong political commitment and the involvement of a range of multi-sectoral stakeholders in both the public and private sectors across the region.

Consequently, the report's central premise is that while the deployment of physical infrastructure remains a priority, deeper regional integration, through regionally cohesive integrated and terrestrial networks, is key for effectively linking Asian LLDCs to the region's infrastructure networks. The report presents a number of strategies, policy recommendations and ESCAP initiatives, designed to reinforce the regional coherence of connecting infrastructure and their cross-sectoral synergies.

For example, new investments will be needed in more and better transport infrastructure and logistics services, particularly along international intermodal transport corridors serving LLDCs. Consequently, the report identifies a number of high priority investments in terrestrial cross-border fibre-optic infrastructure for ICT connectivity. It notes further that while such investments can improve competition, pricing and network robustness, such bilateral

solutions would bring even greater benefits if they were integrated into a regionally cohesive approach that provides multiple configurations of routings. This is the rationale underlying ESCAP's Asia-Pacific information superhighway (AP-IS) initiative.

ESCAP's analysis also shows that the exploitation of new technologies can augment existing infrastructure by improving its efficiency and operations. In this regard, members and associate members of the Commission recently agreed to consider ICT connectivity amendments to the intergovernmental agreements on the Asian Highway and Trans-Asian Railway networks. This decision could represent another major milestone in the continuum of regional cooperation, as Asian LLDCs evolve into regional and global transit corridors for the movement of goods, services, people, information, knowledge, electricity/power, among others.

Similarly, in the energy sector, ESCAP is promoting the concept of an Asian energy highway (AEH), which aims at developing power connectivity for enhanced energy security. The concept is focused on optimizing the use of all energy resources, i.e. renewable energy resources and fossil fuels. It is envisioned as a necessary system for sustainable development because the growing demand for electricity in the region cannot be met in an optimal and equitable way unless there is an integrated regional power grid and electricity market.

This publication is, therefore, a substantive contribution to the policy debates about wider LLDC connectivity at the Second United Nations Conference on Landlocked Developing Countries, and will help shape future policymaking in the region and beyond. The outcome of this event will, among others, help to shape the preparatory process for ESCAP's Second Ministerial Conference on regional economic integration in 2015, and will also feature prominently in the future 5-year Regional Action Programme to be adopted at the Asia-Pacific Ministerial Conference on Transport which ESCAP will organize in 2016.



Shamshad Akhtar

Under-Secretary-General of the United Nations and
Executive Secretary, United Nations Economic and Social Commission for Asia and the Pacific

Executive summary

Geography adds dramatically to the development challenges facing landlocked developing countries (LLDCs). The only industrialized LLDCs are those in the European Union, and they have already for some time resolved their transit problems. Consequently, the most important demand of LLDCs has always been free access to the sea.

From past to present

The problems of Asian LLDCs (ALLDCs) have always been high on ESCAP's regional policy-making agenda. Significantly, it was the Economic Commission for Asia and the Far East (ECAFE), the precursor of ESCAP that gave the issue international recognition for the first time.¹ Through ECAFE's Committee of Industry and Commerce, the Commission at its twelfth session in February 1956, adopted a resolution, opening up a new United Nations avenue that gave the needs of LLDCs a multilateral approach and credible international standing. Today, more than a half century later the issue remains a top priority for ESCAP. The secretariat's work has evolved in a manner that is well aligned with the *Draft Programme of Action for Landlocked Developing Countries for the Decade 2014-2024*. The findings of this report are particularly relevant to Priority Two of the Draft Programme of Action, namely "Infrastructure Development and Maintenance" in which transport, ICT and energy are recognized as priority sectors for achieving enhanced connectivity of LLDCs.

Overall, LLDCs have performed relatively well during the past decade of implementation of the Almaty Programme of Action (APoA). ALLDCs made tangible improvements in physical infrastructure to the extent that it is no longer an explicit binding constraint. Cross-border cooperation also improved, facilitated by international organizations that include ESCAP. Having said this, there is still a long way to go in linking LLDCs to regional infrastructure networks in a coherent way. Consequently, the report's central premise is that while the deployment of physical infrastructure remains a priority, deeper regional integration, through regionally cohesive terrestrial networks, is key for effectively linking LLDCs to the region's infrastructure networks. Furthermore, a related aspect is that as ALLDCs develop their transport and energy networks, they can enhance operational efficiencies by capitalizing on technological innovations. Information and knowledge are the new factors of production for achieving economic competitiveness and by strengthening cooperation in ICT connectivity, ALLDCs have unprecedented opportunities to mitigate, if not overcome, their longstanding problems of geographic disadvantage.

From geographical disadvantage to geographic dividend

Indeed, the region's vibrant trade relations where the value of information embodied in goods traded continues to increase, have made it essential for approaches that go beyond single mode solutions (e.g. road, rail, ICT). Multimodal and cross-sectoral solutions along international corridors that are networked with each other are key for effectively linking ALLDCs to the region's infrastructure networks. Notably, cross-sectoral infrastructure synergies can be exploited by enabling the sharing

¹ Uprety, K. (2006). *The transit regime for landlocked states: international law and development perspectives*. World Bank publications.

of passive elements of infrastructure, such as towers, ducts, and rights-of-way. This would not only cut costs of network expansion in all three sectors, but also augment revenue generation. Importantly, on 15 October 2014 in a joint session of the ESCAP Committees on Transport and ICT, the first time that such a session was held, members and associate members of the Commission agreed to consider, through the respective working groups, ICT connectivity amendments to the agreements on the Asian Highway and Trans-Asian Railway networks. This decision could emerge as another milestone in the continuum of regional cooperation, as ALLDCs evolve into regional and global transit corridors for the movement of goods, services, people, information, knowledge, and electricity/power, among others.

Likewise, the development of dry ports is all the more important for ALLDCs. Dry ports are essential to the advent of efficient intermodal transport corridors which offer a framework within which issues relating to trade, transport, technologies, as well as social and environmental concerns can be addressed in an inclusive manner. Supporting progress in dry ports is particularly timely, as the capacities of existing infrastructure in maritime ports are, in many cases, limited, operation costs are high and new facilities are urgently required. Furthermore, ICTs present an important means of augmenting the services provided by such facilities. By running fibre optic cables along the Asian Highway, and Trans-Asian Railway, networks, ICT infrastructure will converge at dry ports (many of which are already located, or planned for location along these intermodal transport corridors). The services provided by ICT hubs do not need to be located in physical proximity to the congested mega-cities of Asia - their virtual functions make them well suited to location in remote areas. Furthermore, through an ICT network infrastructure that connects LLDCs directly (rather than through transit countries onto submarine cables), the introduction of affordable state-of-the-art ICT applications will modernize customs clearance and a range of other operations offered by dry ports. It increases the efficiency of dry ports, augments the variety of services offered and in turn enhances the ability of dry ports to compete with maritime ports.

Some of the key sectoral issues highlighted in this report are the following:

Transport networks

ALLDCs have made undeniable efforts to improve the quality of their transport infrastructure and services. Under various bilateral, multilateral and self-funded arrangements, ALLDCs have also consented investment to increase land transport connectivity with their neighbouring countries through the continued development or modernization of their road and rail networks.

However, according to the World Economic Forum, infrastructure ratings in ALLDCs remain below the world's mean value. While substantial progress has been made in the development and upgrading of the Asian Highway network in ALLDCs, 55 per cent of the network in these countries is still of class III standards (38 per cent) or below Class III (17 per cent) standards. The resulting high vehicle operating costs often deter road transport operators from running international services. Of particular note is that many of the Asian Highway sections that do not meet the minimum class III standard are the ones offering connectivity with neighbouring countries. In addition, low-quality roads are often the most accident-prone resulting in a punitive economic impact that ALLDCs can ill afford. The World Health Organization estimates that road injuries cost low- and middle-income countries an estimated US\$ 100 billion.

Furthermore, the low rating received by rail is a particular concern given that the distances between ALLDCs and the region's main maritime ports are of a scale on which the rail mode should find its full economic justification and the fact that a number of ALLDCs are major exporters of mineral resources in the logistic of which rail transport plays a crucial role. In general, the efficiency of rail transport in ALLDCs is hampered by the existence of different technical standards on both sides of a same border or the absence of rail infrastructure, i.e. missing links.

The secretariat works in close collaboration with the Governments of ALLDCs to address the issues highlighted above within the activities of the respective working groups on the Asian Highway and Trans-Asian Railway networks, or under the framework of specific technical assistance projects.

All the efforts deployed by the secretariat and other development partners show that bridging infrastructure gaps remains a complex and expensive medium- to long-term challenge for LLDCs and one that will continue to require a strong political commitment and the involvement of a range of multi-sectoral stakeholders in both the public and private sectors.

Studies also show that there exists tremendous potential for a greater utilization of regional transport networks through the development of intermodal facilities, such as dry ports, and greater integration of modes to create the necessary conditions for LLDCs to enjoy the economic prosperity that has so far eluded them. The current efforts need to be augmented by investing in (i) more and better transport infrastructure and services, particularly along international intermodal transport corridors serving LLDCs, (ii) the development of cross-border and transit transport facilitation and (iii) establishment of an enabling environment for the advent of efficient logistics and (iv) development of new technologies smoothing the operationalization of transport infrastructure networks such as Intelligent Transport Systems technology.

ICT connectivity

Optic fiber cables have been deployed domestically in all ALLDCs, reaching most of the major population centres in a meshed grid network. The secretariat's analysis, which includes information drawn from the ESCAP/ITU map of the information superhighway² show that on average 62.8% of ALLDC's population are within 25 Km of a transmission network. This compares favourably with the ESCAP region's average of 58.8%. However the intensity and coverage of these networks vary substantially across ALLDCs. Azerbaijan and Bhutan, are among the ALLDCs where tremendous strides have been made, while the poorest ALLDCs (Afghanistan, Nepal and Uzbekistan) have almost no fibre reaching rural areas. Those ALLDCs that have been able to greatly improve their connectivity, are also the ones that prioritized ICT development in their national policy agendas and made large infrastructure investments. These experiences show that there is no absolute inevitability in landlockedness, and that with appropriate investments and policies, ALLDCs can match if not outperform the achievements of their neighbouring sea-accessing countries. In short, ICTs can help level the playing field for LLDC and compensate, at least in part, for their geographic disadvantage in other sectors such as trade and transport.

The key ICT connectivity problem for ALLDCs is the very high prices they face. The problem is to be found in the international segment of connectivity routes. While of course, the affordability of connectivity depends on the degree of competition on the retail market segments at the national

² See: www.itu.int/itu-d/tnd-map-public/

level, for ALLDCs without exception, it also hinges crucially on the price of transit purchased at the borders. Up to 90 percent of ALLDC's digital traffic is routed onto submarine cables, and so the connectivity prices reflect the margins that telecom carriers in sea-accessing countries are able to impose on landlocked neighbours, in addition to the price for capacity sold through the submarine cable.

Azerbaijan and Kazakhstan constitute exceptions in that they enjoy considerably lower transit prices, at US\$20 and US\$15, per megabit per second (Mbps), respectively. Interestingly, both countries have multiplied their points of physical connectivity to international networks, so much so that they are also beginning to act as transit countries for through-traffic of third countries, thereby importing large international bandwidth capacity and consequently triggering economies of scale that allow them to command much lower prices than most other LLDCs, including for their own domestic market.

At the other end of the spectrum, twice-landlocked Uzbekistan faced a hefty US\$ 347 per Mbps per month for international connectivity in 2012. Most other Central Asian countries, as well as the Lao People's Democratic Republic also faced prices of more than US\$ 100 per Mbps for international capacity. This compares very unfavourably to prices paid by other countries of the region. Only Myanmar, after years of isolation, and with a nascent ICT market, faces a comparable situation. In other developing economies, prices are on average, at least 20% lower. Such premia not only penalize final consumers, but also limit the potential contribution that broadband can make to an ever increasing range of applications, including logistical efficiencies along the transport and trade international supply chains.

Delving deeper, ESCAP analysis has shown that ALLDCs are almost solely dependent on submarine connectivity offered by transit countries because they have limited (one, two or three) cross-border terrestrial fibre optic links which operate at low capacity and therefore do not present a competitive alternative to submarine routes. Over and above this, the submarine cable system itself, also suffers from at least five critical choke points, to the extent that the global telecom industry has declared itself desperate for a terrestrial solution that will resolve these critical weaknesses – this presents ALLDCs with a strategic window of opportunity.

Consequently the report identifies high and medium priority investments in terrestrial cross-border fibre optic connectivity. While such investments can improve the situation in terms of competition, pricing and network robustness, such bilateral solutions would bring even higher benefits if they were integrated into a regionally cohesive approach. In short, to maximize the benefits of investments in cross-border infrastructure for ALLDCs, such investments should be part of a seamless meshed network that provides multiple configurations of routings. This is the rationale underlying ESCAP's Asia-Pacific information superhighway (AP-IS) initiative. It is aimed at connecting each country's backbone networks and integrating them into a cohesive land- and sea-based fibre infrastructure that will provide increased route diversification, increased international bandwidth and lower prices for all developing countries. A framework of common principles and norms for its further development is under development through a Working Group that was set up by ESCAP's Committee on ICT, at its fourth session held from 14-16 October 2014.

Energy grids

In Asia, the energy demand is expected to double by 2050, of which the demand for electric power will account for the bulk of increases. Meeting the region's increased demand is a priority for energy security and a push factor for policy makers in countries relying on energy imports. Traditionally, meeting such demand would be planned and implemented within the boundaries of national borders. However, due to the imbalanced distribution of resource reserves in this region, regional cooperation is an effective means of supporting national efforts; energy infrastructures are therefore important enablers of regional collaboration, for example, connected power grid and pipelines that allow cross-border trade.

Most LLDCs are still in the process of setting clear policies and strategies, as well as appropriate institutional arrangements and robust financial mechanisms to close the energy infrastructure gaps.

There are also a number of other multi-country subregional initiatives that involve one or more ALLDCs, and that have focused on electricity and power grid integration. The Association of South-east Asian Nations (ASEAN) Power Grid – an intergovernmental programme that has been optimizing energy trading opportunities within the region since the 1990s; CASA-1000 – for the Central Asia-South Asia Regional Electricity Market uses the surplus hydropower from Kyrgyzstan and Tajikistan to meet power deficits in Afghanistan and Pakistan; the Greater Mekong Subregion Power Market; the South Asian Association for Regional Cooperation (SAARC) Market for Electricity which is the main component of SAARC's Energy Ring; Gobitec and an Asian super grid for renewable energies in North-East Asia; Unified Energy System of Central Asia –the Unified Energy System network is a synchronous grid extending across the Russian Federation and Central Asian countries.

Building on these subregional initiatives, the secretariat has been promoting the concept of the Asian energy highway (AEH) which aims at developing power connectivity for enhanced energy security. The concept is focused on optimizing the use of all energy resources, i.e. renewable energy resources and fossil fuels. It also intends to do more than just promoting trade and investments in physical infrastructure. It is envisioned as a necessary system for sustainable development because the growing demand in the region for electricity cannot be met in an optimal and equitable way unless there is an integrated regional power grid and electricity market.

Under the framework of the Asian energy highway, the secretariat will play a role in promoting the wider application on good practices that supports and improves performance of each subregional initiative; building trust among countries, subregions and organizations, and establishing a better foundation (relationships, standards, institutions, etc.) for future integration. At the same time, particular attention and priority should be given to ALLDCs to meet their special needs. An Asian energy highway would not only connect physical infrastructures but also involve integrated market mechanisms that enable power to be moved more efficiently and sustainably. It will also optimize the allocation of power between supply and demand centres. Such a regionally integrated market would enhance energy security since greater diversification of national energy supplies would reduce exposure to potentially volatile markets, and thus help to reduce the potential for geopolitical conflicts. It will also help ALLDCs to create job opportunities.

Financing: the essential enabling condition

Financing represents an important challenge given the considerable amounts required to expand and maintain infrastructures, and the budgetary pressures experienced by many ALLDCs. Notwithstanding new forms of innovative financing mechanisms that have appeared recently, international finance institutions (IFIs) continue to be large providers of funds. They have thus maintained their historical function of acting as stable and secure lenders, that provide funding at concessional rates, and with due guarantees. Their role in recalibrating the risk-reward equation of infrastructure investments cannot be overemphasized, as it is key for the long term buy-in from the private sector who otherwise would be reluctant to take on the risks involved.

A flurry of initiatives in recent years, has brought to the fore the importance of this function. An ASEAN Infrastructure Fund was set up with funding from the ADB and ASEAN members, the World Bank proposed a Global Infrastructure Facility for infrastructure funding, Brazil, the Russian Federation, India, China and South Africa (BRICS group) proposed a New Development Bank, while China, is spearheading the establishment of an Asian Infrastructure Investment Bank. These initiatives will help advance the regional integration of infrastructure, while at the same time they are reflective of an emerging new world order that is multi-polar, characterized by diversity and more decentralized geopolitical decision-making. In this evolving configuration, regional cooperation emerges as a centerpiece.

Conclusion: preparing for the future

The outcome of the Second United Nations Conference on LLDCs will be of high importance to ESCAP. It will be a major input into the preparatory process for ESCAP's Second Ministerial Conference on regional economic integration, in which connectivity within and among the three sectors will be given special attention, as instruments that can accelerate regional integration. The outcome of the LLDCs conference will also feature prominently in the future 5-year Regional Action Programme that will be submitted for adoption at ESCAP's Ministerial Conference on Transport to be organized in 2016.

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I. Introduction

In *The Wealth of Nations*, Adam Smith argued that specialization is the key to productivity gains and its associated increases in output and trade. To realize these gains, however, access to markets has to be ensured, and in this regard, landlocked developing countries (LLDCs) have a key geographic disadvantage compared to countries with coastlines and deep sea ports. They have no direct access to maritime transport routes which play a significant role in international trade.

More recently, rapid development related to the information and communications revolution has presented with a more complex picture. New opportunities have opened up for transit in transport and energy sectors, as well as in the ICT sector itself. On the other hand, as the ICT sector also depends on physical infrastructure, there is a persistence of the problem of lack of direct access to the sea, namely ALLDCs are unable to directly access submarine cable system – currently the routes along which up to 90 percent of digital information and communications travel.³ Consequently, LLDCs remain constrained by their economic remoteness, long distances to seaports over challenging terrains, inefficient infrastructure and restrictive regulatory environments. The need to enhance connectivity by linking LLDCs to regional infrastructure networks is thus a key determinant of LLDCs improved access to new or existing markets, overall development of ALLDCs and economic integration of the region as a whole.

In preparation for both the comprehensive review on the implementation of the APoA, and the evolving new programme of action for the next decade, this report has been prepared to guide discussions of the side event on “Linking LLDCs to regional infrastructure networks” in Vienna, Austria on 5 November 2014. The objective is to present an assessment of infrastructure development in ALLDCs as it evolved during implementation of the APoA, in terms of connectivity to regional infrastructure networks. The report highlights divergences, as well as common challenges and opportunities. It identifies missing infrastructure links, holding back cohesive and seamless connectivity and it proposes policy actions, including financing mechanisms to strengthen the role of infrastructure as a regional public good. The central premise of the report is that ALLDCs could be at the threshold of a new era of economic development and may be better served by looking at each other not as competitors for markets or foreign investment, but as long-term partners whose economic growth and dynamism are essential to their own. It is also worth noting that infrastructure is only one part of the equation as the regulatory environment also has a significant role to play for achieving efficient infrastructure networks. For purpose of this report, however, the focus is on physical infrastructure. Reform in policy and regulatory frameworks are also vital, but outside the scope of this report.

This work is now well aligned with the LLDCs evolving action plan (2014-2024), in which transport, ICT and energy are recognized as priority sectors for enhanced connectivity of ALLDCs. In particular, on 15 October 2014 in a joint session of the ESCAP Committees on Transport and ICT, the first time that a joint session between the committees was held, members and associate members of the Commission agreed to consider, through their respective working groups, amendments to

³ United Nations Economic and Social Commission for Asia and the Pacific ICT and Development Section, ICT and Disaster Risk Reduction Division, (2014). *Discussion Paper Series on Problems and Challenges in Transit Connectivity Routes and International Gateways in Asia*, Discussion Paper series 2014/1, p.3.

the Asian Highway and Trans-Asian Railway Network agreements. Indeed, the region's continued economic growth and vibrant manufacturing industry have made it essential for countries to go beyond the mere development of transport infrastructure to a recognition of the need to link many individual transport solutions offered by road, rail, inland waterways, ports and airports, into seamless transport solutions along international intermodal transport corridors. Moreover, the co-deployment of transport, ICT and energy infrastructures are important tools for building synergies across infrastructures that will transform the region's transport corridors into networked economic corridors as the region's key means of linking LLDCs to infrastructure networks.

A. The Almaty Programme of Action

To deal with the constraints facing landlocked developing countries, the International Ministerial Conference of Landlocked and Transit Developing Countries and Donor Countries and International Financial and Development Institutions on Transit Transport Cooperation was held in Almaty, Kazakhstan, from 25-29 August 2003.

Discussions at the Conference led to two outcome documents, namely: (i) the "Almaty Programme of Action (APoA): Addressing the Special Needs of Landlocked Developing Countries within a New Global Framework For Transit Transport Cooperation for Landlocked and Transit Developing Countries" and (ii) the Almaty Ministerial Declaration. Both documents reflected a broad consensus by the international community to commit resources to addressing the special needs and problems of landlocked developing countries (LLDCs) resulting from their lack of direct territorial access to the sea. They also took particular relevance in the context of the Millennium Development Goals adopted three years earlier at the Millennium Summit held at the United Nations Headquarters in September 2000.

The objective of the APoA is to establish a new global framework for developing efficient transit transport systems in landlocked and transit developing countries, taking into account the interests of both groups of countries. In particular, the APoA aims to *"(a) secure access to and from the sea by all means of transport according to applicable rules of international law; (b) reduce costs and improve services so as to increase the competitiveness of their exports; (c) reduce the delivered costs of imports; (d) address problems of delays and uncertainties in trade routes; (e) develop adequate national networks; (f) reduce loss, damage and deterioration en route; (g) open the way for export expansion; and (h) improve the safety of road transport and security of people along the corridors.*⁴ Within the context of these objectives, it recognizes the role of communication facilities in ensuring smooth and speedy transit, and recommends the development and extensive use of common ICT-based management and monitoring systems.

In short, the APoA recognized the establishment, operationalization and maintenance of efficient, safe and secure transport as well as communication infrastructure networks as essential to addressing the special needs of LLDCs. The focus was on transport infrastructure. Telecommunications was less prominent, perhaps due to the fact that the transformational power of broadband Internet was at a nascent stage. Nevertheless communications infrastructure, public—private partnerships and streamlined telecommunications facilities were also recommended as key strategies for increasing access to ports, commercial centres and overseas markets.

⁴ Almaty Programme of Action, Part III Objectives, paragraph 10.

B. The role of ESCAP: a historical perspective

Geography has always added dramatically to the development challenges facing LLDCs. Historically, therefore, the most important demand of LLDCs has always been free access to the sea. The only industrialized LLDCs are those in the European Union, and they have already for some time resolved their transit problems. Considerable problems remain for LLDCs in Africa, Asia and Latin America, who are among the poorest countries in the world. Half of all landlocked developing countries are classified as least developed, with a majority in Sub-Saharan Africa, while many others are in Central Asia and various parts of South and South-east Asia.

The problems of LLDCs have always been high on ESCAP's regional policy-making agenda. Significantly, it was in the Economic Commission for Asia and the Far East (ECAFE), the precursor of ESCAP, that the issue was given attention, at the international level, for the first time.⁵ Through ECAFE's Committee of Industry and Commerce, held in January 1956, the Commission at its twelfth session in February 1956, adopted a resolution recommending that the members recognize fully the needs of members deprived of access or easy access to the sea with regard to transit trade, and grant to these countries necessary facilities in conformity with the international law and practices.⁶ With that, ECAFE opened a new United Nations avenue that gave the issue a multilateral approach and credible international standing. The Resolution was also instrumental in promoting the insertion of transport projects in the economic development plans of States. A year later, on 20 February 1957, the General Assembly adopted Resolution 1028 (XI), on landlocked developing countries and the expansion of trade, that recommended that member states recognize the transit needs of LLDCs.

Up to that point, much of the discourse was focused on the needs of LLDCs rather than the rights of LLDCs. This changed when in another milestone, the ECAFE Ministerial Conference on Economic Cooperation in Asia, held in Manila in December 1963, adopted a resolution supporting the need to recognize the rights of LLDCs to free transit to the sea. It was the first time the words "right of free transit" was inserted into an international resolution concerning LLDCs. The resolution which was sponsored by four Asian LLDCs, Afghanistan, the Lao People's Democratic Republic, Mongolia and Nepal went on to form the foundation of the New York Convention the first multilateral agreement that recognizes in a single instrument enforceable rules for transit rights of LLDCs.⁷ In a further impetus, a resolution was adopted during a 1964 meeting in Tehran, Islamic Republic of Iran, immediately preceding the first UNCTAD conference. This resolution was important in that it set the stage for the problem of free access to be considered during subsequent UNCTAD conferences.

ESCAP also contributed to keeping LLDCs high on the ECOSOC policy agenda. Significantly, ECOSOC during the 34th plenary meeting adopted a Resolution on Restructuring the Conference Structure of ESCAP on July 18, 1997, not too long after 9 of the former fifteen Republics of the Union of Soviet Socialist Republics were added to the landlocked developing countries list, which decided to retain and invigorate a special body that had been created earlier to act as the focal point on LLDC issues. The decision to reinvigorate the special body was noteworthy because it reflects an understanding of the problems of LLDCs by the international community.

This culminated in the Almaty International Ministerial Conference of 2003. The Conference's focus on an efficient transport sector as a vehicle to drive forward the agenda of the upcoming decade,

5 Uprety, K. (2006). *The transit regime for landlocked states: international law and development perspectives*. World Bank Publications

6 UN Doc. E/CN.11/425

7 Uprety, K. (2006). *The transit regime for landlocked states: international law and development perspectives*. World Bank Publications

aligned well with ESCAP's transport work articulated around the three components of Asian Highway, Trans-Asian Railway and facilitation of land transport. Furthermore, in witness to the fact that the world was changing at a very fast pace, the APoA also recognized the importance of communication networks. ESCAP established a new programme of work on ICT in 2001, and by 2008 a dedicated Committee on ICT had held its first session. In 2013 the Commission adopted Resolution 69/10 on Promoting Regional Information and Communications Technology Connectivity and Building Knowledge-networked Societies in Asia and the Pacific, which requested the secretariat to work towards a regional framework for action that strengthens regional policymaking processes related to ICT for inclusive and sustainable development.

In 2014, in recognition of growing cross-sectoral infrastructure synergies, the Commission adopted Resolution 70/1. As part of a large regional economic integration strategy for the region, the Resolution set up a Working Group on transport, ICT and energy.

Energy has also emerged as another important infrastructure. Historically, LLDCs have depended on the continued availability of biomass and fossil fuels, such as oil, gas and coal, for fuels and electricity at moderate prices. However, overexploitation of biomass resources, declining economic feasibility of remaining fossil fuel reserves and rising international concern with carbon emissions mean that these sources of energy will become less and less affordable in the future. Consequently, ESCAP has adopted a number of related resolutions, which starting in 2007, were adopted on an almost yearly basis. Significantly, the 68th Session of the Commission adopted a resolution (68/11) in 2012 requesting the secretariat to identify options on connectivity for energy security, including an integrated regional power grid called the "Asian energy highway". Similarly, at global level, the General Assembly has recognized the centrality of energy on numerous occasions. Leaders gathered at the Rio+20 Conference declared that "we are all determined to act to make sustainable energy for all a reality and, through this, help to eradicate poverty and lead to sustainable development and global prosperity". Moreover, the UNSG's Initiative on Sustainable Energy for All (SE4ALL) with three interlinked objectives that underpin the goal of achieving sustainable energy for all by 2030 also has important implications for LLDC as follows: (a) ensuring universal access to modern energy services; (b) doubling the rate of improvement in energy efficiency, and (c) doubling the share of renewable energy in the global energy mix.

II. Review of progress in infrastructure development and maintenance

Over the past decade, LLDCs have made significant progress in transport, ICT and energy infrastructure as the data presented below will show. At its start, the Almaty process was focused on LLDCs and aimed at building partnerships to overcome their specific problems, while the involvement of transit countries was motivated by their concern with sovereign rights and territorial integrity when allowing the passage of foreign goods and passengers through their territories. Ten years later, a significant change in mindsets has evolved in which closer cooperation among LLDCs and between LLDCs and transit countries has emerged. LLDCs are articulating their needs more specifically and there is greater buy-in from the transit developing countries who realize the benefits to be gained from well-managed transit arrangements, both in terms of regional integration, augmented economic links and good neighbourliness, for win-win outcomes.

Nevertheless, LLDCs lag behind the progress made by other developing countries of the region and much remains to be done, before LLDCs become truly connected to the region's infrastructure networks. According to the World Bank, the cost of exporting via maritime routes from LLDCs is reported to be twice as high as the world's average, and to date this "cost gap" has not been bridged.

A. Quality of infrastructure

The progress achieved and remaining challenges can be illustrated through cross-country comparisons such as the World Bank 2014 survey of logistic professionals (Table 1 below). According to these professionals, the quality of trade and infrastructure (i.e. airports, ports, railroads, roads, warehousing/transloading facilities and information and communication technology) has shown relative improvement in LLDCs since the World Bank started to monitor a set of indicators measuring on-the-ground efficiency of trade supply chains. The latest 2014 edition, which covers 160 countries worldwide, shows that LLDCs continue to rank relatively low in international comparison with only one of the Asian LLDCs in the top 100 - the survey participants marked the quality of infrastructure around 2 (low) and 3 (average) while the maximum grade is 5 (very high).

Table 1: Ranking of infrastructure components of the logistics performance indicator

Countries	2007	2010	2012	2014	Ranking Infrastructure (2014)
Afghanistan	1.10	1.87	2.00	1.82	158
Armenia	1.77	2.32	2.38	2.38	107
Azerbaijan	N/A	2.23	2.42	2.71	68
Bhutan	1.95	1.83	2.29	2.18	132
Kazakhstan	1.86	2.66	2.6	2.38	106
Kyrgyzstan	2.06	2.09	2.49	2.05	147
Lao PDR	2.00	1.95	2.40	2.21	128
Nepal	1.77	1.80	1.87	2.26	122
Mongolia	1.92	1.94	2.22	2.29	120
Tajikistan	2.00	2.00	2.03	2.36	108
Turkmenistan	N/A	2.24		2.06	146
Uzbekistan	N/A	2.54	2.25	2.01	148

Source: World Bank, *Connecting to Compete – Trade Logistics in the Global Economy*, 2014, Appendix 1, pp. 34 to 37.

Meanwhile, the Global Economic Forum provides useful information as regards the quality of infrastructure by modes across 148 economies as assessed by 15,000 surveys of business leaders representing the main sectors of the economy (agriculture, manufacturing industry, non-manufacturing industry, and services) in response to the question: “How would you assess general infrastructure (e.g., transport, telephony, and energy) in your country?” Table 2 below presents results from the 2013-2014 report which by and large confirm the overall difficulties of infrastructure in LLDCs. Table 2 shows that, on average, infrastructure ratings in LLDCs are below the world’s mean value although many countries do better on an individual basis in one sector or another. Of note is the fact that of all the LLDCs for which values are available, only one, i.e. Azerbaijan fares at or above the mean value for land transport infrastructure, while for electricity Bhutan, given its natural endowments, achieves the highest score. In communications infrastructure, Kazakhstan emerges as top ranked among LLDCs of the region.

Table 2: Infrastructure ratings by modes

Countries	Road infrastructure		Rail infrastructure		Port infrastructure ⁽¹⁾		Air infrastructure		Electricity infrastructure		Mobile telephone infrastructure	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Afghanistan	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Armenia	3.7	82	2.6	69	3.0	122	4.5	66	5.2	60	106.9	80
Azerbaijan	4.0	74	3.9	36	4.5	60	5.1	48	4.8	75	107.5	78
Bhutan	4.3	57	No rail infrastructure in Bhutan		n.a.	n.a.	3.5	115	5.9	35	74.7	120
Kazakhstan	2.8	117	4.4	27	2.7	135	4.1	89	4.8	78	175.4	10
Kyrgyzstan	2.5	133	2.5	76	1.3	148	3.1	128	2.7	122	124.8	46
Lao PDR	4.2	65	No rail infrastructure in Lao PDR ⁽²⁾		2.6	137	4.3	76	5.2	61	101.9	90
Mongolia	2.3	141	2.6	66	2.6	140	3.2	126	3.6	103	117.6	55
Nepal	2.7	126	1.1	121	2.7	134	3.0	131	1.6	144	52.8	135
Tajikistan ⁽³⁾	3.2	98	3.5	43	1.7	143	4.2	88	n.a.	n.a.	n.a.	n.a.
Turkmenistan	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Uzbekistan	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Asian LLDCs Average	3.3	99	2.9	63	2.6	127	3.9	96	4.2	85	107.7	77
Global Mean Value	4.0	n.a.	3.2	n.a.	4.2	n.a.	4.4	n.a.	4.5	n.a.	n.a.	n.a.

Source: World Economic Forum, "The Global Competitiveness Report", 2013-2014

Note: On a scale of 1 to 7 where 1 = extremely underdeveloped—among the worst in the world; and 7 = extensive and efficient—among the best in the world; for mobile telephone infrastructure, scores indicate the number of mobile telephone subscriptions per 100 population and number of active telephone lines per 100 population accordingly. (1). River ports and Caspian Sea ports; (2).The 3.5-km rail extension from Nongkhai (Thailand) to Thanaleng (The Lao People's Democratic Republic) cannot be considered as constituting a rail network for the purpose of this assessment; (3). Figures are for 2012-2013

1. Transport

The low rating received by rail is of particular concern as the distances to maritime ports of the region are of a scale on which the rail mode should find its full economic justification. This corroborates the findings of the above-mentioned World Bank 2014 survey of logistic professionals in which a majority of respondents rated the quality of rail infrastructure as low or very low as reflected in table 3 below. While roads fared better than rail in the survey, the overall rating also leaves a lot of room for improvement. While table 3 does not distinguish LLDCs from non-LLDCs, it is fair to assume on the basis of the data in tables 1 and 2 that LLDCs pull satisfaction ratings down.

Table 3: Quality of road and rail infrastructure (percentage of respondents)⁸

		East Asia and Pacific	Europe and Central Asia	South Asia
Road	Low or very low	46	56	32
	High or very high	16	10	27
Rail	Low or very low	60	64	57
	High or very high	6	4	7

The relatively mixed picture coming from the preceding data should, however, not underestimate the heightened level of awareness and initiatives that are taking place in the transport sector since the adoption of the APoA amongst LLDC governments and neighbouring countries.

a) Railways

The main challenge for railway transport in the ESCAP region as a whole remains the numerous missing links and different technical standards which prevent the network from functioning as a continuous system.

A 'missing link' is the absence of physical linkages between the railway networks of neighbouring countries or an absence of continuous railway infrastructure within one country, often due, in this latter case, to local geography, e.g. Lake Van in Turkey. Missing links between networks of neighbouring countries exist either because the link never existed, e.g. between the Lao People's Democratic Republic and China, or ceased to exist due to political events, e.g. between Cambodia and Thailand. Currently, there are an estimated 10,900 km of missing links in the TAR network, i.e. 9.30 per cent of the identified network, and their construction will cost in excess of US\$ 59 billion. With 42 per cent of the missing links and 70 per cent of the estimated investment required to build them, ASEAN is the least rail-connected subregion. However, all subregions are affected to some degree by the existence of missing links, in particular LLDCs.

The following paragraphs shortly describe the missing links relevant for the region's LLDCs and the progresses recently achieved as well as the key challenges remaining.

(1) South-East Asia - The Lao People's Democratic Republic

An important component of the SKRL project is the 417-km US\$7 billion north-south rail link that will cross the territory of the Lao People's Democratic Republic from Boten at the border between China and the Lao People's Democratic Republic to Nongkhai on the Thai-Lao border. Although a memorandum of understanding was signed between the Governments of China and the Lao People's Democratic Republic in 2009, the cost of the project has delayed the start of construction.

The project is actually part of an ambitious master plan of the Laotian government to develop a modern rail infrastructure and connect it with the networks of China, Thailand and Viet Nam. This master plan also includes a 450-km line section from Vientiane to Mu Gia at the border with Viet Nam (pre-feasibility study completed in March 2011), as well as a 222-km line from Mukdahan at the Thai-Lao border to Lao Bao at the border with Viet Nam (pre-feasibility study completed in September 2009) with an onward link to the Viet Nameese port of Da Nang. As regards the latter, the

⁸ World Bank, (2014) "Connecting to Compete – Trade Logistics in the Global Economy, Appendix 2, p. 38.

Laotian government awarded in November 2012 a 50-year concession contract worth \$5 billion to a Malaysian contractor which will have to construct and operate the railway.

On a smaller scale, the extension of the rail link from Thanaleng to Vientiane for which Thailand has agreed to provide financial support could be completed shortly. A first step was completed in March 2009 with the inauguration of a 3.5 km extension of the Thai network from Nongkhai to Thanaleng in Lao People's Democratic Republic. Coupled with the development of an Inland Container Port in the vicinity of Vientiane, the 9-km section line will facilitate rail movement to the port of Laem Chabang (800 km) on the Gulf of Thailand and, further south, to the Malay port of Port Klang (2,250 km) on the Strait of Malacca.

(2) East and North East Asia - Mongolia

In 2010, the Government of Mongolia sanctioned the expansion of its rail network, in particular through the construction of approximately 2,500 km of new rail lines with the aim of providing an efficient conduit to convey Mongolia's natural resources to the international market via ports in China and the Russian Federation. Based on an estimated cost of US\$ 2.5 to 2.8 million per kilometer, the total investment requirements are in the order of US\$6 to US\$7 billion. While these requirements are important, it must be noted that the construction and operation of industrial lines usually lend themselves well to Public-Private Sector partnerships between governments and mining corporations.

(3) South West Asia and Central Asia – Afghanistan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan

Afghanistan never actually developed a rail network of any significance although some planning was made as early as in the 19th century. A rail track was built in Kabul in the early 20th century (1920s) but was nearly as quickly dismantled. In the days of the Union of Soviet Socialist Republics, two feeder lines (one from Turkmenistan and one from Uzbekistan) crossed the northern borders but did not extend beyond the Afghan border post. This situation explains why Afghanistan was not among the countries that negotiated and adopted the Intergovernmental Agreement on the Trans-Asian Railway Network. However, the situation is gradually changing and planned railway development could have a significant impact not only on Afghanistan but also on all the LLDCs in Central Asia. In 2010, with ADB funding, a 75-km single-track rail link was completed from Khairaton at the border with Uzbekistan to Mazar-i-Sharif. In addition to the above, the Islamic Republic of Iran has now been working on the construction of a 205-km rail link from Sangan (eastern part of Iran) to Herat (western part of Afghanistan).

Further, plans are also under way to link the main cities located in the north and south of Afghanistan with their neighbouring countries, i.e. Islamic Republic of Iran and Pakistan. The network being considered will comprise two main corridors, namely:

- (a) an eastern north-south corridor with a distance of about 720 km from Mazar-i-Sharif to Jalalabad via Kabul with a branch line to the copper mine at Logar;
- (b) a northern east-west corridor with a distance of about 1,250 km from Kundus to Herat via Mazar-i-Sharif. Branches will connect this main line to rail border points in Tajikistan

and Turkmenistan.⁹ These corridor and branch lines would offer rapid transit for Central Asian republics to Iranian ports on the Persian Gulf;

(c) meanwhile, branch lines have been discussed from Chaman and Torkham in Pakistan to Kandahar and Jalalabad, respectively. These links could give access to the ports of Karachi (Pakistan) and Mumbai (India), and later to the port of Gwadar when Pakistan Railways complete the 900-km to link the port facilities to the country's main rail network at Mastung.

Besides these developments in Afghanistan, other rail development projects are planned or being implemented which could change the picture of transport for LLDCs in Central Asia. In particular, on the eastern side of the Caspian Sea, a 677 km rail link from Uzen (Kazakhstan) to Bereket-Etrek (Turkmenistan) and Gorgan (Iran) is being built. About 137 km of the link will be in Kazakhstan, 470 km in Turkmenistan and 70 km in the Islamic Republic of Iran where it will link with the country's main rail routes going all the way to sea ports on the Persian Gulf, i.e. the existing port at Bandar Abbas and the future port being developed at Chabahar. In May 2013, Kazakhstan and Turkmenistan celebrated the completion of a 146km line from Uzen (Kazakhstan) to Serhetyaka (Turkmenistan) as part of the project. The related section in the Islamic Republic of Iran was also inaugurated in May 2013. Meanwhile, bogie changing facilities are being built at the border between Turkmenistan (which operates on a 1.520mm gauge) and the Islamic Republic of Iran which operates on a 1.435mm gauge.

In March 2012, the Governments of China and Kyrgyzstan signed a memorandum of understanding to study the possibility of rail-connecting the two countries. While investment needs are high, i.e. in excess of US\$ 4 billion, the project would offer an additional routing option between China and LLDCs of central Asia compared with the only current option via Kazakhstan.

(4) Caucasus – Armenia and Azerbaijan

On the western side of the Caspian Sea, the railways of the Islamic Republic of Iran have been working for a number of years on completing the 372-km Qazvin-Rasht-Astara link. As of June 2012, 75 per cent of the 205 km section between Qazvin and Rasht had been completed, while work had started on the 167 km section from Rasht to Astara at the border with Azerbaijan. The construction of this line section will eventually complete a north-south international corridor along the western side of the Caspian Sea, which is being promoted by a tripartite joint venture of the Iranian, Russian and Azerbaijan railways (the long-term plan being to create a north - south corridor between St Petersburg and the major container port at Bandar Abbas, eliminating the need for shipping traffic down the Caspian Sea).

Access to sea ports for Azerbaijan should also be improved with the completion of the 105-km line section between Kars (Turkey) and Akhalkalaki (Georgia) that will provide Azerbaijan with access to Turkey's Mediterranean ports of Isenderun and Mersin, and to the Aegean port of Izmir. The project, which will enable continuation of container block-train services from China, will eventually offer a new route from Asia to Eastern and Southern Europe when the Marmaray project of an undersea tube tunnel through the Bosphorus Straits is fully commissioned.

⁹ Feasibility studies have started on sections of the proposed Herat - Kundus corridor with ADB providing assistance for the 225-km section from Mazar-i-Sharif to Aqina at the border with Turkmenistan

As regards rail development in Armenia, the Government has cleared the way for a feasibility study for a 316-km single-track electrified line section to link the national network to that of the Islamic Republic of Iran at Meghri. In January 2013, a tripartite agreement was signed by representatives of Dubai-based investment fund Rasia FZE, Russian Railways's subsidiary South Caucasus Railway (SCR) and the Armenian ministry of transport and communications. In 2012, Rasia FZE signed a concession agreement with the Armenian government to develop the project on a Public Private Partnership (PPP) basis. The concessions set deadlines for completing feasibility studies, engineering design, project financing, and construction. The project has an operating term of 30 years with an option for a 20 year extension.

(5) South Asia - Bhutan and Nepal

In South-Asia, Nepal has sketched a plan to develop an extensive rail network, the core corridor of which would be a 917-km long east-west line from Kakarbhitta to Mahendranagar. In connection, Nepal and India have looked into the future realization of joint projects to link a number of Nepalese cities to India's rail network via five new cross-border links which would usefully supplement the only currently existing 12-km connection between Raxaul (India) and Birgunj (Nepal). These five mooted connections are (i) Jogbani (India) to Biratnagar (Nepal), 17.65 km; (ii) Jayanagar (India) to Bardibas (Nepal), 68 km; (iii) Nautanwa (India) to Bhairahawa (Nepal), 15.3 km; (iv) Rupaidiha (India) to Nepalgunj (Nepal), 12.11 km; and (v) New Jalpaiguri (India) to Kakarbhitta (Nepal), 70 km.

In addition, while Nepal's rail development was for a long time only being considered in a southerly direction to India, the Government of China is currently working on extending the Tibet line from Lhasa to Xigaze about 280 km south west of Lhasa and studying the feasibility of a future extension to Nyalam, 120 km from Kathmandu.

As regards connection with Bhutan, Indian Railways has already completed a number of feasibility studies with respect to (i) a 51-km track from Assam's Pathshala to Bhutan's Nanglam, (ii) a 58-km track from Assam's Kokrajhar to Gelephu, and (iii) a 17-km track from West Bengal's Hasimara to Phuentsholing. The latter link is likely to be implemented first although the location of the rail station in Bhutan may be changed to Toribari, near the Pasakha industrial estate, where vacant flat land is reportedly available for the future development of a dry port.

b) Euro-Asian transport links

With the same aim of developing efficient regional transport networks, ECE and ESCAP launched in 2003 a project to promote the development of Euro-Asian inland transport links (EATL) that could provide competitive alternative transport options to maritime routes for trade between Asia and Europe. The project has been implemented in two phases.

Under the phase I (2003-2007), four Expert Group Meetings have been organized and the 18 participating countries identified the main Euro-Asian rail, road and inland waterway routes to be considered for priority development as well as the main transshipment points along these routes. As a result, a list of 230 transport projects of an estimated cost of over US\$43 billion was evaluated and prioritized.

Eight additional countries joined the project for the Phase II (2008-2012) bringing the total number of participating countries to 27 (including 9 of the 12 Asian LLDCs). Seven Expert Group Meetings were organized during that period. Review of priority investments was continued and a new

infrastructure investment plan was developed including 311 projects along the EATL routes of a total cost of approximately US\$ 215 billion. A SWOT analysis specifying the strong and weak points of the EATL land transport links, the potential for their future development as well as the related threats was also elaborated.

As part of the project, a Geographic Information System (GIS) database was created and is now available online which is a basic tool for future efforts aimed at developing efficient, safe and secure Euro-Asian transport links.

Overall the project has so far produced country-demanded, tangible results and proposals for the development and operation of safe, secure and efficient Euro-Asian transport solutions which provided valuable support for the implementation of the APoA. There is however substantial work ahead and building Euro-Asian inland transport links remain a long-term undertaking that could be certainly benefit from the development of efficient logistics system. Possibly, the idea supported by the EATL project could be merged into the collaborative efforts by the secretariat, member countries and other development partners to opt for the wider concept of developing international intermodal corridors.

c) Dry Ports

Countries can indeed make greater use of the Asian Highway and Trans-Asian Railway routes by improving transport facilitation measures and by investing in intermodal facilities, such as dry ports.

As a link in the transportation chain, dry ports have proven to have a positive effect on the efficiency of the transport and logistics chain. Well-managed dry ports, particularly those located at a significant distance from a seaport, help reduce transportation costs and total transit time. This feature is particularly important for remote hinterland areas and LLDCs. Experiences from within and outside the region show that successful dry ports increase logistics efficiency and allow a modal shift from roads onto rail or inland waterways, thereby supporting policies aiming to reduce carbon emissions within the logistics chain. At the same time, a number of dry ports have provided valuable space for a range of value-adding logistics services allowing some of them to turn into large logistics park or become the nucleus for special economic zones.

Recognizing the above, the Forum of Asian Ministers of Transport at its first session (Bangkok, December 2009) adopted the “Bangkok Declaration for Transport Development in Asia” in which they stressed the important role of dry ports in integrating modes of transport, reducing border crossing and transit delays, facilitating the use of energy-efficient and lower emission means of transport, and creating new opportunities for the growth and establishment of development clusters. The Declaration also requested the secretariat to provide connectivity and integration of the Asian Highway network, the Trans-Asian Railway network and other transport modes by working towards the development of an intergovernmental agreement on dry ports.

As already mentioned previously, acting on this mandate, the secretariat prepared a working draft of the Agreement which was reviewed and refined through a series of three subregional meetings, two of which were hosted by LLDCs, namely the Lao People's Democratic Republic (July 2011) and Tajikistan (December 2011). The Commission adopted the Agreement at its 69th session and a signing ceremony was organized during the Forum of Asian Ministers of Transport at its second session, on 7 November 2013, when 14 member States signed the Agreement, including five

LLDCs.¹⁰ Annex 1 to the Agreement lists the dry ports of international importance that member States have earmarked for development. Table 4 shows the number of these dry ports in the region's LLDCs.

Table 4: Number of dry ports of international importance earmarked for development by governments of LLDCs

Countries	Number of dry ports	Countries	Number of dry ports
Afghanistan	8	Lao PDR	9
Armenia	4	Mongolia	5
Azerbaijan	21	Nepal	5
Bhutan	6	Tajikistan	7
Kazakhstan	5	Turkmenistan	n.a.
Kyrgyzstan	2	Uzbekistan	n.a.

A number of LLDCs have started to implement projects to develop modern facilities or upgrade existing ones. Recognizing that an important factor in unlocking trade is the availability of adequate logistics facilities and services, the Governments of China and Kazakhstan have been cooperating on the development of the “Khorgos-East Gate” free economic area located in the south-east of Kazakhstan and just a kilometre away from Kazakhstan’s border with China. The area includes Khorgos International Centre for Cross-Border Cooperation, centres for trade activities, a dry port, a complex for transport and logistics, an industrial area and space for industrial companies. The project, which is included in the strategic plan for the development of Kazakhstan by 2020, has an estimated cost of around \$3.5 billion of which around 75 per cent is to be covered by private investments.

The Government of Uzbekistan has also taken a number of initiatives to develop intermodal corridors and dry ports in the country, in particular at Angren in the Tashkent region to serve the Andijan, Namangan and Ferghana regions of eastern Uzbekistan, and Navoi, 350 kilometres south-west of Tashkent. The Navoi dry port has been developed in connection with the Navoi Free Industrial Zone (FIZ) close to the international intermodal hub at Navoi airport which began operation in 2009 under management from Korean Air. The facilities are located along major subregional road, rail and aviation routes to capitalize on the country’s transit potential. Concomitantly, the Government has implemented a number of policies in the form of tax incentives and exemption of customs fees to encourage industries to cluster in the Navoi FIZ.

In South Asia, the government of Nepal has developed the Birgunj ICD with financial support from the World Bank. The ICD has a 12 kilometre rail link to the Raxaul railhead at the Nepal-India border with further rail connection to the Kolkata/Haldia port complex in India. It is equipped with the automated UN-sponsored system for customs data (ASYCUDA). To ensure smooth movements of trade, the Government of Nepal concluded a rail service agreement with India for the operation of dry ports. The Birgunj facilities are leased to the private sector for operation. It currently handles containers, tank wagons for liquid cargo, and flat wagons for bilateral break-bulk cargo, receiving an average of around 15 - 16 freight trains per month. In a country in which climate change and global warming can have serious consequences, the potential for emission reduction of the rail-based

¹⁰ Armenia, Lao People’s Democratic Republic, Mongolia, Nepal, Tajikistan.

Birgunj facilities is an important reason behind their establishment and the policy of developing similar facilities at other locations in the country.

Dry ports are all the more important for LLDCs. Furthermore, they are essential to the advent of efficient intermodal transport corridors which offer a framework within which issues relating to trade and transport as well as social and environmental concerns can be addressed in an inclusive manner. Supporting progress in dry ports is particularly timely as the capacities of existing infrastructure are, in many cases, limited and new facilities are urgently required. In this regard, there is potential for ICT to augment such facilities. By running fibre optic cables along the Asian Highway, and Trans-Asian Railway, ICT infrastructure will converge at dry ports (many of which are already located, or planned for location along these intermodal transport corridors). The services provided by ICT hubs unlike other infrastructure hubs do not need to be located in physical proximity to the congested mega cities of Asia, with their high operation costs and increased exposure to disasters. Due to their virtual functions these hubs can be located in remote areas simultaneously enhancing the commercial viability of both dryports and internet hub cities - by modernizing dry ports, through an ICT network infrastructure that connects LLDCs directly (rather than through transit countries onto submarine cables), it would allow the introduction of state-of-the-art ICT applications for customs clearance and a range of other processes related to the movement of goods. This would help dry ports to increase their efficiency and ability to compete with maritime ports, by offering a wide variety of services over and above storage facilities. However, it is no easy task due to the number and variety of stakeholders and to the difficulties in securing the necessary financing. Coordination among different government ministries/departments and the private sector is important to create an environment that is conducive to the development of dry ports.

The Trans-Asian Railway and Asian Highway networks already offer a number of corridors within which member countries may already plan joint and coordinated development of international intermodal transport. The following routes offer interesting prospects for the development of such corridors serving LLDCs:

- Liayungang (China) – Central Asia corridor,
- Bandar Abbas (Islamic Republic of Iran) – Central Asia corridor,
- Tehran (Islamic Republic of Iran) – New Delhi (India) – Dhaka (Bangladesh) corridor with feeder connections to Bhutan and Nepal,
- Vientiane/Thanaleng (The Lao People's Democratic Republic) – Bangkok (Thailand) – Kuala Lumpur (Malaysia) corridor,
- Ho Chi Minh City – Hanoi (Viet Nam) – Beijing (China) – Ulaanbaatar (Mongolia) / Central Asia corridor.

In addition, as indicated above, work currently in progress to complete a number of missing links in the Trans-Asian Railway network will soon offer continuous rail infrastructure along a corridor that will stretch from Western Europe to Bangladesh via Poland, Belarus, the Russian Federation, Azerbaijan, the Islamic Republic of Iran, Pakistan and India. Meanwhile, a Baku – Istanbul corridor with possible extension into southern Europe will be of benefit to LLDCs in the Caucasus region with the completion and commissioning in 2015 of the Kars – Akhalkalaki section between Turkey and Georgia.

In the ASEAN subregion, the completion of the links planned under the SKRL project and the Transport Strategy for the Greater Mekong Subregion will also lead to the emergence of corridors such as, but non exhaustively, the following:

- Singapore to Kunming (China) via Kuala Lumpur (Malaysia) – Bangkok (Thailand) and Vientiane (The Lao People’s Democratic Republic),
- Phnom Penh (Cambodia) to Yangoon (Myanmar) via Ho Chi Minh City (Viet Nam), Vientiane (The Lao People’s Democratic Republic),
- Nanning (China) to New Delhi (India) via Kunming (China), Mandalay / Kalay (Myanmar) – Jiribam (India).

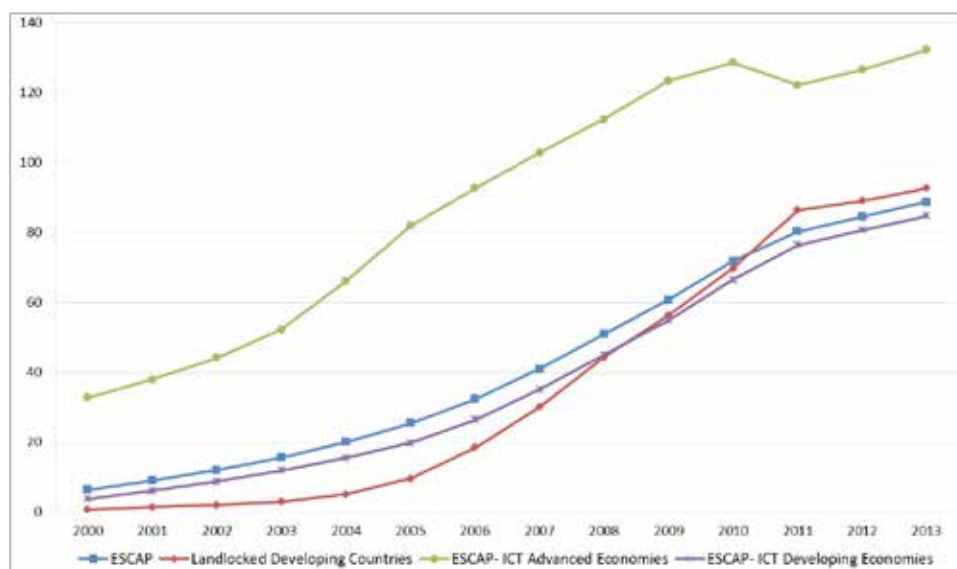
2. ICT connectivity

This section explores recent trends in ICT connectivity in Asian LLDCs. It draws comparisons between this group of countries and ESCAP developing countries as a whole, and identifies major trends within the LLDC group itself. The section examines major ICT metrics such as mobile phones, internet use, broadband access and affordability. It also uses emerging data sources to analyse connection quality issues in LLDCs, an issue of growing importance.

a) Mobile telephony

The advent of mobile telephony has transformed lives in developing countries, including in Asian landlocked developing countries. According to data collected by ITU, Asian landlocked developing countries overtook averages for the ESCAP region, in terms of mobile phone penetration rates (subscriptions per 100 inhabitants) in 2010. In 2013, the average mobile phone penetration rates stood at 92.7 percent in LLDCs versus 88.8 percent for ESCAP as a whole, as highlighted in figure 1 below.

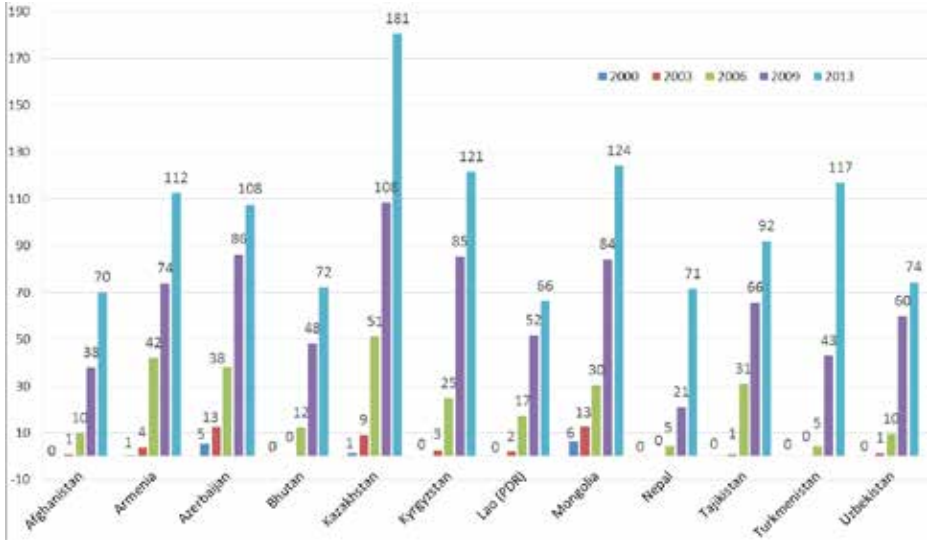
Figure 1: Mobile-cellular telephone subscriptions (per 100 inhabitants, selected ESCAP sub-groups 2000-2013)



Source: ESCAP, based on ITU World Telecommunication/ICT Indicators Database, 2014.

Such average measures conceal important variations across the Asian Landlocked developing countries group, as highlighted in figure 2. Apart from Uzbekistan which exhibits relatively low levels of penetration rates in 2013 (74.3 percent), all LLDCs with mobile penetrations rates below the ESCAP average are LDCs (Afghanistan 70.0, Bhutan 72.2, the Lao People's Democratic Republic 66.2 and Nepal 71.5 percent).

**Figure 2: Mobile penetration in Asian LLDCs in recent years
(Mobile-cellular telephone subscriptions per 100 inhabitants)**



Source: ESCAP, based on ITU World Telecommunication/ICT Indicators Database, 2014.

Mobile phone penetration has passed the 100 subscriptions per 100 inhabitants in Kazakhstan, Mongolia, Kyrgyzstan, Turkmenistan, Armenia and Azerbaijan. In recent years, given the rate of penetration achieved, growth in mobile penetration has slowed down in a number of LLDCs, a trend also seen at the regional level and beyond.

Mobile phone signal coverage has expanded to reach quasi ubiquity, despite the challenging topography in Armenia, Azerbaijan, Bhutan and Kyrgyzstan (all over 97.5 percent of the population covered by a mobile signal). Only in The Lao People's Democratic Republic (72.0 percent) and Afghanistan (88.0 percent), despite the progress achieved in recent years, is there still room for substantial improvements in coverage.

b) Internet access and use

Third generation mobile networks (3G) are characterized by the fact that they offer access to the Internet through mobile devices. 3G coverage is rising but shows larger differences across Asian LLDCs than 2G. The data available for 2012 indicates that Armenia and Azerbaijan has reached almost systematic population coverage by 3G signal (more than 95 percent in each countries), while at the other end of the spectrum, the level of 3G coverage was only 19.0 percent in the Lao People's Democratic Republic, with rural areas in particular, lagging far behind.

At 25.5 percent, Internet use by individuals in Asian LLDCs is somewhat lower than in ESCAP as a whole (32.4 percent). This group average is partially determined by the low usage of internet in two of the most populated Asian LLDCs Afghanistan (5.9 percent) and Nepal (13.3 percent), but also in other LLDCs such as Kyrgyzstan (23.4 percent), the Lao People's Democratic Republic (12.5 percent), Mongolia (17.7 percent), Tajikistan (16.0 percent) and Turkmenistan (9.6 percent). On the other hand, internet use is much more widespread in Azerbaijan (58.7 percent), Kazakhstan (54.0 percent), Armenia (46.3 percent) and even in twice-landlocked Uzbekistan (38.2 percent). Low internet usage is explained by landlockedness, a point that is taken up again, below. Landlockedness is however, only a partial component, as Asian LDCs with sea access are also affected by low internet usage. Bangladesh, Cambodia, for example, have very low internet usage rates (6.5 percent, 6.0 percent and 1.2 percent respectively). Policy stances and the regulatory environment play as important a role as geographic factors.

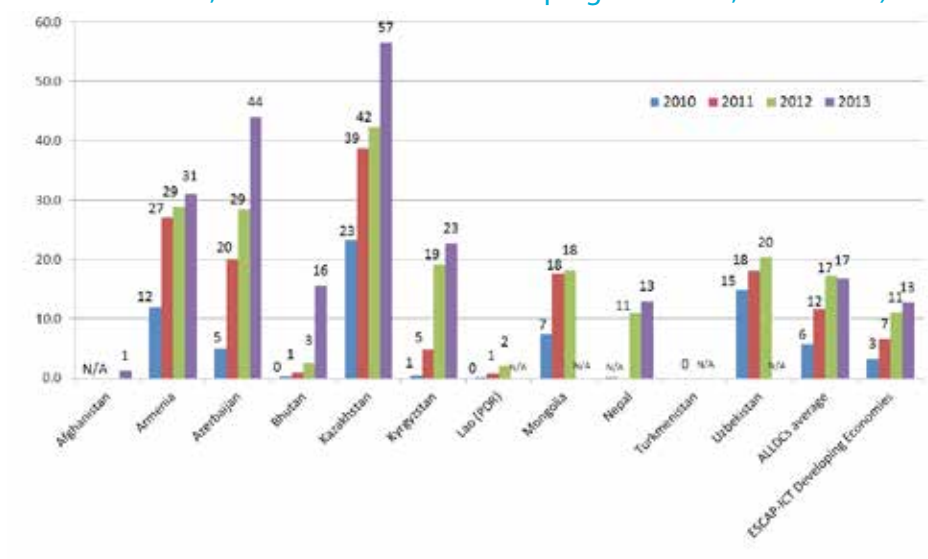
Broadband internet offers far more development-enhancing applications than traditional internet access and can therefore have far reaching development potential. Fixed broadband remains limited in most Asian LLDCs, while mobile broadband has made significant inroads.

Fixed (wired) broadband penetration is rather low, on average for Asian LLDCs, at 3.1 subscriptions per 100 inhabitants, while the same rate stands at 7.7 for ESCAP as a whole and at 6.1 for ESCAP developing countries. Again, given that Asian LLDCs are a heterogeneous group in many ways, it is not surprising to identify large disparities across the group. Comparisons with non-landlocked neighbouring countries of similar development levels (in GNI terms) reveals that fixed broadband penetration in most Asian LLDCs is comparable to that of non-LLDCs. Fixed broadband penetration rates in Bhutan (2.7), the Lao People's Democratic Republic (0.1) and Nepal (0.8) are similar to those of Bangladesh (0.6), Cambodia (0.2) or even Pakistan (0.6). In the Caucasus region, Armenia (7.9), Georgia (10.2) and Turkey (11.2) also have fixed broadband rates that are in the same orders of magnitude, while landlocked Azerbaijan has 17.0 percent. In North and Central Asia however, fixed broadband penetration rates are low (below 2 percent) with the important exception of Kazakhstan (11.6).

Mobile broadband, on the other hand, is making significant inroads into LLDCs. This is a very recent phenomenon with most of the deployment occurring since 2010, while fixed broadband deployment started about five years earlier. While not yet offering the same service conditions and potential benefits as fixed broadband, mobile broadband has helped to fill the gap in fixed broadband, and its deployment is usually significantly cheaper. In 2012,¹¹ active mobile-broadband subscriptions per 100 inhabitants reached 19.8 percent in ESCAP LLDCs against 16.2 for ESCAP developing countries as a whole. As shown in figure 3, only Afghanistan, the Lao People's Democratic Republic, Tajikistan and Turkmenistan have not yet seen significant mobile broadband deployment. Mobile broadband uptake has been highest in the higher income countries of the group with Kazakhstan having more than 56 active mobile broadband subscriptions per 100 inhabitants. However, the uptake of mobile broadband across other LLDCs has often been faster than that of fixed broadband. For example, in Kyrgyzstan, while fixed broadband penetration is only 1 percent in 2013, mobile broadband reached 22.7 percent.

¹¹ The dataset for 2013 is not sufficiently complete, preventing the calculation of an average rate of mobile broadband penetration for LLDCs as a group for 2013.

Figure 3: Active Mobile-Broadband Subscriptions (per 100 Inhabitants, Asian Landlocked Developing Countries, 2010-2013)



Source: ESCAP, based on ITU World Telecommunication/ICT Indicators Database, 2014.

Notwithstanding the important question of the type of usage that is being made of the Internet in these countries, it is important to better understand the barriers to Internet usage in these developing countries. These obstacles typically include affordability and the quality of services, which are both analyzed below.

c) Broadband Internet prices

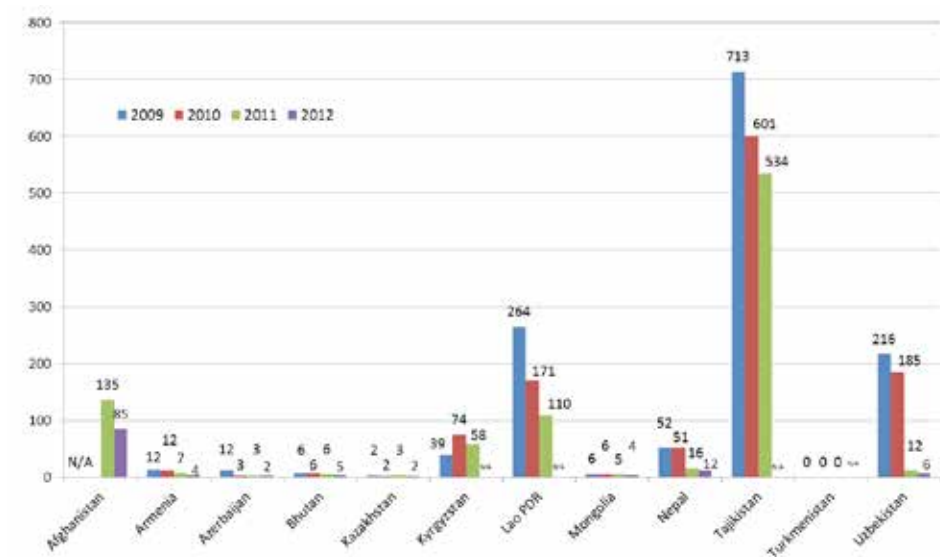
As in other Asian countries, broadband prices in Asian LLDCs have decreased sharply in the past few years. However, they remain prohibitive in some instances, reflecting a digital divide between the LLDCs themselves.

When it comes to broadband prices, there seems to be a “landlockedness penalty”, since Asian LLDCs had significantly higher fixed broadband connection prices in 2012 than the average of ESCAP developing countries, with a fixed broadband subscription costing 26.5 versus 5.7 percent of Gross National Income per capita, respectively. Then again, these average levels conceal large disparities across LLDCs. In Afghanistan, a fixed broadband subscription costs a prohibitive 85.4 percent of GNI per capita in 2012, as illustrated in figure 4. At the other end of the spectrum, fixed broadband subscription only costs 1.6 percent of gross national income per capita in Kazakhstan and less than 5 percent¹² in Armenia, Azerbaijan, Bhutan, and Mongolia.¹³ In some instances, fixed broadband services may be still restricted to the most commercially viable areas in LLDCs, typically major urban hubs.

12 Broadband Commissions Target 2: Making broadband affordable states that, [by 2015, entry-level broadband services should be made affordable in developing countries through adequate regulation and market forces (amounting to less than 5 percent of average monthly income)]. See: www.broadbandcommission.org/Documents/Broadband_Targets.pdf

13 Data available for 2011 indicated that the cost of fixed broadband subscriptions as a percentage of GNI per capita was as high as 109.7 percent in the Lao People's Democratic Republic and 533.9 percent in Tajikistan.

Figure 4: Fixed broadband monthly subscription charge (US\$ as a percent of GNI per capita)



Source: ESCAP, based on ITU World Telecommunication/ICT Indicators Database, 2014.

Table 5: Demand for data transmission capacity

International Internet bandwidth consumption by landlocked developing countries sharing the Asian Highway

Country (alphabetically)	Annual bandwidth consumption (Mbps)					Annual growth rate (%)				
	2008	2009	2010	2011	2012	2008	2009	2010	2011	2012
Afghanistan	245	265	912	1 897	3 147	29	8	244	108	66
Bhutan	75	116	330	485	640	150	55	184	47	32
Kazakhstan	3 752	11 123	36 967	74 368	122 566	155	196	232	101	65
Kyrgyzstan	524	1 019	1 335	2 005	5 129	32	94	31	50	156
Lao People's Democratic Republic	481	756	1 616	2 682	4 190	48	57	114	66	56
Mongolia	2 169	3 621	6 372	11 180	17 280	1 199	67	76	75	55
Nepal	199	1 085	1 775	4 865	7 960	135	447	64	174	64
Tajikistan	129	179	235	595	3 108	90	39	31	153	422
Turkmenistan	344	54	69	290	400	1 047	-84	28	320	38
Uzbekistan	498	1 085	1 332	5 066	12 595	108	118	23	280	149

Source: TeleGeography, Q2, 2013.

Note: data indicate international internet band width consumption by Asian landlocked developing countries sharing the Asian Highway.

d) Data quality issues

Another important indicator, especially for the link between broadband access and socioeconomic development, and one that has become of increased relevance in the recent past is the quality of services experienced at the consumer level. Because the quality and performance of internet connectivity is linked to the use of content rich applications inherent to the knowledge society, quality can have significant socio-economic impacts.

In LLDCs, as in other developing countries, there is great variance depending on local conditions. Overall there have been marked and steady improvements in international bandwidth per Internet user, as is the case with speed metrics. However, growth is inconsistent, with mean download speeds ranging from 1,071 kilobits per second to 13,821 on average for LLDCs as a group (table 6). The variability is extremely high with a standard deviation of 4,581.93 kbps, which is a full 61 percent of the average rate illustrating the high degree of differences in conditions of service among regional LLDCs.

Table 6: Speeds per selected ALLDCs (in ascending order, 2014)

Country	Mean Download kbps	Mean Upload kbps
Afghanistan	1071.98	740.92
Uzbekistan	2629.41	2172.53
Lao PDR	3950.33	4938.59
Azerbaijan	4419.49	2465.04
Bhutan	4887.83	2471.67
Nepal	5773.92	4260.87
Kyrgyzstan	9339.74	8871.24
Armenia	9810.64	7825.27
Tajikistan	12736.99	9113.34
Mongolia	13575.54	10576.59
Kazakhstan	13821.82	11704.10

Source: Speedtest.net (retrieved June 2014) and analysis by ESCAP.

Note: measured as internet bandwidth available per user.

In addition to measurement of connection speeds, examination of the quality of these network connections provides further insights. Measurements such as latency (delays in transmission), and packet loss (the percentage of lost information), also provide a quantifiable basis for a comparison of broadband connection quality. Data on packet loss is available for approximately 90 countries. The data indicates that the mean global packet loss packet rate is 1.68 percent, with mean global latency at 107.31 milliseconds. Several ESCAP LLDCs have been able to deliver conditions of service which exceed this global average. As an example, among a sample of countries for which data is available, users in Azerbaijan will experience the lowest percentages of dropped packets. Azerbaijan also experiences relatively low latency, while a user in Nepal will experience almost double the latency experienced in Singapore. This data emphasizes the importance of considering network quality, accessibility and speed as a holistic set of indicators, which when taken together, provide more accurate insights into national ICT networks.

Table 7: Selected ESCAP Network Reliability Indicators

Country	Year	Mean Packet Loss Per 100	Mean Latency
Azerbaijan	2013	0.32	83.96
Russian Federation	2014	0.83	72.09
Hong Kong, China	2014	1.00	72.13
Singapore	2014	1.40	64.49
Kazakhstan	2010	1.26	92.35
Nepal	2012	1.85	92.65

Source: Speedtest.net (retrieved June 2014) and analysis by ESCAP.

Differences among LLDCs and between these landlocked and other advanced countries illustrate that further coordination and investment is necessary for this critical infrastructure to be inclusive and resilient with some landlocked developing countries demonstrating significantly higher rates of infrastructure improvement than others. This data also suggests that landlockedness itself is not a significant determinant of network performance for these countries. As such, ICTs represent potential to mitigate the classical challenges facing landlocked developing countries and to promote growth that is equitable, inclusive and sustainable.

e) Status of domestic connectivity

Future prospects for accelerating connectivity will be to a large extent determined by the terms of access to fibre infrastructure by telecom operators. The development of extensive national backbones and local loops is the essential, albeit insufficient condition for broadband expansion. Furthermore, fibre optic cable networks generally offer superior solutions in terms of capacity and upgradability in comparison to other network solutions, such as satellite and microwave, although last mentioned options have an important role in particular cases, such as inhospitable sparsely populated terrains.

Fibre has been deployed to some extent in all Asian LLDCs, and usually reaches most of the major population centres in a meshed grid network. Information available to ESCAP, and reflected both in ESCAP/ITU's maps of the information superhighway¹⁴ and in ESCAP's subregional broadband market studies¹⁵ show however that the intensity and coverage of these networks vary substantially across Asian LLDCs. Table 8 shows that on average the backbone coverage both in terms of land areas (38.5 percent) and population coverage (62.5 percent) is slightly higher in LLDCs than for the average of ESCAP (34.2 percent and 58.8 percent respectively). Again, there are wide disparities across countries with quasi universal coverage of both population and land area in Armenia, against only 37.1 percent of the population within 25 km of a transmission network in Afghanistan. Most Central Asian Countries, as well as Mongolia, have less developed national fibre network coverages in comparison to other LLDCs, and ESCAP as a whole.¹⁶

14 See: www.itu.int/itu-d/tnd-map-public/

15 See: www.unescap.org/resources/publication-depth-study-broadband-infrastructure-north-and-central-asia-mr-michael-rud-dy-0, and www.unescap.org/resources/depth-study-broadband-infrastructure-asean-region-0

16 Data available from the ESCAP/ITU transmission maps, which are regularly year updated as information is made available. See: www.itu.int/itu-d/tnd-map-public/ for further details.

Table 8: Selected broadband capacity indicators (2013)

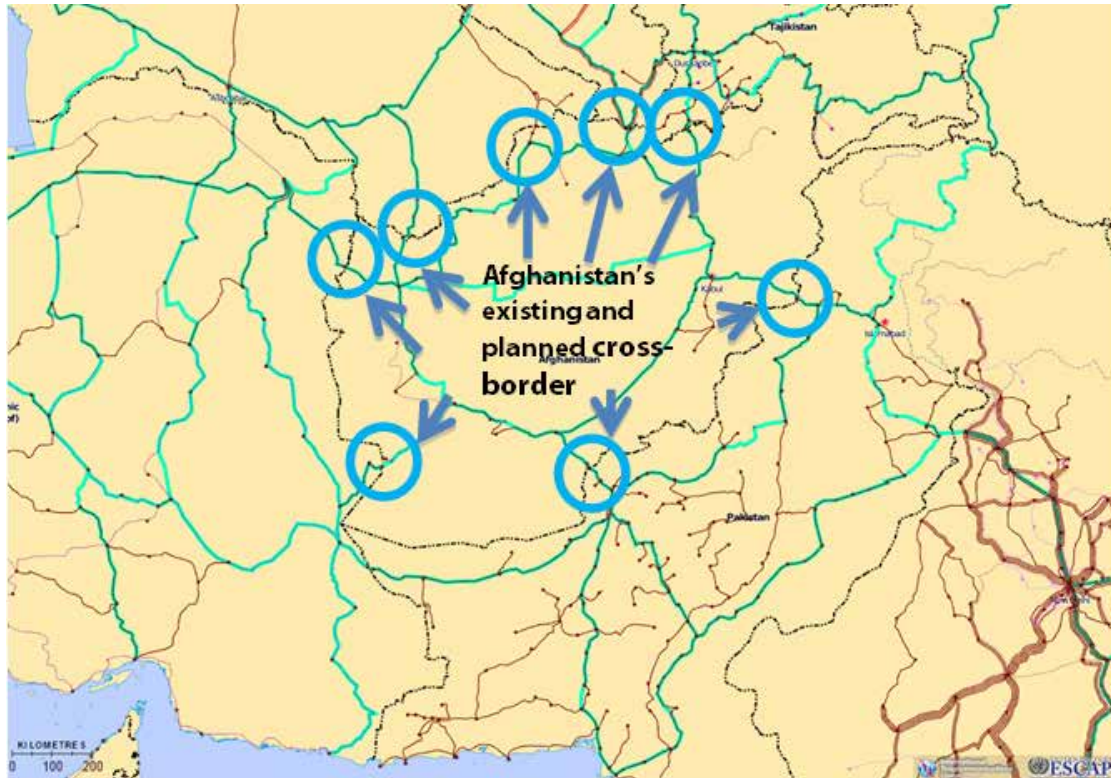
Economy	Population within 25 Km of a transmission network (percent)	Area within 25 Km of transmission network (percent)	Total transmission network length (Route kilometres)
Average Asian Landlocked Developing Countries	62.8	38.5	4'762
Afghanistan	37.1	n.a.	3'004
Armenia	99.4	99.0	3'075
Azerbaijan	79.3	65.5	2'502
Bhutan	78.4	73.3	830
Kazakhstan	44.2	3.9	15'616
Kyrgyzstan	n.a.	n.a.	3'019
Lao P.D.R.	63.9	48.2	7'756
Mongolia	53.8	13.0	9'120
Nepal	45.0	22.1	1'567
Tajikistan	83.0	41.4	2'778
Turkmenistan	43.8	5.1	3'226
Uzbekistan	63.2	13.7	4'655
Average ESCAP	58.8	34.2	289'529

Source: ESCAP/ITU online maps of the information superhighway, ITU transmission indicators, updated annually.

As far as extension of the fibre network into rural areas is concerned, there is almost none in the poorest LLDCs (Nepal, Afghanistan, Uzbekistan), while at the other end, fibre is being deployed to every village in Azerbaijan, where broadband coverage was expected to be available in all villages by 2013, thanks to public private sector collaboration.¹⁷ While Armenia, Azerbaijan, Bhutan, and the Lao People's Democratic Republic have a tight and meshed national fibre network, in some Central Asian countries and in Nepal, backbones are less dense. In Afghanistan the backbone network clearly runs along the main highways with extensions to the borders, as is visible from figure 5 below. This is less evident in other LLDCs. In most cases, and in particular in Central Asian countries, the domestic backhaul market is dominated by one operator, often the incumbent state telecom operator. In other Asian landlocked developing countries such as Armenia, up to 3 operators run national backbone services, which potentially allows for competition on this segment of the market and more affordable retail services. In general therefore, LLDCs' national backbone infrastructure reflects their development levels.

¹⁷ See [www.unescap.org/sites/default/files/Broadband percent20Infrastructure percent20in percent20North percent20and percent20Central percent20Asia percent20FINA L percent20_English.pdf](http://www.unescap.org/sites/default/files/Broadband%20Infrastructure%20in%20North%20and%20Central%20Asia%20FINAL%20_English.pdf),

Figure 5: Fibre backbone and the Asian Highway routes (light blue)



Source: ESCAP/ITU online maps of the Asia-Pacific information superhighway.

Note: black dotted lines depict international boundaries, dark red fibre optic cables.

f) International connectivity

Broadband affordability depends on the degree of competition on the retail market segments at the national level. However, the information contained in table 9 also shows that it hinges on the price of transit purchased at the borders, and this is especially so in the case of LLDCs, who cannot directly purchase capacity from a submarine gateway. The price for international transit capacity entering LLDCs therefore reflects the margins that telecom carriers in sea-accessing countries are able to impose on landlocked neighbours, in addition to the price for capacity sold through the submarine cable. This is evident from table 9 which shows typical prices for international capacity in a number of countries, including some Asian LLDCs. Such information is only available from private sources, and does not constitute official data. However, it does provide important insights revealing that most LLDCs face very high prices for access to international data transit. Azerbaijan and Kazakhstan constitute exceptions in that they enjoy considerably lower transit prices (20\$ and 15\$ respectively per Mbps). Both these countries have multiplied their points of physical connectivity to international networks. Interestingly, they also act as transit countries for through-traffic of third countries, thereby importing large international bandwidth capacity and consequently triggering economies of scale that allow them to command much lower prices than most other LLDCs, including for their own domestic markets.

At the other end of the spectrum, twice-landlocked Uzbekistan faced a hefty US\$ 347 per Mbps per month for international connectivity 2012. Most other Central Asian countries, as well as the Lao People's Democratic Republic also faced prices of more than US\$ 100 per Mbps for international capacity. This compares very unfavourably to prices paid by other ESCAP countries. Only Myanmar, with its nascent ICT market faced a comparable situation. In other developing economies, prices are usually at least 20 percent lower. This high premium not only penalizes final consumers, but also severely limits the potential contribution that broadband can make to an ever increasing range of applications, including logistical efficiencies along the entire transport and trade international supply chains.

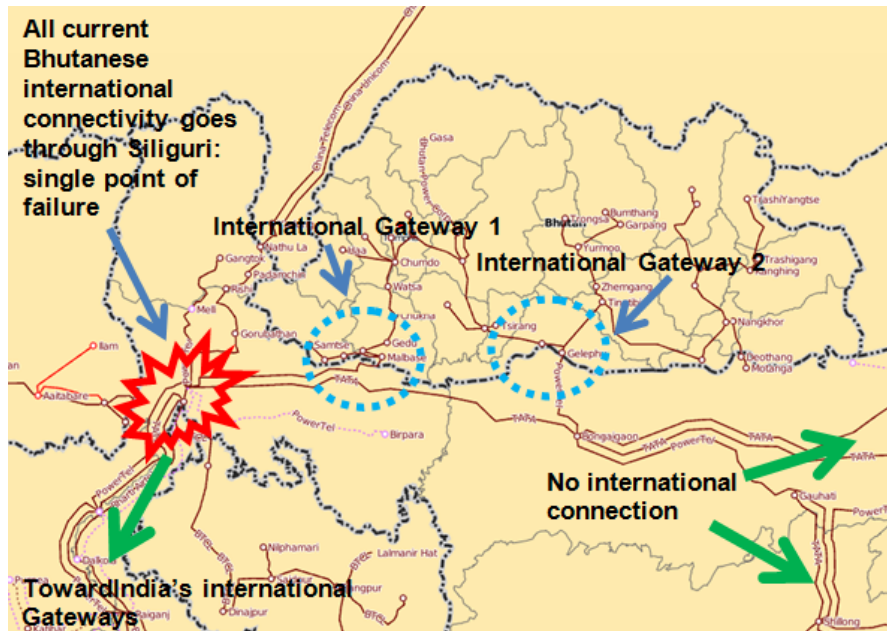
Table 9: Typical international capacity price on selected markets

Market	Typical International Connectivity Pricing (US\$ per Mbps per month)					
	2008	2010	2011	2012	2013	2014
Azerbaijan	350		40		20*	
Kazakhstan				15		
Kyrgyzstan				>100		
Lao PDR				100		
Tajikistan				>100		
Turkmenistan				>100		
Uzbekistan		1510	529	422	347	
Russian Federation				1.80 to 4		
Cambodia					80	
Indonesia				60 to 70		
Malaysia				25		
Myanmar				>100		
Philippines				>80		
Singapore				10		
Thailand				80		
Viet Nam				70		
New York						1.64
London						1.36
Hong Kong, China						6
Sao Paulo						18

Source: Terabit for countries, Telegeography for cities.

Landlockedness inflicts a premium on international transit prices, which is passed on to consumers. For some LLDCs, landlockedness can result in a problematic configuration of international networks, which exposes them to bottlenecks that constitute single points of failures. The situation of Bhutan provides a case in point. Its two international gateways are connected to the Indian network. However, all the fibre-based traffic in this part of India travels through a single point: the city of Siliguri, as North Eastern India is not yet connected to international networks. As shown in figure 6 below, Siliguri therefore constitutes a major bottleneck exposing Bhutan's domestic network to intense vulnerability, in what is already a highly seismic region.

Figure 6: Bhutan's international connectivity

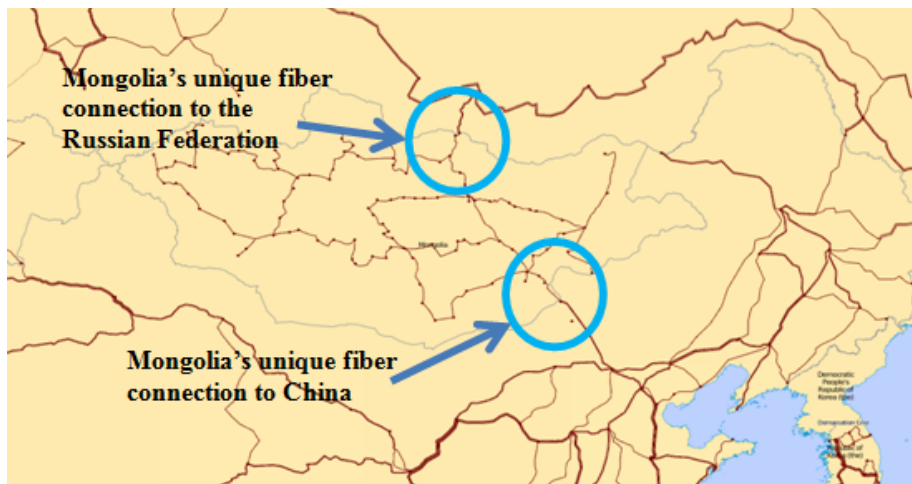


Source: ESCAP/ITU map on the Asia-Pacific information superhighway.

Note: black dotted line depicts international borders, red lines depict fibre optic cable.

Nepal also routes its international fibre traffic through a single country, India. Nepal is reportedly currently developing a new fibre route towards China.¹⁸ Mongolia can access both Chinese and Russian fibre networks but appears to have only one international gateway with each of these countries, as per figure 7 below.

Figure 7: Mongolia's current international connectivity to the Russian Federation and China



Source: ESCAP/ITU Map on the Information superhighway.

18 See: [www.unescap.org/sites/default/files/Bhutan percent20Presentation.pdf](http://www.unescap.org/sites/default/files/Bhutan%20percent20Presentation.pdf).

The redundancy of connectivity of Mongolia could be greatly improved if additional high capacity fibre transmission links were created with its neighbours. This could be done along the segments of the Asian Highway that connect Mongolia to the Russian Federation and to China, as visualised in red on the map below (figure 8).

Figure 8: Mongolia’s potential additional fibre connections and the Asian Highways



Source: ESCAP, based on ESCAP/ITU Map on the information superhighway.

Figure 9: Afghanistan’s cross-border fibre connections



Source: ESCAP, based on ESCAP/ITU Map on the information superhighway.

A number of LLDCs are currently considering investments in additional fibre optic links see for example Figure 9 for Afghanistan. Likewise Bhutan, is assessing an investment in an additional route towards Bangladesh's point of landing of a major international submarine cable (SEA-ME-WE-4), in Cox Bazar, through Tripura/Argatala in India.

While such investments can improve the situation in terms of pricing and network redundancy, such bilateral solutions lack the benefits of a regionally coordinated approach which would envisage transmission network routes as part of a seamless meshed network that provides multiple configurations of routings. This is the rationale underlying ESCAP's Asia-Pacific information superhighway initiative.

g) International connectivity

Table 10, drawn from ESCAP's three in-depth subregional studies¹⁹ gives a snapshot of the status of cross border fibre optic cable connectivity.

Table 10: Overview of international fibre optic connectivity of LLDCs and key transit countries

Country	Evaluation in comparison to rest of ESCAP region
Azerbaijan	The status of Azerbaijan's connectivity is moderate. It is reliant on its neighbors, particularly the Russian Federation, for transit capacity; however, recent projects such as the Europe Persia Express Gateway (EPEG) and planned projects such as TASIM and the Trans-Caspian Links could position the country as a transit hub for the region.
Bangladesh	With only one submarine cable and limited terrestrial connectivity to India, the country is extremely vulnerable to outages, particularly those caused by cable disruptions in Egypt.
Bhutan	While Bhutan has made tremendous strides in the rollout of fibre for domestic connectivity, its international connectivity is fragile and dependent upon the vulnerable submarine connectivity of its neighbours. Bhutan has two international terrestrial fibre optic cables to India. However, both fibre paths converge at a single point, Siliguri, India, where they are then routed to the submarine cable gateways, raising concerns about the vulnerability of the country's international connectivity. The South Asia Subregional Economic Cooperation (SASEC) program's Information Highway network which will connect Bangladesh, India, Bhutan, and Nepal when completed will allow for the implementation of submarine cable connectivity via the Cox's Bazar, Bangladesh landing point of the SEA-ME-WE-4 submarine cable system. As part of the SASEC project, in June of 2014, Railtel Corporation of India completed installation of a 10 Gbps link from Thimphu to Phuentsholing and Gelephu.

¹⁹ Michael Ruddy and Esra Ozdemir, *Publication on the in-Depth Study of Broadband Infrastructure in North and Central Asia*, (2014). Available at: www.unescap.org/resources/publication-depth-study-broadband-infrastructure-north-and-central-asia-mr-michael-ruddy-0; and *Publication on an In-Depth Study of Broadband Infrastructure in the ASEAN Region*, (2014). Available at: www.unescap.org/resources/depth-study-broadband-infrastructure-asean-region-0

India	India is served by 11 major interregional submarine systems and multiple terrestrial links, as well as the world's two largest undersea fibre optic networks owned by Indian investors after having been acquired separately by Indian operators Tata Communications and Reliance Communications in 2004. India has excellent international connectivity. Furthermore, other Indian operators including the country's largest mobile operator, Bharti Airtel, also have significant investments in international telecommunications infrastructure. The Egyptian "choke point" still remains a critical vulnerability, however.
Islamic Republic of Iran	Although the Islamic Republic of Iran has not historically participated in major Europe-to-Asia cable projects such as the SEA-ME-WE-4 submarine systems, the country has excellent connectivity. It developed robust terrestrial links to its neighbors and has joined multiple regional submarine cable systems, giving it diverse access to global connectivity.
Kazakhstan	Kazakhstan's network interconnects with the Russian Federation operators via at least three border crossings, offering a moderate level of international connectivity with the fibre networks of around a dozen regional operators such as Rostelecom, VimpelCom, TTK, and Sinterra (now Megafon).
Kyrgyzstan	Although Kyrgyzstan has terrestrial cable links across each of its borders, to Kazakhstan, Uzbekistan, Tajikistan, as well as through the mountainous Chinese border, it lacks direct access to cost-effective transit capacity, and thus suffers from weak international connectivity.
Lao PDR	Although the Lao People's Democratic Republic has terrestrial cable links to China, Thailand, Viet Nam and Cambodia, it is heavily reliant on transit country connectivity, and as these terrestrial trans-border links operate at low capacity, it remains hampered by weak international connectivity.
Nepal	Nepal Telecom is linked to the networks of three Indian operators, Reliance, BSNL, and Airtel and is almost entirely dependent upon cable routes transiting India. When completed, the South Asia Subregional Economic Cooperation (SASEC) program's SASEC Information Highway network connecting Bangladesh, India, Bhutan, and Nepal, may alleviate this vulnerability through increased redundancies and route diversification.
Pakistan	Although Pakistan is connected to three major intercontinental submarine cable systems and a fourth regional submarine system, its terrestrial connectivity to its neighbors is still under development.
The Russian Federation	The Russian Federation benefits from strong links to its neighbors in Central Asia, Eastern Europe, and China, but the country lacks direct intercontinental connectivity. The proposed Russian Optical Trans-Arctic Submarine Cable System (ROTACS) would provide direct connectivity to Western Europe and Japan, and the BRICS cable system would connect the Russian Federation's east coast to the emerging economies of Brazil, China, India, and South Africa. The Russian Federation's existing submarine connectivity is limited to the Baltic Sea, the Black Sea, the Eastern Mediterranean, and the Sea of Japan.
Tajikistan	Tajikistan has fibre cables running across at least three of its four borders, but usage is hampered by the lack of access to affordable transit capacity
Thailand	Thailand is relatively well-served by regional and intercontinental submarine cables, however, due to high transit prices, operators have been using terrestrial linkages to bypass Thailand's submarine gateways in favour of cheaper prices offered in Singapore.

Turkmenistan	Although trans-border links to each of Turkmenistan's neighboring countries are either in service or under construction, the capacity and robustness of the links is weak.
Uzbekistan	Uzbekistan is linked to each of its neighbors, but it also lacks direct access to cost-effective transit capacity.

Table 10 indicates that transit countries with direct access to submarine fibre optic cables have much better international connectivity than LLDCs. Among the LLDCs, Azerbaijan has the most robust cross-border connectivity.

On that basis and taking into consideration other factors such as geographic position and projected bandwidth demand, the studies identified missing links and ranked them into high, medium and low priority investment needs. Table 11 provides information on the high and medium priority routes.

Table 11: Investment priorities in LLDCs and transit countries

International Border (and border length)	Recommendation
Bangladesh / Myanmar (193 kilometres) High Priority	Additional fibre links are needed in order to ensure that Bangladesh has redundant bilateral connectivity with more than one country.
Bhutan / India (605 kilometres) High Priority	Diversification of Bhutan's fibre links to India is urgently needed in order to ensure the robustness of the country's international connectivity.
India / Nepal (1,690 kilometres) Medium Priority	Despite multiple fibre links, the importance of India's connections with Nepal requires mesh-like connectivity across the countries' border.
India / Pakistan (2,912 kilometres) High Priority	Deploying more robust connectivity between India and Pakistan could be an important step to closer economic partnerships.
Kazakhstan / Kyrgyzstan (1,224 kilometres) Medium Priority from the perspective of Kyrgyzstan	The existing trans-border fibre paths are expected to accommodate near-term demand across the border between Kazakhstan and Kyrgyzstan, although Kyrgyzstan would benefit from additional international transit bandwidth via Kazakhstan.
Kazakhstan / Turkmenistan (379 kilometres) High Priority from the perspective of Turkmenistan	Connectivity between the two countries is considered to be vulnerable due to the presence of only one link; Turkmenistan would gain significantly from additional transit paths via Kazakhstan onward to the Russian Federation.
Kazakhstan / Uzbekistan (2,203 kilometres) Medium Priority from the perspective of Uzbekistan	Connectivity between Kazakhstan and Uzbekistan is expected to be adequate for near-term demand, but Uzbekistan would benefit from increased international transit capacity via Kazakhstan.

Kyrgyzstan / Tajikistan (870 kilometres) Medium Priority in both directions	Although existing infrastructure is expected to meet near-term demand, Kyrgyzstan and Tajikistan would benefit from additional fibre connectivity across their mutual border.
Kyrgyzstan / Uzbekistan (1,099 kilometres) High Priority in both directions	Kyrgyzstan and Uzbekistan would greatly benefit from additional fibre infrastructure, especially with regard to providing redundancy to the existing path.
The Lao People's Democratic Republic to Cambodia (541 kilometres) Medium Priority	Demand between the two countries is weak but transit traffic from the Lao People's Democratic Republic via Cambodia could increase if a new Cambodian submarine cable is constructed.
The Lao People's Democratic Republic to Myanmar (235 kilometres) Medium Priority	Access to Myanmar's SEA-ME-WE-3 landing point could improve the Lao People's Democratic Republic's options for connectivity.
The Lao People's Democratic Republic to Yunnan, Province of China (423 kilometres) High Priority	ETL operates a fibre link to Yunnan Province, China via Boten. The The Lao People's Democratic Republic-China route would benefit from greater competition.
Nepal / China (1,236 kilometres) High Priority	Given Nepal's almost exclusive reliance upon terrestrial connectivity with India, could enhance diversification connectivity via China.
Pakistan / China (523 kilometres) High Priority	Both Pakistan and China would benefit from improved fibre connectivity, as the single fibre link under implementation is not considered to be a definitive, long-term solution for linking the two countries with robust connectivity.
Tajikistan / Uzbekistan (1,161 kilometres) High Priority in both directions	Tajikistan and Uzbekistan require additional fibre connectivity across their border.
Turkmenistan/ Uzbekistan (1,621 kilometres) High Priority in both directions	Given the age of the only link between the two countries, additional fibre is urgently needed between Turkmenistan and Uzbekistan.

3. Energy connectivity

In Asia, the energy demand is expected to double by 2050, of which the demand for electric power will increase significantly during the same period. In the LLDCs, access to basic energy services is one of major challenges. In general, as of 2010, there were still 628 million people without access to electricity and 1.8 billion people using traditional biomass, most of such populations are living in LLDCs – a distinctive characteristic of poverty. (table 12)

Table 12: Electrification rate and population without access to electricity

Country	Electrification rate Share (percent) of population with access (2011)	Population without access to electricity Million (2011)	Remarks
Afghanistan	16.0	23.8	
Bangladesh	60	61	
Cambodia	34.0	9	
DPR Korea	26	18	
India	75.3	306	
Indonesia	73	66	
Lao PDR	78		Target:90 percent by 2020
Mongolia	88		
Myanmar	13	43.5	
Nepal	76	7	
Pakistan	69	56	
Philippines	70	28	
Sri Lanka	85	3	
Tajikistan ²⁰	90	1 (2008)	73 percent rural population, used only 8.58 percent of the total electricity consumed in 2008
Timor Leste	22	0.9	
Viet Nam	96	4	

While a number of countries in the region are net energy exporters, only a few countries satisfy their energy needs from their own resources. The region as a whole is a net importer of primary energy. Notably, some countries are both major importers and exporters of energy, suggesting that even energy-rich countries are dependent on others for the energy security. On the demand side, low electricity access with more than 70 per cent of the population lacking access to on-grid electricity is concentrated in South Asia. Furthermore, the need to meet energy demand to fuel economic growth is a top energy security priority for countries relying on energy imports.

This uneven distribution of energy supply and demand results in significant differences in power generation costs and energy supply as a whole. Thus, there are numerous opportunities for oil, gas and electricity trade in Asia. They can be divided into main groups – infrastructure projects of regional or subregional significance and infrastructure projects of bilateral significance. For hydrocarbon infrastructure, the region already has a number of existing and planned pipeline projects. Subregional initiatives for power grid connections are also increasing. These all have beneficial impacts on LLDCs and bring opportunities for development. For instance, transit fees imposed by Afghanistan on energy exports between Central Asia and South Asia would bring substantial additional revenue to the Government of Afghanistan. However, this potential connectivity is still at a preliminary stage of implementation because LLDCs lack of institutional capacity and investments, among other challenges.

²⁰ Intermediate Strategy for Renewable Energy Sources Based Integrated Rural Development for Tajikistan, UNDP 2011.

a) Sub-regional energy connectivity and integration

Due to energy imbalances within the Asia-Pacific, countries are already becoming increasingly reliant upon cross-border trading in order to secure necessary energy supplies. This trade is primarily restricted to bilateral purchasing agreements between adjoining states in terms of both primary and electric energy transportation; however developments are being made towards a fully integrated regional or sub-regional trading market.

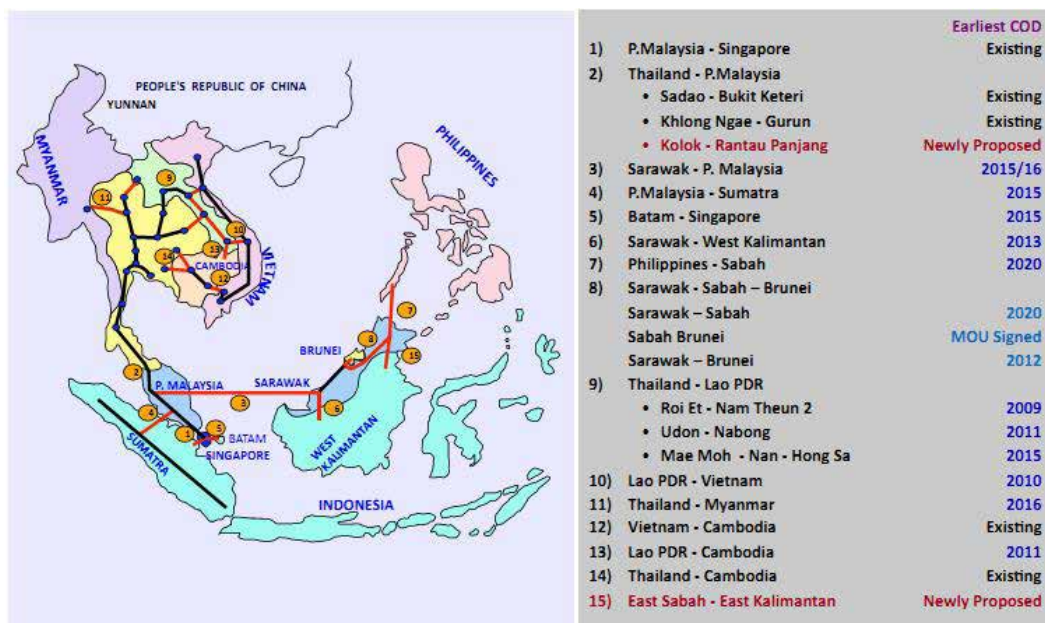
Recognition has been growing for some time within Asia of a greater need for a subregional cooperative effort to manage energy resource demands and ensure energy security. This is shedding light on the benefits that coordinated energy development can bring by delivering the most effective supply of resources that meets projected demands. A number of initiatives that also involve LLDCs are underway in the region.

(1) ASEAN power grid connectivity and the Lao People's Democratic Republic

Energy demand in ASEAN is growing very fast. To meet this growth, particularly for sustainable power utilization, ASEAN has developed a master plan for connectivity. It provided a blueprint on modalities that will connect all member countries' national grids to become the so-called ASEAN power grid.

An ASEAN Power Grid (figure 10) was mandated as a flagship programme in 1997 by ASEAN Leaders with the intention of assisting ASEAN Member States with the optimization of energy generation and sharing through cooperative intergovernmental trading and infrastructure development agreements. A Trans-ASEAN Gas Pipeline is also scheduled to be developed by 2020 through interconnection of existing and planned gas pipelines (ASEAN 2011).

Figure 10: Status of the Development of the ASEAN Power Grid Network 2010 (ASEAN 2011)



ASEAN energy demand is forecast to increase by four fifths between 2011 and 2035, ASEAN energy demand is forecast to increase by four-fifths between 2011 and 2035 to reach a level above that of the current consumption of Japan. ASEAN electricity generation is forecast to increase by more than the current power output of India, and 58 percent of this increase is expected to be produced out of coal, which should emerge as a fuel of choice. Renewables enter into mainstream, estimated to increase from 100 TWh in 2011 to more than 350 TWh in 2035, mostly hydropower, accounting for 20 percent of total generation. Key challenges faced in establishing effective regulatory framework, including harmonization of technical standards, and having mechanism to raise capital.

As the only LLDCs in ASEAN, the Lao People's Democratic Republic has a quite important role for ASEAN power grid based on its great potential of hydropower. Although Laotian government made huge efforts to extend the power grid coverage to rural population, there are about 30 percent of population in rural areas that do not have access to electricity. However, the increase in hydropower is mainly driven by high electricity demand in neighboring countries (mainly Thailand, Viet Nam and China), the opening of Laos's economy for outside investment since 1986 and the rise of regional banks and investors in Asia.

The Lao People's Democratic Republic currently has Memorandum of Understanding (MoU) with Thailand (7,000 MW), Viet Nam (5,000 MW) and Cambodia (1,500 MW) to supply electricity till 2020.²¹ However, from 2006 to 2010, the amount of import of electricity in Laos was higher than the amount of export. This was mainly due to the fact that the electricity grids in Laos are still very fragmented, as well as water shortages in dams. This means that the Lao People's Democratic Republic had to import electricity from Viet Nam and Thailand in border regions and during the dry season. It is estimated that over three-quarters of all current and future electricity generated in Laos is and will be exported to its neighboring countries. The goals of the Government for the power sector are (1) to expand the electricity grid to provide electricity to 90 percent of households by 2020, (2) to increase government revenue from IPP investments, and (3) to "promote" an integrated 500 kV grid in the Greater Mekong Sub region. The role of connectivity initiatives in particular the power grid connectivity will be more important in the near future for sustainable development in the Lao People's Democratic Republic.

(2) SAARC Energy Ring and SAARC Market for Electricity

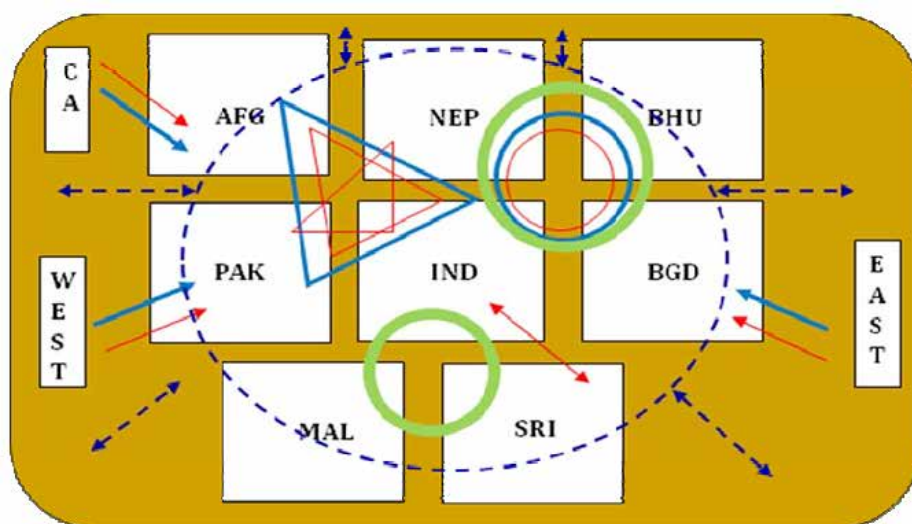
In the SAARC region there are about 1.6 billion people, of which 500 million earn less than 1 USD/day, all countries are oil importing and all with the exception of Bhutan, an LLDC, have an energy deficit.

Securing sustainable energy supplies is a policy priority of SAARC member states in terms of addressing rising oil prices, rapid increases in demand, and associated impacts on economic development as well as political and social stability. Consequently, the SAARC Energy Ring (Figure 11) was adopted by the Third Energy Ministers Meeting in 2009 and expert groups were established on Electricity; Oil and Gas; Renewables; Technology Transfer.

The Energy Ring concept consists of a power grid and a gas grid that are paired through an inter-governmental framework to create an electricity market. The Vision 2020 study that followed assessed the potential for integration of energy within the region in terms of both primary energy transportation pipelines (i.e. oil and gas) and electricity transmission.

²¹ Phomsoupha, X. (2009). Hydropower development plans and progress in the Lao People's Democratic Republic. *Hydro Nepal: Journal of Water, Energy and Environment*, 4, 15-17.

Figure 11: SAARC Energy Ring (SAARC 2010)



The Agreement (IGFA) for Cooperation in Electricity is currently under member States' consideration. The draft IGFA stipulates: unrestricted cross-border trade; commercial negotiation of PPAs; non-discriminatory open access; private sector trading; and participation in power exchanges.

The goal of IGFA is to create a SAARC Market for Electricity (SAME), to be integrated with CASAREM and its flagship CASA1000 project. Financing has been identified as a big gap for the power grid. There was a proposal in the Vision 2020 report to establish a SAARC Energy Fund with contributions from all member states. Although it does not yet exist, there are ongoing bilateral consultations.

(3) CASA - 1000

In addition to increase energy supply, there are important economic benefits as well as political windfalls for LLDCs emanating from greater connectivity in the energy sector. Transit fees accruing to Afghanistan from trade between Central Asia and South Asia is a key example. Similarly, on 11 October 2014, Pakistan and Afghanistan agreed on electricity transit fees of 1.25 cents per kilo watt (KW) as part of the Central Asia-South Asia (CASA-1000) power project. The agreement would help establish commercial arrangements for 1,300 megawatts (MW) of sustainable regional electricity trade between Kyrgyz Republic, Tajikistan, Afghanistan and Pakistan as part of the CASA-1000 electricity transmission and trade project.

In this regard, the Central Asia - South Asia Regional Electricity Market (CASAREM) will have great potential to transmit electricity between the Kyrgyzstan, Tajikistan, Afghanistan and Pakistan, to initially trade summer power surplus from Central Asian countries to South Asia (figure 12). The CASA 1000 Project is considered as the anchor project of the overall development and is comprised of an HVDC line from Nurek HPP in Tajikistan, to Kabul in Afghanistan and finally Peshawar in Pakistan.

Figure 12: CASAREM Project Plan (CASAREM 2012)



However, such connectivity projects are not without their controversy, due to social and environmental impacts cost-benefit, ecological and social aspects analysis should be conducted.

(4) North and Central Asian countries major energy connectivity activities

The vast interdependent electricity systems of the North and Central Asian states stretch from Georgia, Armenia and Azerbaijan on the Black and Caspian Seas to Kyrgyzstan and Tajikistan on the Chinese border, and from the Russian border in the north down to the borders of Turkey, Islamic Republic of Iran and Afghanistan in the south.

They were formed as constituent parts of the united Trans-Caucasus and Central Asian energy systems (with the Interregional Dispatching Offices in Tbilisi and Tashkent respectively). In turn Trans-Caucasus and Central Asian energy systems were part of the Unified Energy System of the former USSR. The regional power systems are combinations of electric power facilities, maintenance and management facilities, interconnected by the unified process of production, transmission and distribution of electricity. The Central Asian interlinked mono-system of hydro-energy and irrigative agriculture is one example. The system allowed a balancing between seasonal swings in electricity demand and irrigation needs as water supply in mountain rivers fluctuated. During winter Kyrgyzstan and Tajikistan accumulated water in reservoirs while receiving energy and energy recourses (coal and natural gas) from Kazakhstan, Turkmenistan and Uzbekistan. In summertime Kyrgyzstan and Tajikistan sent water to Uzbekistan and Kazakhstan for the needs of irrigative agriculture. From there, Kyrgyzstan and Tajikistan supplied neighboring republics with hydropower produced in surplus of national demand.

With the collapse of the The union of Soviet Socialist republics and emergence of severe political and economic crises in the republics of North and Central Asia, the cooperation developed over many years ceased almost entirely. The absence of a common policy and concerted actions led to the destabilization of the functioning systems and a drastic decrease in energy security.

Unified Power System of Central Asia is part of the Unified Power System (UPS) of the former The union of Soviet Socialist republics (common power grid of the URSS) created at the beginning of the 1960s. Unified Power System of Central Asia was designed and developed as a single power grid, which spans over all the Central Asian republics of the former Soviet Union - Kyrgyzstan, Tajikistan, Uzbekistan, Turkmenistan and the southern part of Kazakhstan. North Kazakhstan continued its synchronized operations with another part of UPS, which is now an Integrated Energy System of the Russian Federation.

After the breakup of USSR, countries inherited common technical standards allowing integration to continue. In 1991 senior managers of the national power systems signed an agreement on synchronous operation of power systems of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan, and established an enterprise called “United Dispatch Administration of Central Asia Power Systems” on the basis of the former United Dispatch Administration located in Tashkent. This was the starting point for the post-Soviet history of the Unified Power System of Central Asia.

The legal basis for energy cooperation in the region was regulated under different international and bilateral agreements and as part of the CIS (the Commonwealth of Independent States) cooperation. The CIS Electric Power Council was established in 1992. The Council includes senior officials from the electric power bodies of member states.

Because of various internal political reasons, the Unified Power System of Central Asia experiences continuous difficulties in its joint management and operation. In 2003, Turkmenistan disconnected its electricity lines from the Unified Power System. In 2009, Uzbekistan disconnected its electricity lines from Tajikistan (but not from Kazakhstan and not from the Unified Power System) which leaves Tajikistan isolated from the UPS, unable to import and export electricity to the UPS via Uzbekistan’s electricity networks. In 2007, six CIS countries: Armenia, Belarus, Kazakhstan, Kyrgyzstan, the Russian Federation and Tajikistan signed an Agreement to establish a Common Electricity Market of the CIS Member-states.

(5) Gobitec / Asian Super Grid in Northeast Asia and the role of Mongolia

Northeast Asia (NEA) is a subregion where the demand for energy resources is enormous with major economies competing to maintain their global competitiveness. Hence, energy security has been a key priority challenge for countries in Northeast Asia.

Mongolia is the only LLDC in this subregion with abundant energy resources, the Asian Super Grid (transmission) and Gobitec (generation) are complimentary visions for connecting Mongolia’s renewable energy from the Gobi Desert to electricity demand centers in North-East Asia, including China, Japan and the Republic of Korea. The Russian Federation (exporter) and the Democratic People’s Republic of Korea (importer) are also part of the overall concept.

The main power resources will come from the portion of the Gobi Desert in Mongolia alone with a potential installed capacity of 2,600 GW (1,100 GW wind and 1,500 GW solar). It has huge underutilized resources as current installed capacity is only 50 MW (first wind farm in 2013), with another 52 MW wind farm expected to go online in late 2015.

The latest study undertaken in January 2014 is Gobitec and Asian Super Grid for Renewable Energies in Northeast Asia. It incorporates solar and wind projects totaling 100 GW, over the period of 2015-

2030, with a total estimated investment cost of US\$ 293 billion, of which annual maintenance costs amount to US\$7.3 billion. Approximately 880,000 new jobs in Mongolia (manufacturing, construction, O&M) will be created with an expected income flow of over US\$ 9 billion and almost 560,000 new jobs. For the subregion, a total of US\$ 17 billion/year is expected in economic benefits resulting from cost savings in electricity production and 187 Gt CO₂/year in carbon dioxide emission reductions. At present, there is no clear lead institution or intergovernmental framework, although several actors are involved. At least 3 groupings exist but the relationships among them are unclear: Among them are the North-East Asia Super Grid Consortium of research institutes, China Renewable Energy Society, Japan Council for Renewable Energy, Korea Photovoltaic Society (RoK), and Mongolia Energy Development Association. A number of international organizations, research institutes, private companies and government bodies are also involved– DESERTEC Foundation, Energy Charter Secretariat, International Renewable Energy Agency (IRENA), Energy Systems Institute (the Russian Federation), Japan Renewable Energy Foundation, Korea Energy Economics Institute (RoK), Ministry of Energy (Mongolia), Newcom Group (Mongolia), and SoftBank Corp (Japan)

B. Review of ESCAP's Regional Initiatives

These initiatives fall either under the frameworks of multilateral agreements between governments, or within the frameworks of regional or subregional organizations such as ESCAP, the Asian Development Bank (ADB), the Association of South-East Asian Nations (ASEAN), the Economic Cooperation Organization (ECO) or the South Asian Association for Regional Cooperation (SAARC).

At ESCAP level, the efforts of LLDCs to enhance connectivity have been effectively supported by the work of the Working Groups on the Asian Highway network and Trans-Asian Railway network. Meanwhile, the work of the ASEAN secretariat within the framework of the Singapore-Kunming Rail Link (SKRL) project looks at improving connectivity between the Lao People's Democratic Republic and its neighbours, and the Central Asia Regional Economic Cooperation (CAREC) programme of the ADB is a partnership of 10 countries and six multi-lateral institutions promoting development cooperation in transportation, trade facilitation, energy and trade policy. The backbone of CAREC is the construction of six efficient land transport corridors linking Central, East and South Asia with the Middle East and Europe.

Further to the above, the important role of dry ports in the advent of an international integrated intermodal transport and logistics system for the region was recognized in the Ministerial Declaration on Transport Development in Asia and the Pacific of November 2006. The Declaration recognized the role of dry ports in extending the reach of the Asian Highway and Trans-Asian Railway networks, and their potential to become centres for economic development, particularly in landlocked developing countries and wider domestic hinterlands.

Additional support for the development of dry ports in support of international intermodal corridors came in December 2009 with the adoption of the "Bangkok Declaration for Transport Development in Asia" by the Forum of Asian Ministers of Transport at its first session. The Declaration stressed the important role of dry ports in integrating modes of transport, reducing border crossing and transit delays, facilitating the use of energy-efficient and lower emission means of transport, and creating new opportunities for the growth and establishment of development clusters. The Declaration also

went one step further by requesting the secretariat to provide connectivity and integration of the Asian Highway network, the Trans-Asian Railway network and other transport modes by working towards the development of an intergovernmental agreement on dry ports.

Acting on this mandate, the secretariat prepared a working draft of the Agreement which was reviewed and refined through a series of subregional meetings. The finalized draft of the Agreement was approved by the Committee on Transport at its third session in October 2012 and adopted by the Commission at its 69th session. The signing ceremony for the Agreement took place during the Forum of Asian Ministers of Transport at its second session held in Bangkok from 4 to 8 November 2013.

As Governments struggle to reconcile the increasing demand for transport infrastructure and services with the imperative of a reduction in the negative externalities of the transport sector, the Intergovernmental Agreement on Dry Ports, together with the Intergovernmental Agreements on the Asian Highway and Trans-Asian Railway networks, form an institutional framework aiming at supporting member countries in their efforts to work together towards the development of regional transport corridors using the routes of the Asian Highway and Trans-Asian Railway and identified dry ports of international importance as a canvas to define an hinterland development strategy, help landlocked developing countries access markets at lower costs than is currently the case, and advance the emergence of an efficient logistics industry across the region.

The following paragraphs give an account on the work already accomplished or being contemplated towards the realization of these objectives.

1. Asian Highway Network

The Asian Highway network comprises of 143,000 km of roads and highways in 32 member countries (figure 13). The network was formalized through the Intergovernmental Agreement on the Asian Highway Network that entered into force on 4 July 2005. To date 29 member States have become parties to the Agreement, including 11 LLDCs.²²

²² Afghanistan, Armenia, Azerbaijan, Bhutan, Kazakhstan, Kyrgyzstan, the Lao People's Democratic Republic, Mongolia, Nepal, Tajikistan, and Uzbekistan.

Figure 13: Asian highway route map



This agreement has been the basis of ESCAP Secretariat work to promote and facilitate the development and upgrading of the network, notably through five Working Group sessions in which the LLDC member States and other States have actively participated (the latest was held in Bangkok in October 2013).

With these objectives in mind, ESCAP has implemented a project on “Promotion of Investment in the Asian Highway Network: Prefeasibility Studies of Priority Sections” under which technical assistance was provided to four developing member countries including to two LLDCs, i.e. Kyrgyzstan and Mongolia, to undertake prefeasibility studies of selected priority routes and promote investment in the Asian Highway. As part of the project activities, national capacity building workshops to undertake prefeasibility/investment studies have been delivered in these countries. Similar activities had already been carried out in 2007 with the implementation of prefeasibility studies along sections of AH32 in Mongolia and AH82 in Armenia.

Thanks to these efforts and the work of other development partners road infrastructure in LLDCs has been greatly improved with approximately 10,000 km of AH routes in these countries (or 30 per cent) being upgraded to a higher Class.

In particular, the share of AH routes falling below the minimum standards has decreased from 32 per cent to 17 percent. However, another 6,123 km of AH routes still do not meet the minimum Class III standards. Although there are no “missing links” in the Asian Highway network in terms of an absence of road infrastructure, poor road quality in some areas often act as a deterrent for international transport due to increased vehicle operating costs. Table 13 below shows the current status of the Asian Highway network in the region’s 12 LLDCs, while table 14 shows the share of paved roads in their respective national road network.

Table 13: Status of Asian Highway network in LLDCs (km)

Countries	Primary	Class I	Class II	Class III	Below Class III	Total	Status year
Afghanistan	0	10	2,519	0	1,718	4,247	2008
Armenia	0	147	721	58	40	966	2013
Azerbaijan	0	291	1,174	0	0	1,465	2013
Bhutan	0	7	116	0	47	170	2013
Kazakhstan	0	557	5,407	6,389	475	12,828	2010
Kyrgyzstan	0	0	303	1,324	136	1,763	2013
Lao PDR	0	0	244	2,307	306	2,857	2010
Mongolia	0	8	1,702	158	2,450	4,318	2013
Nepal	0	0	218	1,082	13	1,313	2013
Tajikistan	0	20	978	0	914	1,912	2013
Turkmenistan	0	60	0	2,120	24	2,204	2008
Uzbekistan	0	1,195	1,101	670	0	2,966	2008
Total		2,295	14,483	14,108	6,123	37,009	
Percentage		6	39	38	17	100	
2004 percentage		1	14	53	32		
Corresponding percentage for Asian Highway network	10.89	17.90	37.15	24.51	9.56		

Table 14: Paved roads in LLDCs as a percentage of national road network²³

Countries	Percent	Latest year	Countries	Percent	Latest year
Afghanistan	36.4	2010	Lao PDR	13.7	2009
Armenia	93.6	2009	Mongolia	3.5	2002
Azerbaijan	55.6	2011	Nepal	53.9	2008
Bhutan	34.2	2011	Tajikistan	82.7	1995
Kazakhstan	88.7	2011	Turkmenistan	81.2	2001
Kyrgyzstan	91.1	2001	Uzbekistan	87.3	2001

The number of road accidents occurring on specific road sections is a good indicator of the quality of road infrastructure and tool for maintenance/investment planning. Table 15 shows that except for Azerbaijan, Bhutan and Uzbekistan, road fatalities in LLDCs are relatively on a par with the region's and world's overall average. Given that the World Health Organization estimates that 92 per cent of the world's road fatalities occur in low- and middle-income countries, while road injuries cost them an estimated US\$ 100 billion, urgent action is required on that front to reduce that amount and channel savings into productive investment in the transport sector.

²³ data.worldbank.org/indicators/IS.ROD.PAVE.ZS

Table 15: Number of road fatalities in LLDCs²⁴

Countries	Number of registered vehicles	Road accident fatalities	Estimated road accident fatalities per 100,000 population
Afghanistan	731,428	6,209	19.8
Armenia	300,091	558	18.1
Azerbaijan	982,553	1,202	13.1
Bhutan	57,618	96	13.2
Kazakhstan	3,249,966	3,514	21.9
Kyrgyzstan	430,314	1,022	19.2
Lao PDR	1,008,788	1,266	20.4
Mongolia	365,959	491	17.8
Nepal	1,178,911	4,787	16.0
Tajikistan	357,869	1,244	18.1
Turkmenistan			
Uzbekistan		3,107	11.3
ESCAP region		18.62	18.62
World		18.04	18.04

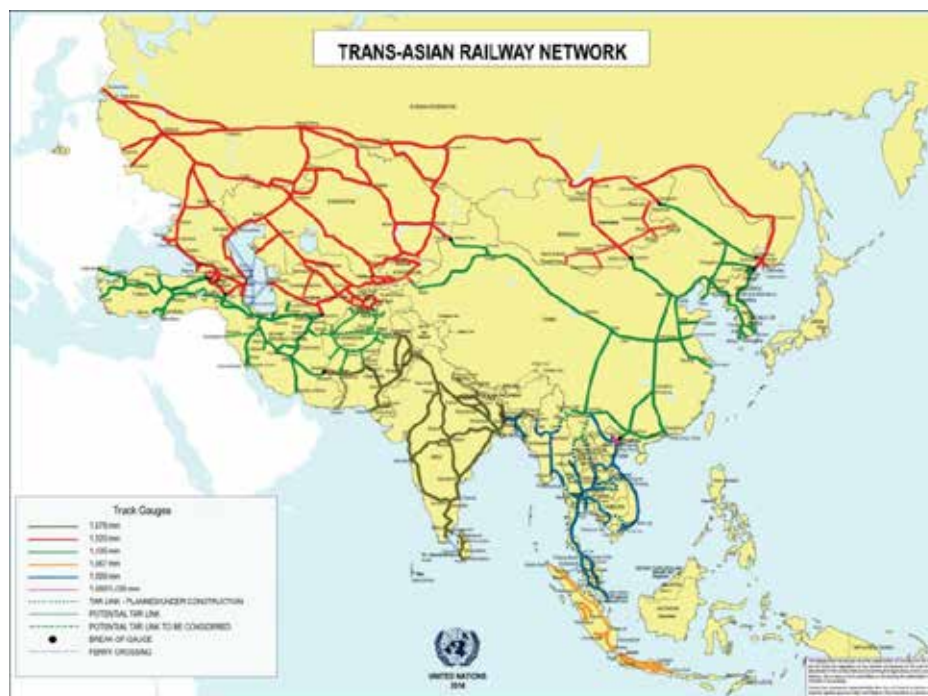
In view of this the secretariat has provided advisory services through national workshops over the period 2009-2011, in particular in Azerbaijan, Kyrgyzstan, Lao People’s Democratic Republic, Mongolia, Nepal, Tajikistan and Uzbekistan. The secretariat also organized a series of regional expert group meetings (Bangkok, 2010 and 2011; Seoul, 2013) to endorse a set of road safety goals, targets and indicators in line with the Decade of Action for Road Safety (2011-2020). The workshops and regional meetings generally assisted the LLDC member States to articulate, develop and refine their national road safety strategies and action plans containing measureable road safety goals and targets.

2. Trans-Asian Railway Network

There is growing acceptance that rail has an important role to play in the national and international movements of goods and people. A number of features speak in favour of a greater utilization of rail transport in serving the region’s trade and in particular facilitating the access of LLDCs to international maritime ports. (i) The nearest ports are often several thousands of kilometres away (Table 16), (ii) the distances linking the main origin and destination, both domestically and internationally, are of a scale on which railways find their full economic justification, (iii) the reliance on ports to connect national economies to the world’s markets with the need to clear landside port areas quickly to avoid congestion, (iv) a number of LLDCs are major exporters of mineral resources in the logistic of which rail transport plays a crucial role, (v) the continuing surge in the volumes of goods being exchanged, and (vi) the recognition of rail as an environmentally friendly and safe mode of transport.

²⁴ World Health Organization, “Global Status Report on Road Safety-2013”.

Figure 14: Trans-Asian Railway Network



LLDCs have taken active part in the identification of the Trans-Asian Railway (TAR) network which now comprises 117,500 km of railway line of international importance serving 28 member countries (figure 14). The network was formalized through the adoption of the Intergovernmental Agreement on the Trans-Asian Railway Network which entered into force on 11 June 2009. To date 18 member States have become parties to the Agreement, including 5 LLDCs.²⁵

Table 16: Distances from capital cities of selected LLDCs to main maritime ports (km) using identified Trans-Asian Railway routes

	Lianyungang (China)	Saint Petersburg (Russian Federation)	Vostochny (Russian Federation)
Ashgabad	7,300	4,800	10,100
Astana	5,550	3,350	8,300
Bishkek	5,600	4,650	8,350
Dushanbe	7,300	4,450	10,100
Tashkent	6,000	5,550	8,700
Ulaanbaatar	1,700*	6,750	4,500

* Port of Tianjin

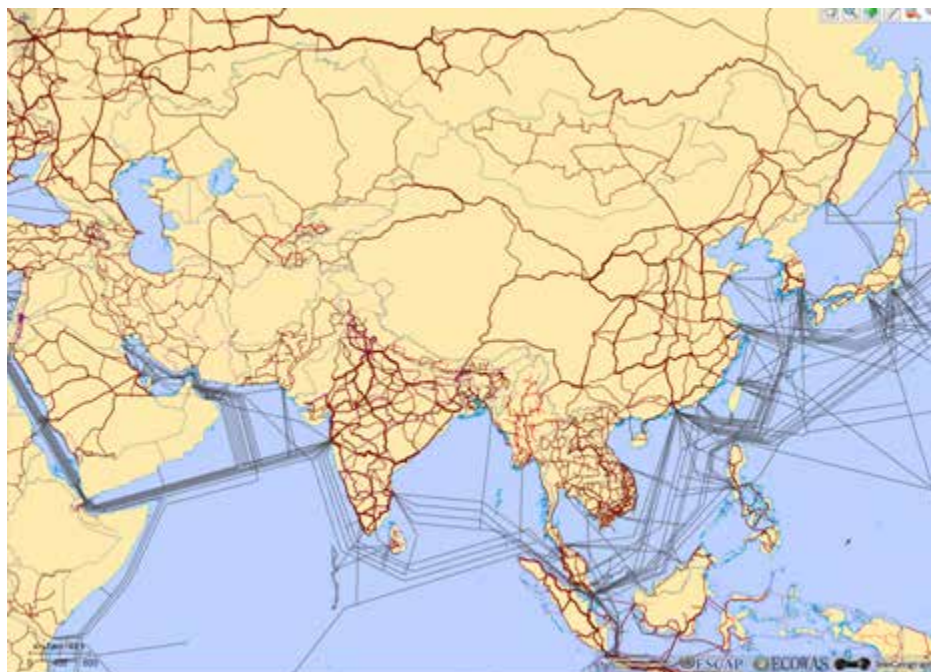
Discussions relating to the future development and operationalization of the network take place at meetings of the Working Group on the Trans-Asian Railway Network which meets biennially. The Working Group already convened three times with active participation of LLDCs.

²⁵ The Lao People's Democratic Republic, Mongolia, Nepal, Tajikistan and Uzbekistan. Armenia, Azerbaijan and Kazakhstan have signed the Agreement but have yet to become parties.

3. The Asia-Pacific information superhighway

Since 2009, the secretariat has been promoting the Asia-Pacific information superhighway initiative as featured in figure 15.

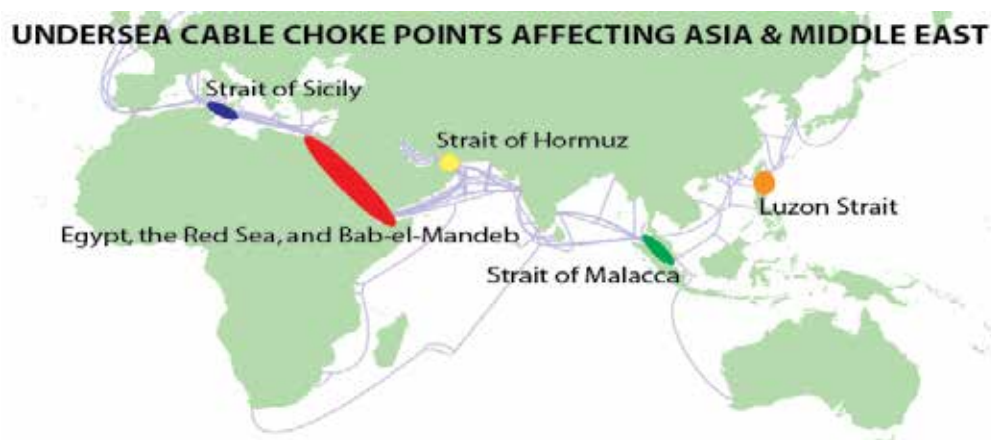
Figure 15: The Asia-Pacific information superhighway



Source: ESCAP/ITU map on the Asia-Pacific information superhighway.

The initiative aims to connect each country's backbone network into a cohesive regional superhighway that would help enhance competition in telecommunications markets and open up opportunities for new investments in fibre optic cable infrastructure. Furthermore, by seamlessly connecting land-cohesive infrastructure with the extensive submarine cable systems would lead to economies of scale and lower Internet prices, particularly for landlocked developing countries and Pacific island countries. It would also help to resolve critical choke points.

Figure 16: Terrestrial as a solution for submarine structural weaknesses



Besides the fact that submarine cables are not directly available to LLDCs, ESCAP analysis has shown that the global telecom industry is desperate for a terrestrial solution that will resolve critical weaknesses in the submarine cable system (figure 16).

To assist in fact-finding, ESCAP has developed in close cooperation with ITU the online maps of the Asia-Pacific information superhighway (available at www.itu.int/itu-d/tnd-map-public/). This is the first time that these cross-border terrestrial transmission networks are being mapped out. They help to identify missing links and bottlenecks in transmission infrastructure. In addition, as they overlay roads and railway infrastructures from the Asian Highway and Trans-Asian Railway, they will also facilitate the identifications of potential cross-infrastructure synergies in deploying fibre along transport infrastructure.

Based on this work, a framework of common principles and norms for the further evolution of a seamless information and communication space in the region, is under development through a Working Group that is subsidiary to ESCAP's Committee on ICT. These principle, being worked on, and outlined below, are based on outcomes of expert consultations held in Manila, Philippines (September 2013), Baku, Azerbaijan (December 2013), Almaty, Kazakhstan (June 2014) and Paro, Bhutan (October 2014).

Fully integrated and coherent: Robust, cross-border connectivity, developed in a mesh configuration, would increase international bandwidth capacity and allow for in-network healing in the event of cable disruptions.

Transparency, open-access and non-discriminatory pricing: Operators accessing the network on equal, transparent and non-discriminatory terms would help lower the costs for international bandwidth. Open-access principles implemented across the region would allow developing countries, landlocked developing countries, and Pacific island developing countries to receive bandwidth at fair and reasonable prices.

Uniform quality: A single uniform network with standard terms and quality of service guarantees would address the inefficiencies, and operational complications, arising from the existing patchwork of domestic backbones.

Leverage existing infrastructure: Utilizing existing passive infrastructure in energy, water, transport and telecommunications, including the accompanying rights-of-way, would lower deployment costs and increase network reliability. This could be achieved through partnerships with existing long-distance infrastructure networks such as the Asian Highway, the Trans-Asian Railway, or power transmission networks. Partnerships with ongoing and planned terrestrial links, such as the Trans-Eurasian information superhighway (TASIM), could also feed into a pan-Asian terrestrial network.

Regional and sub-regional Internet Exchange Points: Shorter paths between Internet Exchange Points, Internet service providers and the consumer would yield higher performance at lower prices. The establishment of additional regional and sub-regional Internet Exchange Points, therefore, should form a key part of efforts to develop pan-Asian terrestrial networks.

Regional cooperation: A regional approach - that leverages on sub-regional approaches where relevant, - can add significant value. If coordination is lacking, countries may choose to improve international connectivity by negotiating for transit capacity with neighboring countries, on their own, without contemplating the impact of such decisions on the wider region. Such bilateral approaches have contributed to the existing fragmentation of backbone connectivity in the region. Developing bilateral relationships with networks in other countries, without an overarching regional framework, would also limit competition at cross-border links and international gateways. A cohesive regional network, however, would bring less connected countries directly into the global Internet, stimulating overall demand and ultimately, lead to lower broadband prices, higher productivity contributions and improved economic growth overall.

4. The Asian energy highway

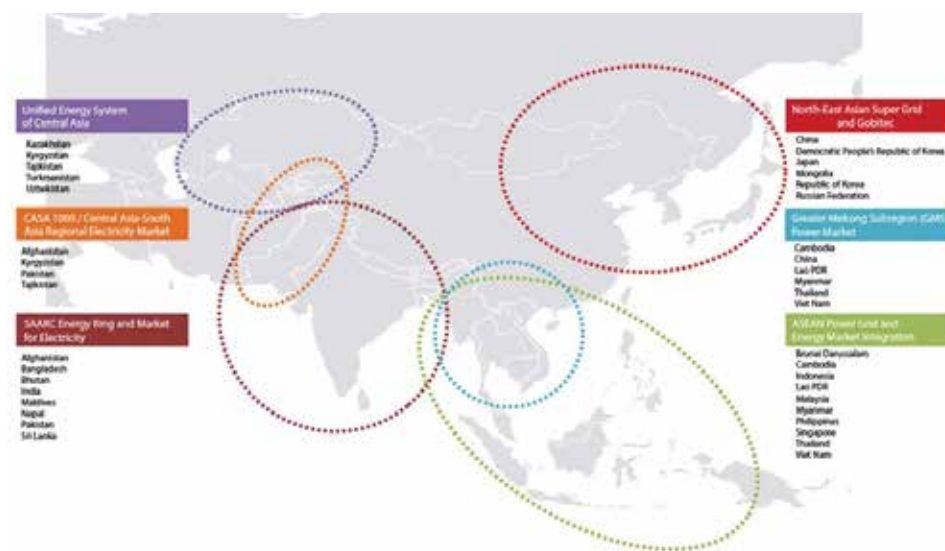
The Asian energy highway (AEH) concept is a proposal which aims to recognize and improve upon existing initiatives for sub-regional energy cooperation by advancing at a regional level, energy planning, infrastructure development and power trading in the Asia-Pacific. In light of the growing dominance of the power generation sector in terms of consumption of energy resources, the development of an integrated regional grid could become a focal point for diversification within the mix of sources from which energy is generated. This would optimize efficiencies in consumption and reduce exposure to shortages in a cleaner and lower carbon emitting way. It will ultimately contribute to the SE4ALL goals and the post-2015 development agenda.

The AEH could achieve this through the development of improved energy pooling via increased geographic coverage and load balancing capacities creating economies of scale for bulk generation, while reducing generation excesses. In creating an Asian energy grid, opportunities for access could also be enhanced in terms of delivering a more secure supply to intensive demand centers, whilst also increasing the potential for remote access through improved geographical coverage of networks. The facilitation of competitive pricing mechanisms could also be enhanced through market integration.

A regional planning perspective for energy distribution and security is likely to garner financial benefits in terms of an overall reduced net expenditure on energy infrastructure inherent to trans-border integrated solutions.

A unique opportunity exists therefore to identify shortfalls and opportunities for supply within the near and long term and collectively take advantage as a region.

Figure 17: Ongoing subregional energy connectivity initiatives towards the AEH



a) Technical feasibility

The efficient and therefore effective range of transmission systems and their capacity to integrate is increasing, opening both access to power resources previously considered remote and enhancing grid interconnection capabilities. This is primarily due to developments in Ultra High-Voltage (UHV) transmission capacities, particularly those of High-Voltage Direct Current (HVDC) technology.

The AEH could either develop as an evolution of sub-regional grid interconnection linkages, be developed principally as a 'backbone' network of UHV bulk transmission lines, or as a combination of both. Such decisions would require considerable planning and assessment regarding existing transmission system configurations and energy resource distribution.

The benefits of pooling energy reserves become possible within an interconnected grid system. Such a process has been demonstrated in the past to introduce pricing convergence across countries through competition, and a reallocation of gains and losses correlated with market power. The governance process for such a cooperative effort could be a cumulative effort using an initial intergovernmental standardized framework, with the possibility of an overarching operating network, or interconnected sub-networks that balance trading surpluses and deficits between smaller energy pools.

Furthermore, the introduction of enhanced network communication using smart grid technology can also deliver an improved 'smoothing' effect for load demand and supply storage, by providing information and incentives that enable shifts in consumption away from peak usage periods and enhanced supply storage along the network. An investment opportunity exists in this space through an AEH to facilitate technology transfer at a regional scale, and expedite advancement in grid technology and security in developing countries.

b) Implementation

The development of an AEH will require an effective and inclusive process of governance to appropriately manage the necessary partnerships between government, private and research agencies. Early integration at the technical level will be a critical element in promoting a smooth transition to regional capacity. The promotion of harmonization between electricity industries (both institutional and technical) is essential therefore in order to enhance integration opportunities, including regulatory harmonization between institutions. Ultimately, transparent and fair energy pricing structures will need to be developed in order for a regionally-scaled electricity market to properly function.

III. Challenges and opportunities

The following paragraphs will present some of the challenges and opportunities linked to the objective of bridging remaining gaps in infrastructure connectivity. They are also areas that will need to be addressed in the Draft Programme of Action for Landlocked Developing Countries for the Decade 2014-2024. It is proposed to structure those challenges and opportunities around three key dimensions namely institutional, financial and commercial.

A. Institutional

Having an adequate regional coordination framework is essential for coherent infrastructure development. It is actually even more important for landlocked developing countries as by definition they cannot regulate on their own their access to transport and communication networks to sea ports or maritime landing stations and beyond. Effective cooperation with transit countries is therefore fundamental and the report has shown the importance of some initiatives led by these transit countries that are improving regional connectivity.

Maintaining efficient regional coordination platforms should thus remain a priority to be able to achieve the desired infrastructure connectivity. For that purpose, the different intergovernmental agreements on infrastructure as well as regional cooperation mechanisms outlined in the report offer the necessary tools for consistent planning and identification of priority investments.

Once networks have been identified and formalized, they still need to be developed and upgraded, which is widely recognized as a very demanding process necessitating significant technical expertise. Building sustainable institutional capacity in LLDCs is hence critical for their effective linkage to regional infrastructure networks. The energy sector presents a case in point.

Transmission planning is a complex exercise, requiring significant levels of sophistication in demand forecasting and mapping. Technological development also plays a critical influence. A natural desire by Member States to maintain energy independence from a broader regional energy system is an obvious and potentially limiting obstacle to full integration of energy trading. The challenge is therefore to develop an institutional framework that can support the necessary intergovernmental cooperation in a progressive manner, and which can overcome the hesitations which some nations may have in engaging in big regional development projects. For LLDCs, there are more challenges. However, from the perspective on infrastructure connectivity, the landlocked obstacle could also be converted to a strategic transit revenue generating opportunities as shown throughout the report.

Operating intermodal and cross-sectoral corridors requires a high degree of coordination and cooperation across all stakeholders, including government agencies and institutions, shippers, modal carriers, telecom operators and various interest groups. These functions are more often than not distributed over many ministries or agencies, each of them dealing with one sector or subsector (e.g. rail, roads, ICT, public works). Consequently, investment decisions might be based primarily on the needs of each subsector with little coordination between the different modes. Standards, rules or documentation might also be developed separately making interoperability more complicated.

In short, maintaining coherent regional planning, developing internal capacity for the evaluation and implementation of infrastructure projects and ensuring adequate coordination among the different agencies involved in transport related areas is a pressing challenge.

It also required regional institutions that are in a position to promote the integration of sectors cross-sectorally as well as transborder for improvements in resource efficiency, access, pricing and energy security. Such potential for improvements can constitute a strong incentive for countries to cooperate rather than compete with each other, particularly if international organizations are able to embed such policies within a sustainable development paradigm (i.e. economic, social and environmental), that is shared by all at the global United Nations level.

B. Financial

Notwithstanding new forms of innovative financing mechanisms that have been discussed in various fora, international finance institutions (IFIs) continue to be large providers of funds for LLDCs.

1. International financial institutions

IFIs continue to have an important function in providing stable and secure funding, at concessional rates, and with due guarantees that alter the risk-reward equation and can further incentivize the private sector to absorb the risks inherent in large scale front-loaded investments in infrastructure.

This role has become even more important in recent years, with the increased number of initiatives having come to the fore providing new opportunities. An ASEAN Infrastructure Fund was set up with ADB and ASEAN members funding, the World Bank proposed a Global Infrastructure Facility for infrastructure funding, the BRICS countries proposed a New Development Bank, while China has proposed an Asian Infrastructure Investment Bank. While it remains to be seen how effective each of these initiatives will be over existing international financing mechanisms, the multiple efforts underway are a reflection not only of the huge unmet gap in infrastructure investment, but also the emergence of a multipolar and pluralistic world order with an evolving and variable configuration of the post-World War II Bretton Woods institutional architecture.

On its part, the ESCAP secretariat has continued to work to foster synergies among members and associate members, international financing institutions, and other stakeholders, including the private sector, to explore financing opportunities in priority infrastructure projects along the Asian Highway and Trans-Asian Railway routes, for example through the Asian Highway Investment Forum, meeting held in November 2007 and October 2013 that provided an opportunity for participating countries, international financial institutions and the private sector to discuss investment priorities and different approaches in the financing, development and operation of major highways.

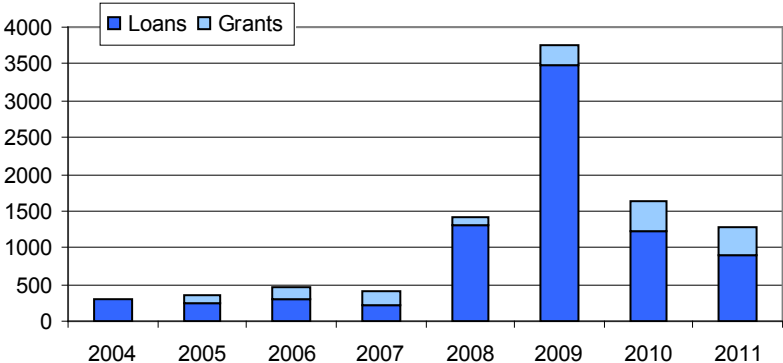
An important initiative in this context is the Central Asia Regional Economic Cooperation (CAREC) Program which is supported by six multilateral institutions and targets eight of ESCAP's twelve LLDCs, i.e. Afghanistan, Azerbaijan, Kazakhstan, Kyrgyzstan, Mongolia, Tajikistan, Turkmenistan and Uzbekistan. The aim of CAREC transport projects is to implement and enhance physical connectivity within the region around six main corridors which all bear close correlation between the targeted road and rail projects and the AH and TAR networks. Under the program, almost US\$10 billion has

been mobilized by participating development banks for transport projects in LLDCs since 2004 (out of which ~85 percent are loans and ~15 percent are grants).

International finance institutions have also been active in the other four Asian LLDCs which are not part of the CAREC program (namely Armenia, Bhutan, the Lao People's Democratic Republic and Nepal) for which the ADB and World Bank allocated an estimated US\$1.5 billion to the transport sector since 2004 (out of which ~90 percent are loans and ~10 percent are grants).

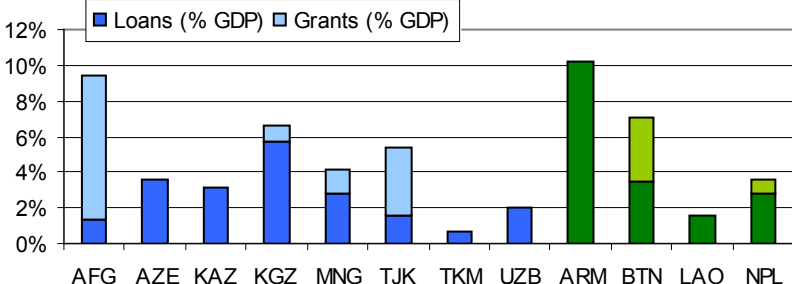
As regards the trend of funding provided to these countries, there has been significant growth (figure 18). Indeed the amount committed has increased on average from 0.4 billion per year in the period 2004-2007 to more than 2 billion per year in the period 2008-2011.

Figure 18: Evolution of financing committed by some key IFIs to LLDCs (US\$ million)



The distribution of funding per country also shows interesting patterns with some countries having funded - via key development banks - investments in transport for up to 10 percent of their GDP while others have mobilized less than 2 percent for the same purpose. The importance of grants is also considerable in some countries reflecting their limited borrowing capacity for non-concessional loans.

Figure 19: Distribution per country of financing provided by some key IFIs over the period 2004-2011 (US\$ million)²⁶



²⁶ Note: blue colour refers to countries member of CAREC while green refers to the other four countries for which only financing from World Bank and Asian Development Bank were taken into account.

2. Public private partnerships

Given the massive financial requirements for developing and maintaining infrastructure, as well as the limited budgetary resources and borrowing capacities of LLDCs, PPPs have emerged as one of the innovative financing solutions that can usefully capture complementarities between the public and private sectors. Besides injections of finance, the private sector brings specialized and more efficient services, particularly in operations and maintenance of infrastructure, and thus improves the durability of financing over the long term. In turn the public sector assures that public good objectives are addressed, such as delivery of affordable and reliable transport services to the poor and the minimization of externalities. In road transport such externalities are particularly important, given the high energy use of the sector (third highest after industry and households), high carbon emissions (around one fifth), noise pollution, and fatalities (around 700,000 per year in Asia-Pacific alone). In ICT infrastructure, where the private sector plays a prominent role, the government can impose universal (or near universal) service obligations. Furthermore, the public sector provides an enabling policy environment and long-term predictability that is embodied in its apolitical permanent institutions, and regulatory and legal frameworks. This is important because the private sector needs to know that its investments are secure and implementable, through for example, the ability of the government to enforce commercial law and legally binding dispute resolution. Additionally, the public sector can lend long-term sustainability to funding flows – a typical challenge in infrastructure projects - when revenue shortages accumulate over time, as usage and user fees (for generating revenue) undershoot planning figures. Guarantees by the public sector can recalibrate the risk-reward, and keep the private sector committed to the project, which in itself is a key condition for the durability of project financing over the long term.

Having said this, in practice, there are few instances of PPPs in LLDCs. When they have been implemented, for example, in a few airport and railway construction projects in Armenia, Kazakhstan, Uzbekistan and the Lao People's Democratic Republic, they have been single country projects. Generally there are very few instances of infrastructure PPPs at the regional level. There is also a big gap between proposals and those that reach implementation stage. Furthermore, many governments still need to understand and put in place the institutional environment conducive to attracting private sector investors. In order to raise awareness on the related issues, the ESCAP secretariat has provided interaction between senior government officials and high-level experts in PPPs, which included secretariat support to three ministerial conferences on PPPs in Seoul (October 2007), Jakarta (April 2010) and Tehran (November 2012). In short, private domestic savings need to be complemented by public funds and supported by multilateral aid agencies, and the multilateral investment guarantees they provide to recalibrate risk-reward ratios between the public and private sectors. There is a need therefore to further develop PPP opportunities in the region through for instance the implementation of adequate regulatory, legislative and governance measures, but other financial mechanisms might also be possible.

Experience in other countries/regions could at least suggest three different options:

- Creating dedicated national institutions for financing infrastructure (e.g. the Infrastructure Development Company Limited (IDCOL) in Bangladesh, the Infrastructure Finance Company (IDFC) and the India Infrastructure Finance Company Limited (IIFCL) in India or the PT SMI in Indonesia);
- Setting-up sub-regional infrastructure funds that could ultimately cover all the landlocked developing countries in Asia. Existing funds in the Asia include the SAARC

- Development Fund (SDF) which has a paid-up capital of US\$300 million and the ASEAN Infrastructure Fund (AIF) having an initial capital equity base of \$485 million;
- Establishing a regional investment facility to mobilize additional funding by using donors grant resources to leverage loans from several international financial institutions. Thanks to the grant money provided, public and private funding could be attracted as the hurdle rate for financial feasibility would be lowered or the risk associated with a specific project could be reduced. Such types of facilities already exist in some regions and have been showing impressive results both in terms in financial leverage and as regards the increased level of collaboration among international institutions involved in infrastructure financing. The facility does not have to be restricted geographically or by sectors and could be used as an instrument to support all types of infrastructure investments in Asia.
 - Co-habitation of infrastructure and leasing excess capacity could provide transport authorities with innovative sources of revenue. A case in point is that of Railtel Corporation, in India. Fibre optic networks are integral components of railway signaling, supervisory control and data acquisition (SCADA) systems. As these functions are not bandwidth intensive, rail authorities inevitably end up with surplus capacity. Railtel leased its unused capacity to telecom operators and has emerged as one of the largest telecom infrastructure providers in the region. In the process it diversified its revenue incomes and achieved robust profit margins, part of which are being reinvested in infrastructure upgrades and maintenance. Railtel managed to attract telecom providers; chiefly, because by leasing existing infrastructure they could avoid the major expenses inherent in civil works associated with transporting raw materials and trenching fibre in remote locations. Furthermore, they could avoid the costs associated with securing rights-of-way in order to access excavation sites and activate the optical fibre. Acquiring these rights can be the single most important factor in mitigating problems with deadline slippages and escalating budgets that often plague infrastructure projects.

In addition to mobilize the necessary resources to develop and upgrade networks, there is a need to maintain existing assets. Failure to do so will impose additional costs which can significantly exceed the costs of timely maintenance. For example, for every dollar spent on preventive road maintenance saves three to four dollars in future road repairs (on top the reduced vehicles operating costs for road users). In an attempt to obtain adequate funding for road maintenance, a number of countries have established dedicated road funds. The principal sources of revenue for these funds are: levies on consumables, mainly fuel; tolls; annual vehicle licence fees; supplementary fees for heavy vehicles; and fines for overloading. Co-deployment of fibre optic cable and leasing of the infrastructure presents another source of revenue for road authorities that is likely to become more and more lucrative in the future. Within the Asian LLDCs, the Lao People's Democratic Republic and Nepal have established road funds. Such funds appear to be an effective means of mobilizing finances for road maintenance. Further investigation on whether these solutions can be applicable in other LLDCs might be desirable. In this regard, the decisions reached by the joint session of the Committee on ICT and Transport on 15 October 2014, on an envisaged amendment of ESCAP's intergovernmental agreements on transport that encompasses provisions to systematically lay out fibre optic, (or at least ducts that will eventually have dark fibre threaded through) when building cross border transport infrastructure will entice international and regional financing institutions to build cross sectoral synergies into project financing.

Independently of the options considered, the availability of grant resources seem to be critical for future infrastructure development especially in the countries having limited borrowing capacity. Without such as support, some key investments (and in particular regional ones) are unlikely to materialize.

C. Commercial

Opportunities for LLDCs to capture an increasing part of freight traffic are significant as international trade is expected to continue to grow and most of these countries are at the crossroads between major trading blocs in Asia or even between Asia and Europe. Development of production centers relatively far away from sea ports such as the increasing industrialization of western China presents also good prospects for channeling more freight flow through some of the LLDCs.

Despite the existing potential, current levels of transit are actually relatively low. For instance, it was estimated by the CAREC initiative that transit trade volume via the region between Europe and East Asia was less than 1 percent in 2005. Competing with maritime transport is obviously challenging given the economies of scale than can be achieved due to the large volume transported but it has been demonstrated that under some circumstances inland transport can be less costly and faster (even when the cost is higher it can still be the best option especially for time sensitive products or high value goods (e.g. automotive parts or computers).

Technical progress is also triggering more opportunities such as the surge in containerization which can reduce considerably the physical barriers created by break of gauge in international rail network. Indeed, the provision of fast and reliable container transshipment can minimize delays required and consequently overcome the issues resulting from the junction of different networks.

To be able to capitalize on this tremendous potential, several challenges remain however to be addressed. First, non-physical barriers – which have not been covered in the present publication – should be eliminated as they are drastically curtailing infrastructure efficiency.

Second, missing links should be completed and roads should be upgraded to a level that can guarantee seamless transport infrastructure networks. This point is obviously related to financial and institutional challenges presented above.

Third, the necessary transport and logistic services should be available and reliable in order to make optimum use of existing infrastructure. Railways should for instance have sufficient capacity to handle future increase in freight transport (e.g. rolling stock) which implies that they are sufficiently profitable or subsidized to make the necessary investments. Efficient logistics services should be provided. This implies the availability of trained professional in the sector. In this regard, the secretariat has assisted member countries by developing training programmes and training capacity for freight forwarders, multimodal transport operators and logistics services providers.

Fourth, inland transport links should be satisfactorily marketed to shippers in order to create the necessary demand that would justify the continued provision of infrastructure. Several initiatives have been taken by ESCAP in that respect (e.g. the promotion of demonstration runs of container block trains or the organization of meetings of railway managers and shippers to increase the commercial attractiveness of rail such as the ones organized in Busan, Republic of Korea (June 2011) and Bangkok (October 2012). Further similar support should be continued.

Fifth, cross-sectoral synergies should be captured: up to 80 percent of the cost of fibre deployment is related to civil engineering works such as digging trenches and laying down ducts. Moreover, data available for developed countries show that the cost of fibre network installation during open road construction is less than 1 percent of project total. These cost aspects underlie the case for leveraging synergies in fibre optic cable deployment along infrastructure networks, in particular transport infrastructure such as roads and railways. In this regard, ESCAP is particularly well placed, with its long institutional involvement in transport networks, and in particular, the Asian Highway and Trans-Asian Railway agreements, discussed above. Because the 143,000 km of highways passing through 32 member States, and the 117,500 km of railway lines serving 27 member States connect densely populated areas of the region, in a seamless way, a number of benefits for LLDCs come to the fore:

- Meshed networks provide existing rights-of-way for fibre optic cables. This is of importance when fibre-optic cables cross national borders, as this is where the longest delays and consequently cost overruns in project implementation take place. Second, it provides redundancy in transmission routes, a concept that is very important for the telecom sector considering that it is estimated that a cable snaps somewhere in the world every 30 minutes. LLDCs that rely on single or two or three points of connectivity are critically vulnerable to such failures.
- Fibre optic cables deployed on roads and railway could be leased by road or railway authorities to data carriers, thereby increasing revenues for these transport entities. This is already being done by affiliates of railways in several countries of the region such as India, China or the Russian Federation.

Sixth, Similar synergies can also be tapped with cross-border energy infrastructure, in particular high voltage power transmission lines, as well as pipelines. Both types of energy carrying infrastructure typically contain fibre optic, for internal communication and monitoring purposes. High-voltage transmission lines are being utilized at the regional level to build cross-country meshed fibre optic cables backbones. A good example is the SIEPAC system in Central America that connects the national high voltage transmission grids of 6 Central American Nations. The 1793 kilometres long network of transmission lines includes an OPGW cable of 36 fibres. In order to exploit the fibre, and proceed with the required complementary investments to finalize the backbone, the regional entity owning the network created a network operator: REDCA, which acts as regional carrier in connecting national backbones. The REDCA network also connects the Mexican terrestrial backbone and is building an extension to connect to the Colombian network. It is expected to bring much needed redundancy to the national backbone of the Central American nations, which are currently heavily dependent on submarine cable access. This example of fibre co-deployment at the regional level between developing countries bears some relevance for Asian Landlocked developing countries, many of which are rich in fossil or hydroelectric resources, and which plan to interconnect their national electricity grids at the subregional level.

Seventh, open access principles are key as transport, ICT and energy infrastructure projects get funded and deployed. Open access is the key principle of ESCAP's Asia-Pacific information superhighway initiative is that the fibre-optic cable should be available on an open access basis to data carriers and telecom operators on a non-discriminatory basis. Practices from around the world

illustrate an emerging consensus on the general principles for open access on fair, reasonable, and non-discriminatory terms. In the European Union and the United States, for example, open access is used in policy frameworks where public funding for broadband networks is envisaged. Increasingly, open-access obligations are imposed by public authorities in the context of private sector mergers or acquisitions, as well as for those operators who are awarded public funding for broadband infrastructure projects. These obligations, widely used when deploying fibre to underserved or rural areas, are aimed at stimulating competition and assisting third-party access to broadband infrastructure. Such open access obligations should apply on fibre laid-out against regional infrastructure project, allowing for increased competition and lower prices for backhaul routings into Asian landlocked developing countries.

IV. Looking forward:

Recommendations for connectivity strategies

Based on the review of progress achieved and of the challenges and opportunities linked to future infrastructure development presented throughout this publication, the following recommendations may be considered:

- make the most of existing institutional frameworks promoting a coordinated approach to the development of transport, logistics and ICT by, for instance, becoming parties to the three existing intergovernmental agreements facilitated by ESCAP, i.e. Intergovernmental Agreement on the Asian Highway Network, Intergovernmental Agreement on the Trans-Asian Railway Network and Intergovernmental Agreement on Dry Ports;
- consider acceding to a number of conventions in the area of cross-border facilitation to reduce delays at borders and promote the development of a regional intergovernmental agreement on facilitation;
- build sufficient internal capacity for the efficient evaluation, planning and implementation of transport infrastructure projects with a specific focus on those that will contribute to the development of an international integrated inter-modal transport and logistic system;
- explore the possibility to plan the joint and coordinated development and operationalization of international intermodal transport corridors;
- develop a conducive institutional and legal environment best able to facilitate (i) the emergence of an efficient logistics industry and (ii) participation of the private sector in the financing of infrastructure projects and provision of services;
- consider whether innovative financial mechanisms - such as the establishment of a regional investment facility - could assist in closing the funding gaps and attract more financing for the necessary investments;
- assess and share best regional practices in terms of infrastructure maintenance in order to capitalize on existing assets and reduce the financial burden caused by poor maintenance;
- support the development of new technologies smoothing the operationalization of transport infrastructure networks such as Intelligent Transport Systems technology;
- support commercial initiatives to promote the use of inland transport services for international trade as a competitive alternative to maritime transport;
- develop a framework of principles and norms that will guide the further development of the Asia-Pacific information superhighway;
- develop a repository of projected cross border infrastructure corridors with the potential to host fibre optic cables. This information could be integrated into the online ESCAP/ITU map of the information superhighway to help the region identify where missing links to the Asia-Pacific information superhighway could be addressed at lower costs thanks to cross-sectoral infrastructure synergies;

- through the respective Working Groups of ESCAP's intergovernmental agreements on land transport amend the agreements to include provisions that encourage co-deployment of fibre optic cables with the construction, maintenance and upgrade of land transport infrastructure;
- implement an integrated regional energy plan for Asia and the Pacific that addresses energy security within the region, through further development of the Asian energy highway initiative;
- involve a variety of stakeholders in the AEH initiative, which is by its very nature a transnational project that will require significant cooperation at all levels, and transparency within partnerships and management processes;
- in building the AEH initiative, leverage on existing subregional initiatives, while also recognizing that the majority of interconnection agreements are predominantly progressing as either unilateral or bilateral trading arrangements, and that an opportunity exists therefore to widen the spread of benefits within a more regionally integrated multilateral trading framework;
- harness opportunities from collective action, taking advantage as a region of the latest technologies to develop a regional grid that could efficiently meet the growing power demands of the region in the future;
- Promote institutional reforms and harness political will for region-wide infrastructure connectivity through intergovernmental cooperation, in line with the realization of economically sound planning within a complementary governance framework.

V. Conclusions

Since the adoption of the APoA, landlocked and transit developing countries, with the support of their development partners, have made substantial progress in the priority area of infrastructure development and maintenance. Many sections of the Asian Highway network in LLDCs and their neighbouring transit developing countries have been upgraded to higher class standards and some portion of missing links in the Trans-Asian Railway network have been constructed while others are at an advanced stage of planning. Progress has also been made to better integrate these networks at key intermodal facilities such as Inland Container Depots or dry ports. Domestic fibre optic deployment has been extensive, including into rural areas in some countries

Yet, bridging infrastructure gaps remains a complex and expensive medium to long-term challenge for LLDCs and one that will continue to require a strong political commitment and the involvement of a range of multi-sectoral stakeholders in both the public and private sectors.

LLDCs could be on the threshold of a new era of economic development if they accept to reform and coordinate their initiatives. In answering the many challenges that they confront, LLDCs may be better served by looking at each other not as competitors for markets or foreign investment but as long-term partners whose economic growth and dynamism are interlinked.

In achieving greater infrastructure connectivity for LLDCs, ESCAP will promote such an approach and remain a partner of choice that converts ideas into policies and policies into solution-oriented actions. In this respect, the outcome of the 2nd United Nations Conference on LLDCs will be a major input into the preparatory process for ESCAP's Second Ministerial Conference on regional economic integration, planned for the end of 2015, as well as the future 5-year Regional Action Programme that will be submitted for adoption at the Ministerial Conference on Transport that the secretariat will organize in 2016.

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