HFC NODE SPLIT DESIGN

A Case Study

PROJECT OVERVIEW

The project involved the design of a Node Split (Node Segmentation) within an existing HFC network to improve network capacity, reduce subscriber loading, minimize amplifier cascade, and enhance RF signal quality. The objective was to divide overloaded optical nodes into smaller service areas while utilizing the existing network infrastructure as much as possible, thereby minimizing construction costs and supporting future network growth. The design included RF network modifications, fiber connectivity updates, node boundary revisions, and documentation required for construction and implementation.

SCOPE OF WORK

- Review existing RF network and design requirements.
- Identify overloaded nodes requiring segmentation.
- Plan new node locations and revise node boundaries.
- Upgrade RF equipment and reduce amplifier cascade.
- Update fiber connectivity from the nearest MUX to the proposed node.
- Configure new splice cases, pigtails, and node connectivity.
- Perform automated design validation.
- Generate engineering reports, construction drawings, and Bill of Materials (BOM).
- Perform Quality Control (QC) and Quality Assurance (QA).

1. Design Input Review

The engineering team reviewed the existing network design, node upgrade requirements, amplifier replacement requirements, MUX information, and project design instructions before initiating the node split design.

2. Node Split Planning

Overloaded nodes were evaluated based on subscriber loading, amplifier cascade, and RF performance. New node locations were selected to provide balanced service areas, reduce cascade, and improve overall network performance while utilizing the existing network infrastructure wherever possible.

3. RF Network Modification

The existing RF distribution network was reconfigured by:

- Splitting the existing service area into smaller node boundaries.
- Redistributing subscribers between the existing and new nodes.
- Upgrading amplifiers where required.
- Replacing legacy equipment with approved network components.
- Replacing Equalizer (EQ) taps with plug-in taps where applicable.
- Ensuring amplifier cascade, signal levels, and house counts complied with engineering standards.

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Vision Through Mapping

4. Fiber Network Update

Fiber connectivity was updated by identifying the nearest available MUX and routing fiber to the proposed node location. New splice cases, pigtails, and fiber assignments were created following approved engineering standards. If suitable spare fiber was unavailable, a new MUX was proposed. ITU assignments and master circuit connectivity were completed for each new node.

5. Design Validation

After completing the RF and fiber updates, automated validation tools were executed to verify:

- RF signal compliance
- Equipment naming
- Power supply validation
- Network connectivity
- Design completeness

All validation issues were resolved before finalizing the design.

6. Quality Control

Each completed node split design underwent a comprehensive QC review to verify:

- Node placement and boundary updates.
- House count balancing between nodes.
- Amplifier cascade compliance.
- Amplifier and passive equipment upgrades.
- Fiber routing and connectivity.
- MUX, splice case, and pigtail assignments.
- Equipment naming and attributes.
- Automated validation results.
- Compliance with engineering and drafting standards.

Any identified issues were corrected before proceeding to Quality Assurance.

7. Quality Assurance

A final engineering review validated the completed design to ensure all RF, fiber, connectivity, equipment, and documentation updates complied with project requirements and engineering standards before delivery.

7.Deliverables

The completed project included:

- Updated RF Design Drawings
- Revised Node and Segment Boundaries
- Fiber Route Updates
- MUX and Splice Design
- Construction Drawings
- Bill of Materials (BOM)
- Engineering Reports
- Final Node Split Design Package

KEY DESIGN CONSIDERATIONS:

- Reduced subscriber loading by splitting overloaded nodes.
- Reduced amplifier cascade to improve RF signal quality.
- Balanced house counts across all node outputs.
- Reused existing infrastructure wherever practical to minimize construction costs.
- Connected new nodes through the nearest available MUX.
- Optimized fiber routing and splice planning.
- Maintained compliance with engineering standards and automated design validation requirements.
- Designed the network to support future capacity growth and additional node segmentation.

OUTCOME:

The Node Split Design successfully optimized the HFC network by dividing overloaded service areas into smaller, balanced nodes. The design reduced amplifier cascade, improved RF performance, increased available bandwidth, and enhanced subscriber experience without requiring major reconstruction of the existing backbone infrastructure. Updated RF and fiber designs, construction drawings, BOM, and engineering documentation provided a complete package for efficient field implementation while supporting future network expansion and scalability.