TECHNICAL WHITE PAPER

The Engineering Case for a Terrestrial Backbone in a Converged National Architecture

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June 2026

1. EXECUTIVE SUMMARY

This Technical White Paper examines the engineering requirements of a durable national digital television transition for Nigeria. Its central finding is that a converged architecture is technically optimal, and that within that architecture a strong digital terrestrial television backbone is indispensable. Satellite delivery is valuable and necessary, particularly for universal reach in remote areas, but it cannot, on its own, satisfy the full set of national requirements. The two layers are complementary, not interchangeable.

The paper sets out eight technical dimensions on which the terrestrial layer is either essential or materially superior, and concludes with the optimal division of labour between satellite, terrestrial, and Internet Protocol delivery.

2. THE QUESTION

The engineering question is not whether Nigeria should use satellite. It plainly should, and NIGCOMSAT provides a valuable national asset for that purpose. The question is whether a transition relying predominantly on a single satellite, with terrestrial relegated to a minor role, can meet Nigeria's full national requirements. The analysis that follows concludes that it cannot, and that a strong terrestrial backbone is required alongside the satellite layer.

3. EIGHT TECHNICAL DIMENSIONS

3.1 Tropical Rain Attenuation

Satellite signals in the frequency bands used for Direct-to-Home delivery are subject to significant attenuation by rainfall, an effect well characterised in the ITU-R P.618 propagation models. Nigeria's tropical climate, with intense and prolonged rainy seasons across much of the country, produces precisely the conditions under which satellite reception degrades, including service outages during heavy rain. These outages tend to coincide with peak indoor viewing. Terrestrial UHF transmission is substantially more robust under the same rainfall conditions. A resilient national service therefore cannot depend predominantly on a layer that is most vulnerable when it is most needed.

3.2 Portable and Mobile Reception

Direct-to-Home satellite reception requires a fixed dish with precise line-of-sight alignment to the satellite. It cannot serve portable or mobile devices, and it cannot deliver television to a smartphone, a vehicle, or a handheld device. This is a fundamental physical limitation, not a matter of cost. Nigeria's population is young and increasingly mobile-first, and any vision that emphasises reaching citizens on smartphones cannot be met by satellite delivery. The terrestrial path, through DVB-T2 portable reception today and 5G Broadcast direct-to-mobile in the near future, is the only broadcast route to mobile devices. Internet streaming to mobile is possible but carries data-cost economics that place it out of reach for mass-market daily viewing.

3.3 Urban and Metropolitan Capacity

In densely populated metropolitan areas such as Lagos, Kano, Ibadan, Port Harcourt and Abuja, terrestrial transmission delivers very high capacity through frequency reuse across transmitter sites and single-frequency-network techniques. A national satellite beam, by contrast, shares a finite capacity across the entire coverage footprint. For the dense urban markets where the majority of viewing and almost all advertising value is concentrated, terrestrial capacity is materially greater and more cost-effective per viewer.

3.4 Localised and Regional Content

National policy, through the five-tier licensing structure and the reservation of a substantial share of capacity for regional and minority-language content, requires the ability to insert different content in different regions. Terrestrial transmission is naturally suited to this, because transmitters serve defined geographic areas and can carry region-specific services. Delivering the same degree of localisation over a national satellite beam is capacity-expensive and architecturally awkward, and tends to bias the platform toward national homogeneity at the expense of the localism the policy requires.

3.5 Interactivity and Addressable Advertising

The advertising-revenue expansion projected for the transition depends on addressability and granular audience measurement. Terrestrial hybrid broadcast-broadband television, through the HbbTV standard already provided for in Nigeria's framework, enables low-latency interactivity, targeted and addressable advertising, and rich audience analytics. These capabilities are substantially stronger over the terrestrial and hybrid path than over broadcast satellite. The commercial ambition of the transition is therefore better served by an architecture in which terrestrial plays a full role.

3.6 National Resilience and Sovereignty

Anchoring a national broadcast system predominantly on a single satellite introduces a single point of failure. Satellites have finite operational lives, are subject to technical risk, and cannot be physically repaired in orbit. A distributed terrestrial network provides resilience through multiplicity, so that the failure of any single element does not remove national service. For a service of national importance, including its role in emergency and public-safety communication, distributed terrestrial resilience is a material engineering and security consideration.

3.7 Satellite Replacement and Continuity

The satellite presently anchoring the Direct-to-Home plan is approaching the end of its operational life and is scheduled for replacement, with successor satellites planned for deployment over the coming years. A transition architecture that places predominant reliance on a single satellite during a period of planned replacement carries continuity risk. A strong terrestrial backbone provides continuity of national service independent of the satellite replacement cycle.

3.8 Cost of Reception to the Household

Direct-to-Home reception requires, at each household, a dish, a low-noise block downconverter, a compatible decoder, and skilled installation with correct alignment. Terrestrial reception requires only a simple antenna and a set-top box, without alignment. In populated areas already within terrestrial coverage, the household cost of terrestrial reception is lower. For the objective of universal affordable access, terrestrial is the more economical route wherever terrestrial coverage is viable, with satellite reserved for areas beyond economic terrestrial reach.

4. THE OPTIMAL DIVISION OF LABOUR

The engineering conclusion is a converged architecture in which each layer carries the load for which it is best suited:

Layer	Primary Role	Best-Suited For
Satellite (DTH)	Universal national reach	Remote and underserved areas; gap-fill beyond economic terrestrial reach; nationwide baseline coverage
Terrestrial (DTT)	Capacity, mobility, localism	Dense urban and metropolitan markets; portable and mobile reception; regional and local content; addressable advertising; resilience
Internet (IP)	On-demand and interactivity	Catch-up, on-demand and interactive services where broadband connectivity exists

This division of labour is the international norm. No mature digital television transition has relied predominantly on satellite to the exclusion of a terrestrial backbone. The prevailing international direction, expressed in the evolution of the DVB family of standards toward DVB-I service discovery and the integration of 5G Broadcast for direct-to-mobile delivery, is firmly toward hybrid architectures with a strong terrestrial component.

5. CONCLUSION

A converged architecture is technically optimal for Nigeria. Within that architecture, the terrestrial backbone is indispensable: for rain-robust reception in a tropical climate, for portable and mobile delivery to a young population, for urban capacity, for localised and regional content, for interactivity and addressable advertising, for national resilience, for continuity across the satellite replacement cycle, and for affordable household reception in covered areas.

A licensed signal distributor with deployed terrestrial infrastructure and a current technology partnership is positioned to deliver this terrestrial backbone in coordination with the satellite layer. The engineering case and the policy framework point to the same conclusion: a converged transition, using every layer for its strength, is the soundest path to a durable, resilient and commercially successful national digital television service.

Satellite reaches everywhere. Terrestrial reaches everyone where they live, work and move. The national transition needs both, and the engineering is unambiguous on the point.

— END —

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