

## 5G 公专网支撑城市轨道交通“绿智融合”发展

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大力推广 5G 的专业应用,是 5G 应用的国策。放眼未来,公网专用将助力更多企业拥抱 5G,实现数字化转型。将 5G 的公网与专网的应用结合起来,我们称之为 5G 公专网。5G 公专网的黄金时代已经到来。

通过城市轨道交通装备的国产化、自主化、网络化、智慧化、绿色化,中国城市轨道交通发展进入了一个新阶段。当前,一方面城市轨道交通仍处于高速发展期,另一方面各城市明显感到建设和运营方面所带来的经济压力。走数字化转型,向智慧、智能、绿色要效率和效能之路成为城市轨道交通可持续发展的不二选择。数字化的基础离不开移动终端,几乎所有的智慧应用,只要涉及到人就离不开无线移动网络。智能移动终端的连接具有全方位、全专业、大流量、高可靠的特点。5G 公专网与 Wi-Fi6 等其他私有宽带无线网相比,更经济、可靠,更能支撑城市轨道交通的可持续发展。

2023 年 4 月末,我国城市轨道交通日客流量首次超过一亿人次。城市轨道交通乘客几乎都在看手机,因此城市轨道交通是 5G 公专网最集中的使用场景,而且没有之一!大部分乘客在浏览网页、观看视频,网络上行通道还有很大的空间,而智慧城市轨道交通的应用正是以上行流量为主,如:上传车辆、设备的感知信息,上传图像、视频,上传作业反馈情况,等等。在新线建设时,就在公共区布置移动、电信、联通三家运营商合一的 AP(无线访问接入点),在洞内铺设三家运营商统一承载的漏缆,可极大地方便 5G 进入城市轨道交通领域,同时也为 5G 公专网的应用创造了条件。

5G 公专网的运行模式是城市轨道交通可持续运营的重点。可以设想移动、电信、联通三大运营商租用地铁的基础设施(机房、电源、线缆),城市轨道交通公司购买三大运营商的专网服务,双方均有经济收入;城市轨道交通公司以此降低建设和运营成本,并且构建可靠的运行维护体系。如果一个城市的轨道交通公司购买两家以上的电信运营商的专网服务,就需要运营商实现专网的互联互通。

5G 专网应用需要采用 MEC(边缘计算)技术,用 MEC 技术即可将城市轨道交通各专业传输数据落地,而不需要将数据传输到运营商的交换中心进行信息交换,因此可切出一部分 5G 专网频率资源给城市轨道交通在其应用范围内专用,这样既可以发挥 5G 技术的大带宽、低延时、广连接的优势,又能满足城市轨道交通各专业对 5G 专网通信质量和高可靠性的要求。

智慧城市轨道交通规划中的无线传输有两条通道,与列车运行安全相关的信息由 LTE-M(城市轨道交通车地综合通信系统)传输,这是一条满足传输安全要求的专用通道;还有一条是宽流量的 5G 公专网通道。从长远看,5G 公专网是更便捷、高效、经济的宽带无线传输通道,能够满足“绿智融合”发展城市轨道交通的所有应用需求。

为规范城市轨道交通 5G 公专网系统的网络规划、业务应用、产品设计、工程设计、工程验收等环节,中国城市轨道交通协会组织江苏铁塔,移动、电信、联通三家运营商,华为、中兴等装备供应商,中国通号、中铁四院等设计单位,以及武汉、深圳等地铁集团,由南京地铁集团牵头,在遵循 3GPP(第三代合作伙伴计划)相关国际标准的基础上制定城市轨道交通 5G 公专网系列规范,包括城市轨道交通 5G 公专网的总体规范(其中包括需求和总体架构两部分)、设备技术规范、接口技术规范、测试技术规范、工程规范(其中包括设计和验收两个部分)等,并在南京地铁和武汉地铁进行试点。可以预见,5G 公专网的广泛、深入应用及逐步推广,必将成为城市轨道交通可持续发展的必由之路。

## 5G Public-Private Network Supporting Urban Rail Transit 'Green Smart Integration' Development

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Vigorously promoting professional application of 5G is a strategic imperative for 5G deployment in China. From a forward-looking perspective, the dedicated use of public networks in private sector will empower more enterprises to embrace 5G and accomplish digital transformation. The amalgamation of 5G public and private network applications is termed as 5G Public-Private Network (5G PPN). The golden era of 5G PPNs has dawned.

The implementation of URT (urban rail transit) equipment localization, self-reliance, networking, intelligence, and greenization has propelled China URT development into a new stage. In the current context, URT is still witnessing rapid expansion, while cities are evidently grappling with the economic burdens associated with construction and operation. The path to efficiency and effectiveness lies in digital transformation, embracing intelligence, smartness, and greenness, which has become the indisputable choice for URT sustainable development. Mobile terminals are an indispensable component of digitalization infrastructure, as almost all smart applications are dependent on wireless mobile networks when human activity is involved. The connectivity of intelligent mobile terminals exhibits characteristics such as comprehensive coverage, professional versatility, high data throughput, and superior reliability. Compared to other private broadband wireless networks like Wi-Fi 6, 5G PPNs are more cost-effective, reliable, and better suited to support URT sustainable development.

By the end of April 2023, the daily URT passenger volume in China has surpassed 100 million for the first time. Nearly all URT passengers are engrossed in their smartphones, making URT the most concentrated scenario for 5G PPN usage, without exception. Most passengers browse web pages or watch videos, leaving considerable capacity for network uplink channels, while the applications of smart URT are centered on uplink traffic, for example: uploading perception information of vehicles and equipment, uploading images and videos, uploading task feedback. When constructing new lines, APs (unified access points) for China Mobile, China Telecom, and China Unicom are deployed in public areas, while unified fiber optic cables co-laid by the three operators are installed inside tunnels. This greatly facilitates the entry of 5G into URT field and creates favorable conditions for the application of 5G PPNs.

The operation mode of 5G PPNs is a focal point for URT sustainable operation. It can be envisioned that the three major operators, namely China Mobile, China Telecom, and China Unicom, lease the infrastructure of the metro system (equipment rooms, power supply, cables) while URT companies purchase dedicated network services from the three operators, thus economic revenue is generated for both parties. By doing so, URT companies can reduce construction and operation costs while establishing a reliable operation and maintenance system. For a city where rail transit companies purchase dedicated network services from two or more telecom operators, the operators need to coordinate the interoperability among their dedicated networks.

The application of 5G PPNs requires adoption of MEC (multi-access edge computing) technology, which allows the landing of various URT professional transmission data, eliminating the necessity of transmitting the data to the operators' exchange centers for information exchange. Therefore, a portion of 5G PPN frequency resource can be allocated exclusively to URT within its application scope. This approach not only leverages the advantages of 5G technology, such as high bandwidth, low latency, and wide connectivity, but also meeting the communication quality and high reliability requirements of various URT disciplines for 5G PPNs.

In the smart URT planning, there are two wireless transmission channels; information related to train operation safety is transmitted through LTE-M (urban rail transit vehicle-wayside integrated communication system), which is a dedicated channel that meets the requirements for secure transmission; the other one is the high-bandwidth 5G PPN dedicated channel. From a long-term perspective, 5G PPN is a more convenient, efficient, and cost-effective wideband wireless transmission channel that can meet all the application requirements of 'green and intelligent integration' in URT development.

To standardize the network planning, business applications, product design, engineering design, and engineering acceptance of URT 5G PPN system, the China Association of Metros has organized Jiangsu Tower, the three operators: China Mobile, China Telecom, and China Unicom, equipment suppliers such as Huawei and ZTE, design units such as China Railway Signal & Communication Co., Ltd. and China Railway Fourth Survey and Design Institute, as well as metro groups from Wuhan and Shenzhen, under the leadership of Nanjing Metro Group. They have formulated a series of specifications for URT 5G PPN based on the relevant international standards of 3GPP (3rd generation partnership project). These specifications include the overall specifications of URT 5G PPN (consisting of two parts: requirements and overall architecture), equipment technical specifications, interface technical specifications, testing technical specifications, and engineering specifications (consisting of two parts: design and acceptance). Pilot projects are carried out in Nanjing Metro and Wuhan Metro. It can be foreseen that the extensive and in-depth application and gradual promotion of 5G PPNs will become the essential path for URT sustainable development.

Translated by ZHANG Liman