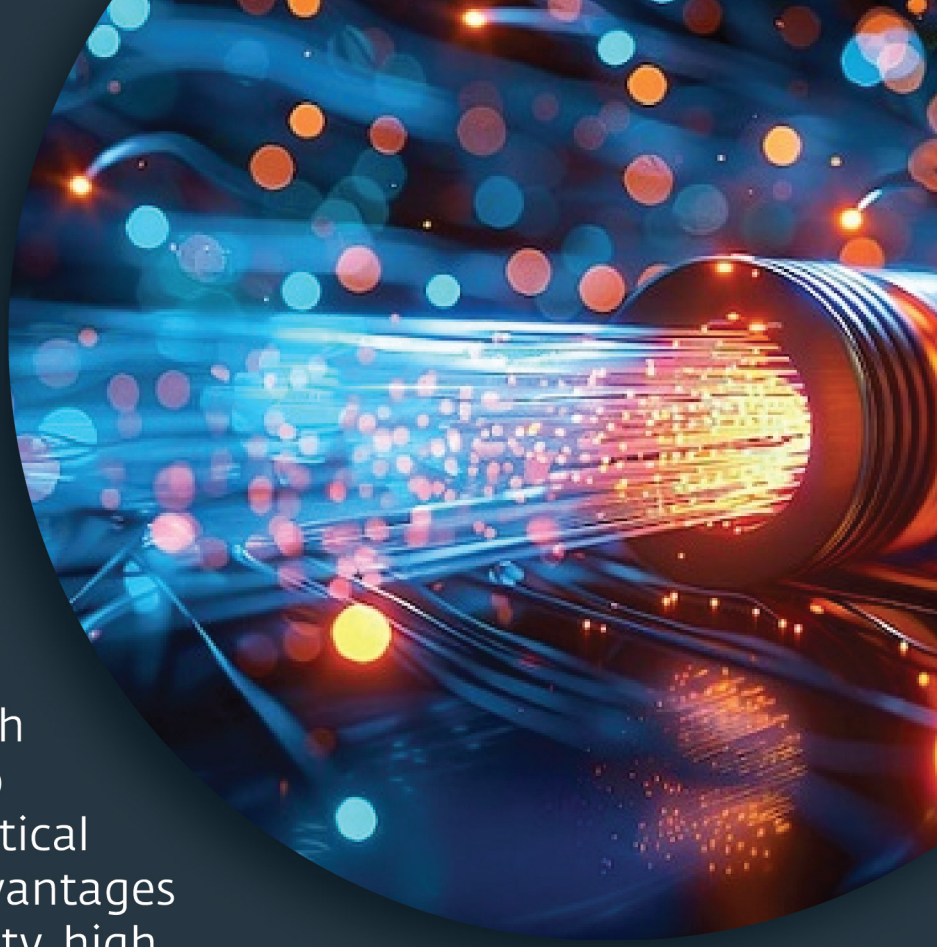
TECH SCAN

HOLLOW CORE OPTICAL FIBER

BAZZAAR®

WHERE MIND MEETS MARKET



Hollow Core Optical Fiber (HCF) is an advanced optical communication technology in which light travels primarily through a hollow, air-filled core rather than through solid glass. Because light travels faster in air than in glass, HCF can transmit data with lower latency compared to conventional solid-core optical fibers. It may also offer advantages such as reduced nonlinearity, high bandwidth capacity, and improved performance in specific high-speed communication applications.

Recent advances in fiber design, fabrication techniques, and loss reduction have made HCF more reliable and increasingly practical for use in data centers, telecommunications networks, cloud computing infrastructure, and future 5G/6G communication systems. Its key advantages include faster data transmission, reduced latency, potential energy efficiency benefits, improved network performance, and the ability to support growing data traffic demands.

As this technology has the potential to significantly impact global communication infrastructure, protecting its intellectual property is highly important. Patents and other IP rights can help safeguard innovative fiber structures, manufacturing processes, system architectures, and commercial applications. Strong IP protection enables organizations to maintain a competitive advantage, prevent unauthorized use of their innovations, and secure returns on research and development investments.

INNOVATION TIMELINE

1964 — Bell Labs explored hollow waveguides for electromagnetic transmission.

1991 — Concept of Photonic Crystal Fiber (PCF) introduced.

1996 — First practical PCF structures demonstrated.

1999 — First Hollow-Core Photonic Bandgap Fiber (HC-PBGF) demonstrated.

2007 — Kagome hollow-core fibers gained attention for broad bandwidth.

2011 — Development of Negative Curvature Fibers (NCF).

2012 — First Anti-Resonant Hollow-Core Fiber (ARF) designs demonstrated.

2014 — Nested Anti-Resonant Fibers (NANF) introduced.

2018 — Advanced negative-curvature and conjoined-tube hollow-core fiber designs demonstrated

2022 — Double Nested Anti-Resonant Nodeless Fiber (DNANF)

2024 — Commercial deployment trials for ultra-low latency networks.

2025 — DNANF achieved record loss of ~0.091 dB/km at 1550 nm.

PATENTABLE COMPONENTS

Fiber Structure and Design - novel hollow-core geometries, anti-resonant or photonic bandgap structures, nested tubes, and designs that reduce loss or improve mode control.

Material Innovations - Covers new glass compositions, coatings, and protective layers that enhance durability, stability, or optical performance.

Manufacturing and Fabrication Processes - methods for preform fabrication, capillary assembly, and fiber drawing with improved precision and scalability.

Performance Enhancement Technologies – Methods to reduce latency, Techniques to minimize dispersion

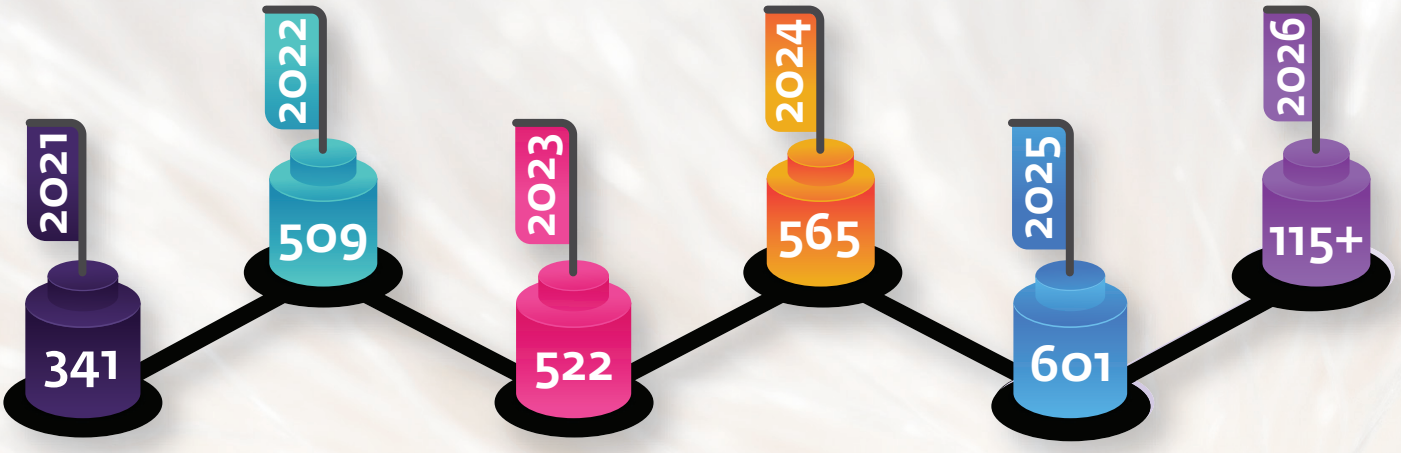
Optical Connectivity and Integration - Technologies enabling reliable connection with other optical systems such as Low-loss connectors and splicing methods, Mode-field adapters and coupling systems and Protective packaging and end structures

Network and System Applications - Data-center interconnect architectures, 5G/6G optical transport systems

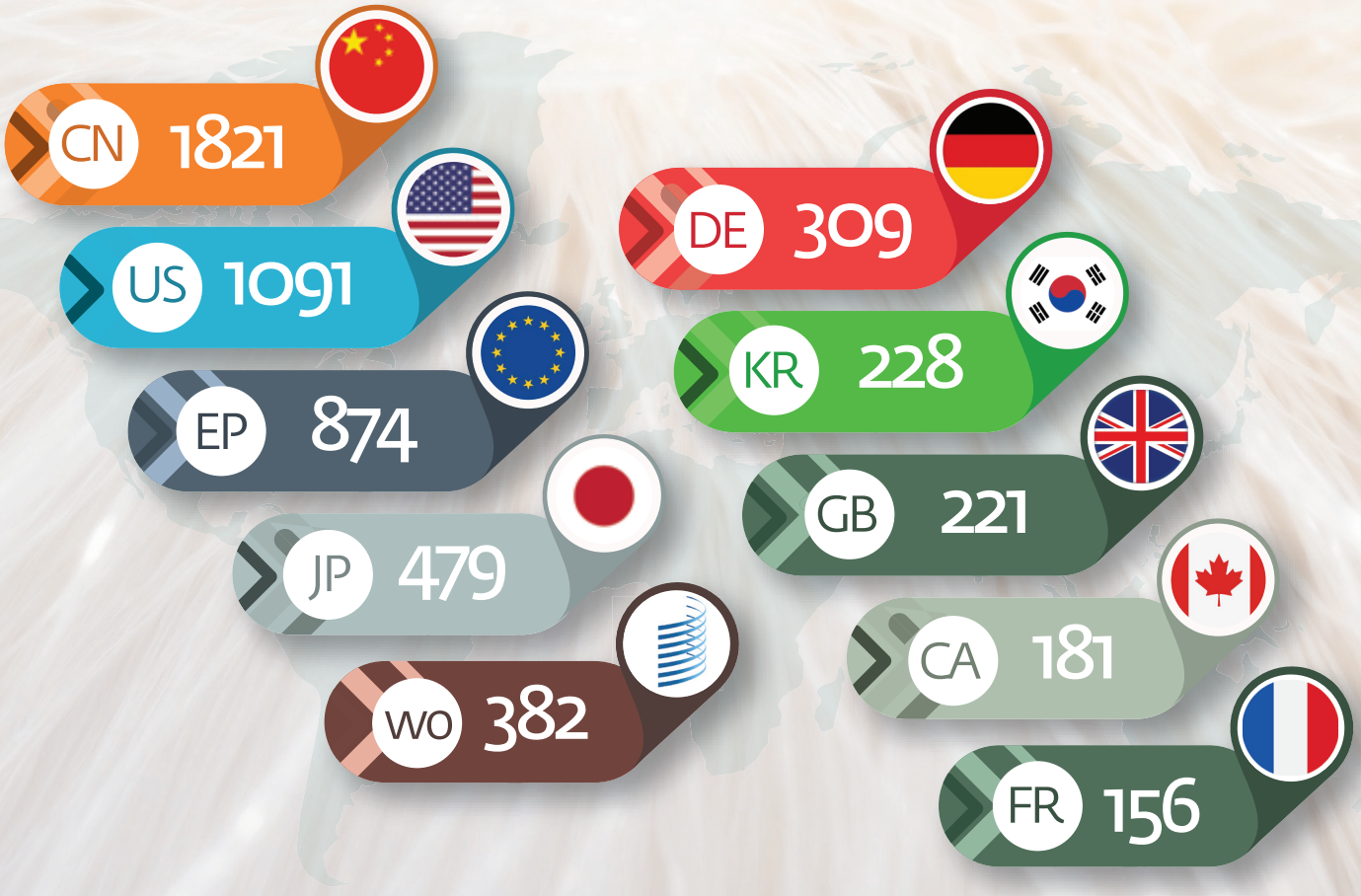
Software and Control Methods - Network optimization algorithms specific to HCF, Signal-processing techniques for HCF transmission, Predictive maintenance methods

Sensing Applications - Gas sensing within the hollow core, Environmental monitoring applications

PATENT STATISTICS



PATENT LANDSCAPE



Database: Questel Orbit
Data Range: 01/06/2021 - 01/06/2026

TOP APPLICANTS

120 ASML

76 YANGTZE OPTICAL FIBRE & CABLE

66 HALLIBURTON ENERGY SERVICES

56 FUJIFILM

43 BEIJING UNIVERSITY OF TECHNOLOGY

32 GUILIN UNIVERSITY OF ELECTRONIC TECHNOLOGY

31 MICROSOFT TECHNOLOGY LICENSING

30 CHINA MOBILE COMMUNICATIONS

28 SHANGHAI INSTITUTE OF OPTICS & FINE MECHANICS - CHINESE ACADEMY OF SCIENCES

27 CORNING

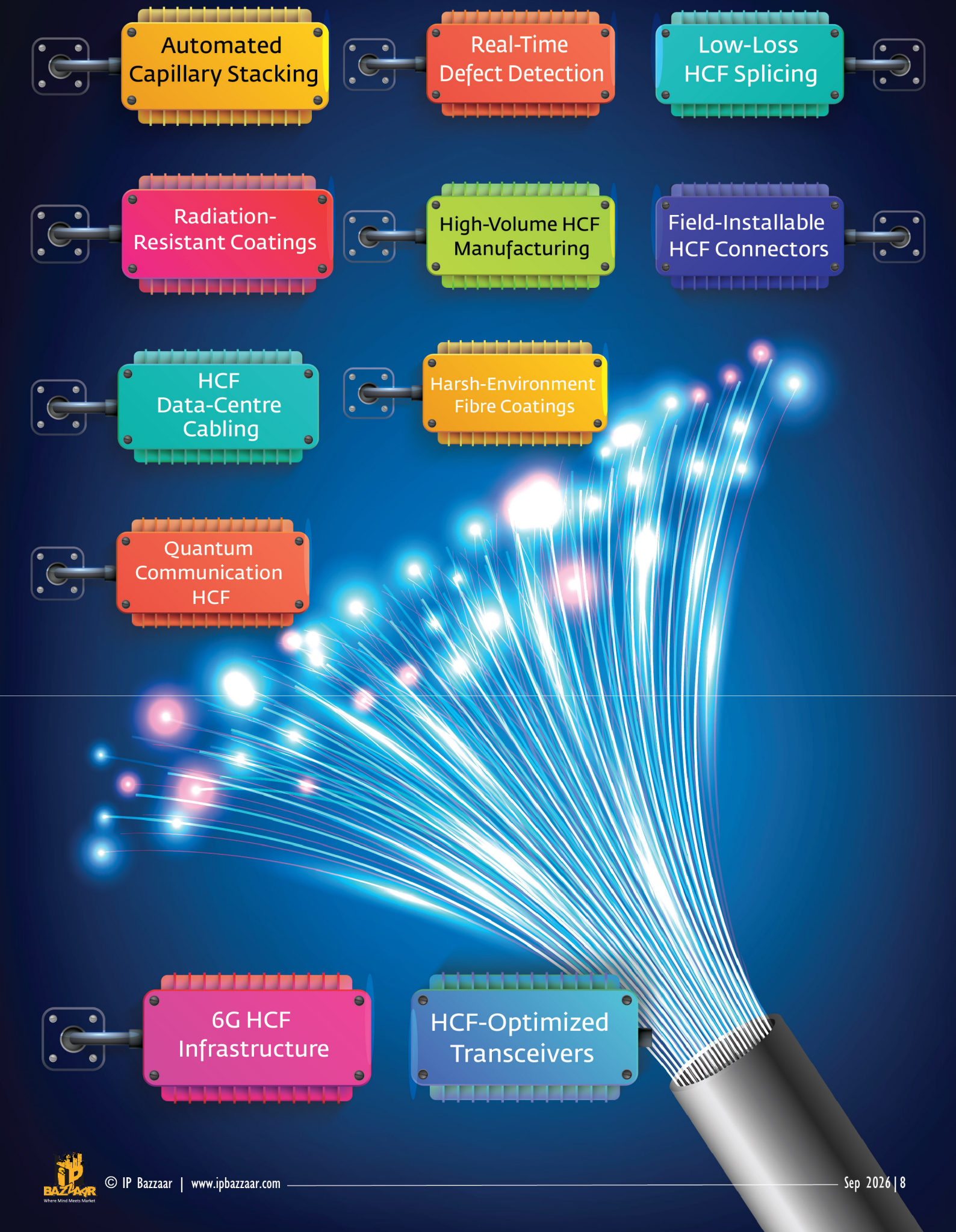
Database: Questel Orbit

Data Range: 01/06/2021 - 01/06/2026

NOTABLE INNOVATIONS

Patent Application	Priority date	Title	Assignee
US3095258	1962-06-22	Melt spinning process for producing hollow-core filament	DU PONT DE NEMOURS
US3538452	1965-04-12	Laser switching device	OPTICS TECHNOLOGY
GB1481455	1973-09-28	Fibre-optic devices	AMERICAN OPTICAL
US4764194	1986-06-19	Method of manufacturing hollow core optical fibers	3M FIBER OPTIC PRODUCTS
US5221308	1988-09-21	Low loss infrared transmitting hollow core optical fiber method of manufacture	3M
US6993230	2003-08-01	Hollow core photonic band gap infrared fibers	US NAVY
KR101299135	2011-08-18	Reflective probe type apparatus for detecting gas and method for detecting gas using optical fiber with hollow core	KOREA INSTITUTE OF SCIENCE & TECHNOLOGY
CN104181648 B	2014-07-07	Hollow-Core Photonic Crystal Fibers gas absorption cell and preparation method thereof	SHANGHAI INSTITUTE OF OPTICS & FINE MECHANICS - CHINESE ACADEMY OF SCIENCES
CN104181648 B	2015-12-23	Hollow core optical fiber and a laser system	NKT PHOTONICS
JP7485253 B1	2022-11-11	Hollow core fiber and method for producing hollow core fiber	SUMITOMO ELECTRIC INDUSTRIES

WHITESPACES



If you would like to learn more about any of these areas or have specific questions, we're here to provide further information and insights. Our team is dedicated to driving progress and staying at the forefront of Hollow Core Optical Fiber.

About IP Bazzaar

IP Bazzaar is an initiative towards successful commercialization of Intellectual Property Rights. IP Bazzaar is a private limited company, acts for both innovators/creators and investors; and manages the commercialisation of Intellectual Property. It operates through a wide network of association with companies, industries, industry-associations, entrepreneurs, government organization, NGOs, Universities, Venture Capitalists, overseas law firms, overseas technology transfer companies and through Patentwire.

Disclaimer

IP Bazzaar has used reasonable endeavours to ensure that contents of this report were correct at the time the relevant pages were created, modified and published. IP Bazzaar does not make any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the firms The views and opinions of authors expressed herein do not necessarily state or reflect those of the firm.

IP BAZZAAR®
Where Mind Meets Market

Contact us:

Lalit Ambastha
Co-Founder, IP Bazzaar
Mob: +91-9811367838
E-mail: lalit@ipbazzaar.com

Medha Kaushik
Director | Special Projects & Tech Transfer
Mob: +91-6359777555
E-mail: medha@ipbazzaar.com

IP BAZZAAR TECHNOLOGY CONSULTANTS PVT. LTD.

716, Seventh Floor, DLF Prime Towers,
Okhla Phase I, New Delhi-110020, India
www.ipbazzaar.com