



IIT MADRAS

Indian Institute of Technology Madras

Technology Transfer Office
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Industrial Consultancy & Sponsored Research (IC&SR)

Method and optical fronthauling system for analog optical fronthauling in 5G communication network

IITM Technology Available for Licensing

Problem Statement

- The traditional cellular Radio Access Network uses digitized radio over fiber to transport **data** from base band units (**BBUs**) to the Remote radio heads (**RRHs**) with CPRI, e-CPRI standards.
- Digitization requires increased processing at both BBU and RRH; multi-sector MIMO requires with large number of cell sites require data rates to the orders of Tbps for *mmwave* transport.
- Present patent provides an energy efficient analog fronthauling system for 5G, and beyond 5G.
- The technique may be extended for 6G applications.

Technology Category/ Market

Technology: Analog optical fronthauling for 5G communication network and beyond; for generation and transport of mm waves.

Industry: 5G & Next Generation networks;

Applications: Infrastructures, Telecom;

Market: The global **5G network** market is projected to grow at a CAGR of **67.4%** during the forecast period (**2021-2030**).

Technology

- Present patent claims an **optical fronthauling system** for generation of *mmwaves* and transport of baseband analog data with reduced bandwidth.
- The components, with the proposed **BBU-RRH** split for analog radio-over fiber link, are shown in Figure 1.
- System comprises a laser source & a IF source, optical modulators, optical upconverter, & optical amplifier which are placed at the optical **BBU**.
- An optical to electrical converter including other associated components are placed at the receiver optical **RRH**.

- Baseband data is modulated directly or externally on IF;
- Dual parallel Mach Zehnder modulator(**DPMZM**) for frequency quadrupling optical signal, separated by a quadruple frequency($4f_{RF}$) with optical sub-carrier at $(f_0 + 2f_{RF})$ & $(f_0 - 2f_{RF})$.
- The final electrical signal comprises the data band at 3 frequencies $(f_{IF}, 4f_{RF} - f_{IF}, 4f_{RF} + f_{IF})$.
- $4f_{RF} + f_{IF}$ is filtered at RRH to retrieve RF modulated data.
- Method can be extended to multi-sector antenna with WDM.

Key Features / Value Proposition

- Technical Perspective:** Provides IF frequency (f_{IF}) by upconverting **5G NR** physical downlink shared channel (**PDSCH**) frames with OFDM signal of a **specific bandwidth** (QPSK, 16QAM, 64QAM, & 256QAM)
- Facilitates **increased processing speed** & provides **efficient performance** as determined by standard EVM measures.
- Industrial Perspective:** The system can be applied in 5G domain including advantageous features like **compact in size, cost-effective & high processing speed, low energy**(refer Figure.2, 3).

Intellectual Property

IITM IDF Ref. 2279;

Patent No:432862 (Granted);

TRL (Technology Readiness Level)

TRL-3/4, Proof of Concept ready & validated

Research Lab

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Images

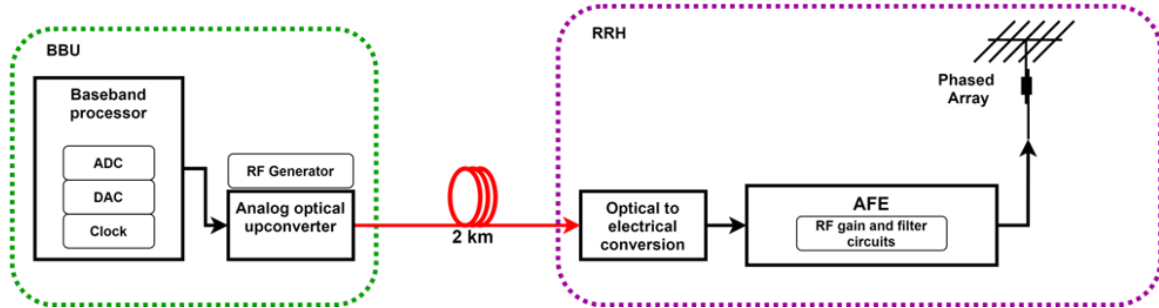


Fig.1 (Above): Optical fronthauling system for analog optical fronthauling.

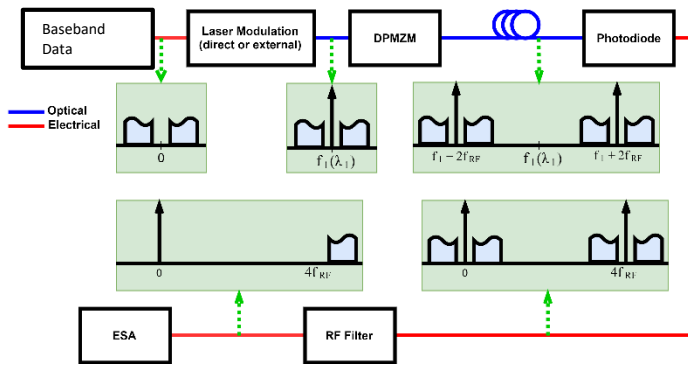
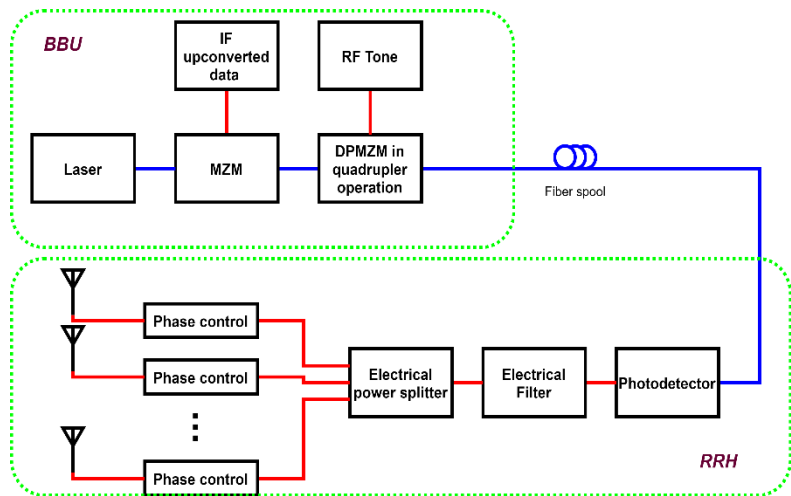


Fig 2 (Left): Block diagram representing the Analog optical upconverter and optical to electrical conversion

Fig 3 (Right): Block diagram for single sector antenna with electronic phase control



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