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Indian Railways fights for its future

Greater Delhi's economic enabler

Ambitious plans are taking shape for an eight-route regional express rail network to serve the rapidly-developing National Capital Region.

VINAY KUMAR SINGH
Managing Director
NCR Transport Corp

Later this year, tenders are due to be called for construction of a 180 km/h railway between Delhi and Meerut, the first line of the future National Capital Regional Rapid Transit System.

Occupying a stratum between Indian Railways' conventional long-distance inter-city and suburban trains, with some of the hallmarks of an urban metro, RRTS will introduce a new approach for India, offering fast, frequent and high capacity intra-regional rail services.

Improved connectivity is needed to address the environmental and mobility challenges posed by a rapidly urbanising society. Now home to 1.2 billion people, India is one of the fastest growing economies in the world. With a young and educated population, rising income levels and a huge market, the country needs to strengthen its infrastructure accordingly.

3 million
PASSENGERS PER DAY TRAVEL ON THE DELHI METRO NETWORK

Road congestion is a major issue in the Delhi region, impacting on economic efficiency and leading to high levels of pollution.

Northern powerhouse

The National Capital Region is one of the largest urban agglomerations in the world; at the 2011 census it had a population of 46 million spread over an area of 58 000 km², and it has since continued to grow. The region embraces the original National Capital Territory of Delhi and surrounding districts in the three adjoining states. At present, around 39% of the NCR population lives within Delhi, which accounts for just 3% of the total land area.

Today, the NCR generates about 7% of India's total gross domestic product. Increased economic activity and employment opportunities have resulted in inward migration from other parts of India, leading to a growing population density and putting an unprecedented load on civic amenities. Many people travel to and from Delhi for work, increasing the demand for mobility. The combined effect of these developments has resulted in severe congestion on roads, high levels of pollution and related health issues, and huge economic inefficiency.

From road to rail

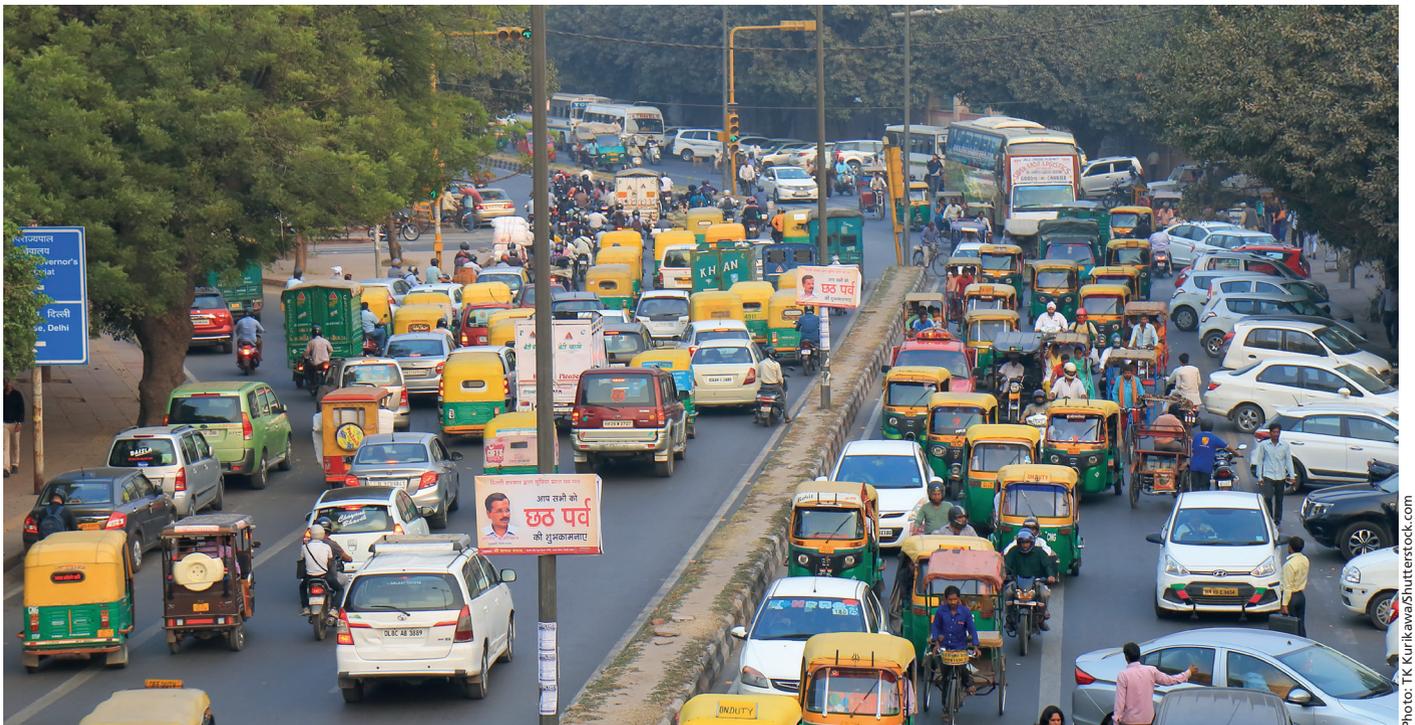
In recent years, India has witnessed a veritable 'metro revolution', which really started when the first Delhi Metro lines opened in 2002. Since then, metros have opened in several cities, and more lines are under construction or planned. The capital's metro is now carrying more than 3 million passengers per day on a network of 277 route-km, which is due to expand to more than 350 km by the end of 2019.

Although, the Delhi Metro has spread beyond the city boundaries, with around 60 route-km in the neighbouring states, intra-regional travel across the NCR is still dominated by private vehicles. Despite huge investment, the road network is not able to keep pace with demand, and regional commutes typically average just 32 km/h.

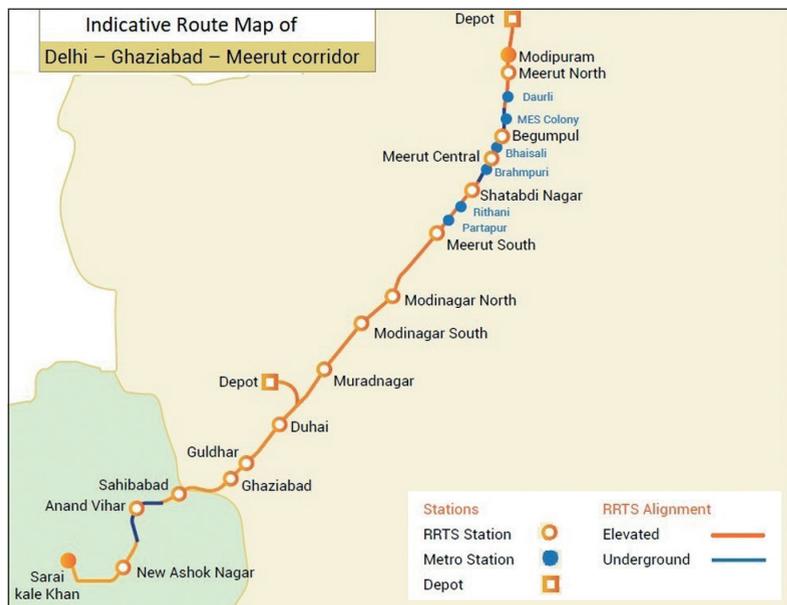
To address the problem, the NCR authorities and the national government began to investigate the potential for some form of regional express rail network, which would require much less land than the equivalent road capacity.

Studies of suburban and regional rail operations in Germany, London, Paris and Spain revealed that these networks also generate a wide range of economic benefits. The provision of high capacity connectivity between urban and suburban areas has encouraged polycentric development. Given such significant value propositions, we believe that regional rail networks have the potential to transform the landscape of our entire metropolitan region.

In August 2013, the government of India sanctioned the creation of the National Capital Region Transport Corp



Regional Express INDIA



The central RRTS line would be shared by longer distance intra-regional expresses and local services on the Meerut Metro.

public transport. Connecting the three corridors in the first phase, and making them interoperable, will allow trains to run through from one route to another, mitigating the risk of congestion at the interchanges and speeding cross-regional journeys.

Funding and implementation

Geo-technical surveys and preliminary work is already in progress along the Delhi – Meerut route, where construction is expected to get underway shortly. This line will be 82 km long, with 24 stations. Most of the route will run on viaduct, with around 14 km underground. Following common international practice, the elevated structure will be constructed through the use of launching girders, while the underground portion will involve both tunnel boring machines and cut and cover methods.

Commissioning is expected in phases, with the first section likely to be operational by 2023. End-to-end journey time between New Delhi and Meerut will be less than 60 min.

Capital cost for this first line is estimated at US\$4.75bn, 40% of which will be funded by the national government and the state governments of Uttar Pradesh and NCT Delhi. The rest is to be raised via soft loans, with various multilateral agencies including the Asian Development Bank. Value Capture Financing including land value capture is an integral part of the project for which NCRTC is closely working with the state governments and development authorities.

RRTS would use a ballastless track-form suitable for speeds of 160 to 180 km/h, together with noise and vibration mitigation measures. Like the more recent metro lines in Delhi and elsewhere, the network would be built to 1435 mm gauge to allow the use of

as the implementing agency for RRTS. It is a joint venture owned 50% by the national government and 12.5% each by the governments of the four NCR states — NCT Delhi, Uttar Pradesh, Haryana and Rajasthan.

NCRTC is tasked with designing, financing, implementing, operating and maintaining RRTS lines across the region, to provide comfortable and fast transit between the main towns and accommodate the strong growth in transport demand.

Eight-route network

The network is being designed to provide the safest, fastest, and most comfortable mode of commuter transport in NCR, offering the seamless connectivity needed to shape balanced and sustainable urban development. RRTS is being designed for a maximum speed of 180 km/h, and an operating speed of 160 km/h. This should provide an end-to-end commercial speed of 100 km/h, which is three times the average currently being achieved by road.

The complete network would serve eight corridors, of which three are being taken up in the first phase, linking

Delhi to Meerut, Alwar and Panipat. These three routes will converge at Sarai Kale Khan in New Delhi, which is set to become a major intermodal hub, being served by Indian Railways and Delhi Metro Line 7 and linked by walkways to the Inter-State Bus Terminal.

Multimodal integration has been a central aspect in the planning of RRTS. There will be links to both regional and inter-city bus terminals and airports, as well as metro and railway stations. The whole concept is predicated on encouraging a shift from private vehicles to public transport.

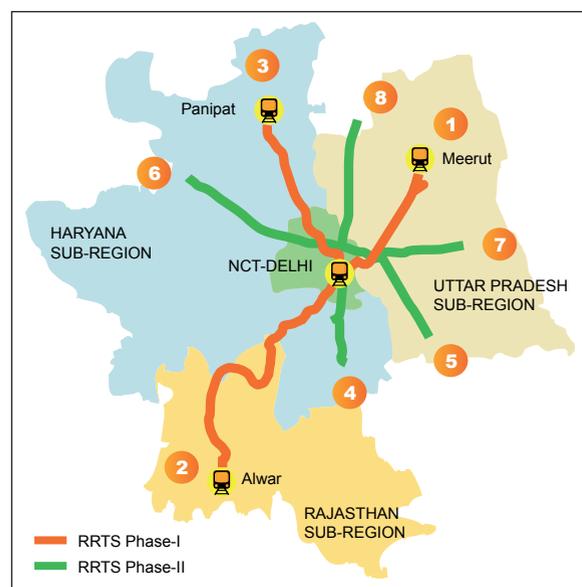
One particular innovation is the proposed Meerut Metro, which would share part of the RRTS infrastructure, but serve six additional stations to provide denser coverage of the local area. Making better use of resources should ensure significant savings in the overall capital cost.

Improved flexibility should help to keep down operating and maintenance costs, while expediting project implementation. In our examination of other networks, it became clear that waiting time and the number of interchanges were major deterrents to the use of

NCRTC is developing plans for eight radial corridors, of which three are being taken forward in the first phase.

Table I. Planned RRTS corridors in NCR

Route	Length km	Journey time min	Stations	Daily ridership
Phase I				
1. Delhi – Ghaziabad – Meerut	82.15	58	24	800 000
2. Delhi – Gurgaon – Rewari – Alwar	180	117	19	900 000
3. Delhi – Sonapat – Panipat	111.2	74	12	550 000
Phase II				
4. Delhi – Faridabad – Ballabhgarh – Palwal	-	-	-	-
5. Ghaziabad – Khurja	-	-	-	-
6. Delhi – Bahadurgarh – Rohtak	-	-	-	-
7. Ghaziabad – Hapur	-	-	-	-
8. Delhi – Shahadra – Baraut	-	-	-	-



INDIA Regional Express

standard equipment from the international market. However, procurement will be in line with the national government's 'Make in India' policy. The network would be electrified at 25 kV 50 Hz, with provision for regenerative braking. RRTS will be the first railway in India to be equipped with ETCS Level 2, using the latest Baseline 3 specifications which support packet switching technology for data transmission.

Stations would be designed to accommodate trains of up to 12 coaches. A fleet



of around 600 vehicles will be required to operate the initial three-line network, which is expected to be used by more than 2 million riders daily. These would be stabled and maintained at six depots.

The aerodynamically-styled trainsets will be fully air-conditioned, with a transverse seating arrangement in the standard coaches and more comfortable seating in business class. Each train would have a separate coach for female travellers. Because of the longer duration of intra-regional trips, the trains would have more comfortable seats than a typical metro trainset, together with luggage shelves throughout.

Still to be determined is the choice of fare collection technology, where the project team is currently investigating the option of implementing Open Loop Ticketing. Other technologies

Table II. Draft rolling stock specification

Gauge mm	1435
Traction supply	25 kV 50 Hz
Vehicle length over couplers m	22.0
Vehicle width mm	3200
Doorways per coach side	3
Door width mm	1300 to 1400
Standing density	4/m ²
Seat pitch mm	
Standard	800
Business class	900
Axleload tonnes	17
Train length	12 cars
Maximum speed km/h	180
Average acceleration (0 to 70 km/h) m/s ²	1.0
Emergency braking rate m/s ²	1.3

Geotechnical investigation and enabling works are already underway along the Delhi – Meerut corridor.

The RRTS station at Anand Vihar will be integrated with Indian Railways and two Delhi Metro lines, as well as the neighbouring Inter-State Bus Terminal.



under discussion include QR code tickets and m-ticketing using NFC-enabled mobile phones.

Economic impact

RRTS is expected to offer significant socio-economic benefits for the NCR. With proposed links between Delhi, Meerut, Ghaziabad and other towns, it would facilitate more efficient commuting between regional hubs as well as to and from the capital. Travellers switching to rail will benefit from substantial time savings, improved comfort and safer journeys. These key advantages will be important in promoting greater use of public transport, and should substantially improve the modal split. On the Meerut route, RRTS is expected to lift the public transport share from the current 37% to around 63%.

With typical journey times of between 30 and 90 min, travellers from towns up to 120 km from the capital will benefit from time savings of 60% to 75%. This would offer significant productivity benefits for the working population, while allowing industries to take a broader labour force.

A report by the Technical Group on Urban Housing in 2012 found that there was a shortfall of 490 000 housing

units in the Delhi area, as the growing population was outstripping the land available for development. RRTS is expected to play a significant role in shifting demand to the peripheries of Delhi and along the corridors where the capital cost of housing is significantly lower.

Towns like Ghaziabad, Modinagar and Muradnagar offer valuable opportunities to develop affordable accommodation around 30 min travel from central Delhi. This will not only help to decongest the capital, but should encourage economic activity across the NCR. Businesses along or close to the rail corridors in particular should benefit from enhanced patronage.

In terms of employment, RRTS is expected to generate both direct and indirect opportunities. Construction of the Delhi – Meerut corridor alone is expected to create around 21 000 direct jobs.

Other economic benefits include reduced road vehicle operating costs, fewer accidents, more efficient fuel usage and a reduced environmental impact. These will all contribute to the business case for RRTS, which in the longer term is set to become the backbone of urban and regional transport across the NCR. ■