THE BELL SYSTEM
TECHNICAL JOURNAL

DEVOTED TO THE SCIENTIFIC AND ENGINEERING
ASPECTS OF ELECTRICAL COMMUNICATION

Volume 51 | July-August 1972 | Number 6

Fifty Years of BSTJ

It is appropriate, on this fiftieth anniversary of the founding of BSTJ, to recall the genesis and purpose of the publication, as set forth in the Foreword to Vol. 1, No. 1, of July 1922 (see opposite page).

This perceptive and prophetic note by the founders of the BSTJ states clearly their conviction that the art of telecommunication would require the ever-increasing application of scientific knowledge and the scientific method, and that this effort would, in turn, expand the boundaries of human knowledge in many fields. The BSTJ was planned to make these advances available to the world, treating a range of subjects as broad as the "science and technique of electrical communication itself."

How well has BSTJ performed this function? How best to catch the excitement and import of the technical papers that span these fifty years? One approach is to select a few out of the many outstanding papers to illustrate the forward thrust of telecommunications over the period. (See foldout.)

The early days

From the beginning, BSTJ authors saw their primary goal as extending the depth of understanding, and particularly of *quantitative* understanding, of the science and technology involved – to lay a solid foundation for the ever-growing nationwide telecommunication network.

This quantitative base extended from Harvey Fletcher's paper on "The Nature of Speech and Its Interpretation" to articles such as George Campbell's "Physical Theory of the Electric Wave-Filter," Harry Nyquist's "Certain Factors Affecting Telegraph Speed," and Clinton Davisson's "The Discovery of Electron Waves." With a systems view the fundamentals of a network combining efficient transmission and switching were worked out. Using the understanding of telephony as a springboard, important contributions were made in a variety of related fields–movie-making, orthophonic recording, and television are examples.

In this era were laid the foundations for the great transmission advances: electric wave-filters, crystal filters and oscillators, Harold Black's epochal invention of stabilized feedback amplifiers, fundamental work on coaxial cable and waveguide systems, HF radio across oceans. All these were based on advances in understanding of the physics and mathematics involved. System applications were paced by the rapid sophistication of design of vacuum tubes. In the same period, panel and crossbar dial systems were developed to meet the needs for improved switching.

The middle period

The World War II years saw a great burst of application to military uses of the knowledge built up during the earlier period. Some of the basic electron tube and radio work reported in BSTJ in the late 30's paved the way for many of these advances. For example, this background made possible the development of the magnetron, newly invented in England, into a reliable generator of microwave pulses and a key to practical radar systems. "The Magnetron as a Generator of Centimeter Waves" by James Fisk, Homer Hagstrum, and Paul Hartman represents one important result of this work.

The mood of the post-World War II period was one of great confidence and expectation, fulfilled in a giant forward step – the discovery of the transistor. This was the key to unlocking the miracles of modern semiconductor electronics. Papers by William Shockley, John Bardeen, and Walter Brattain documented this advance. The transistor was destined to change radically all elements of the telephone network – transmission, switching, and customer systems. Outside the Bell System, it formed the cornerstone for a revolutionized electronics business and a huge new computer industry. Other major advances included Claude Shannon's "A Mathematical Theory of Communication," John Pierce's and Rudi Kompfner's traveling-wave tube work, Harald Friis' microwave antenna and repeater work, and Jack Morton's microwave triode.

The early 1950's saw also the beginning of the bold and massive effort to spread automatic switching throughout the nationwide network, as described in the paper "Automatic Switching for Nationwide Telephone Service" by A. B. Clark and Harold Osborne. And the modern approaches to materials science and engineering were firmly laid, leading to synthesis of a wide variety of new materials with properties especially tailored to meet communications needs – needs extending all the way from tough low-cost cable sheathing to exacting semiconductor properties.

In this period also was made the far-reaching decision that all new Members of Staff in the *development* areas at Bell Laboratories should receive advanced training beyond the Bachelors level. (This was already the practice in the research areas.) This trend shows in BSTJ papers in later years, with many very scholarly and fundamental papers written by members of the development staff. The prophetic words of the "Foreword" of 1922 were to come true with a completeness that might have surprised those early contributors.

Since 1955

The most recent decade and a half shows a continuing evolution in system complexity to meet the telecommunications needs of a population whose telephone usage reached 170 billion calls in 1971. We start this period with the transistor finding its first truly widespread application, and in its wake, a rapidly maturing technology in solid state electronics and an expanding computer capability built firmly on this technology. The mood is one of excitement that "almost anything" in the way of new systems concepts is technologically achievable. Contributing to this mood are the discovery of the traveling-wave maser and the laser, of hard superconductors, and the ever-increasing sophistication in the understanding and use of materials. Parallel advancements in computer science pave the way to rapid development of languages and software systems which spark an explosion of computer applications to design, simulation, control, and manufacture.

In this period of BSTJ history, individual papers shine as before, but our evolving network complexity is suggested in a new way by the increasing number of special "systems" issues. The *Telstar*® Experiment issue documents man's first big step into satellite communications. The issue on No. 1 ESS describes the revolution in switching systems. And the wide range of technology and systems work to achieve a brand new two-way switched audio-video service is reviewed in the *Picturephone*® System issue.

Looking ahead

We enter the 70's with new building blocks such as charge-coupled devices, magnetic bubbles, miniature solid-state lasers, and minicomputers becoming available, and this reinforces our confidence that almost any technical challenge can be met. Within the field of switching, the burgeoning use of stored program electronic systems continues to point the way to new services. In transmission there is a strong feeling that we are on the threshold of another giant step – one which may have almost as widespread an effect on how we carry future telecommunication signals as the transistor has had on today's transmission network. That step is the emergence of low-loss optical fibers as a practical medium for information transmission.

But we also enter the 70's with increased awareness that our new system choices must show substantial economic and service margins over existing systems if we are adequately to provide the new services that our advancing technological base promises. Topping past achievements is no small challenge, but the use of new technology to build on these accomplishments promises achievements yet unforeseen.

The sweeping observation of fifty years ago that "electrical communication touches upon almost every branch of science" seems equally applicable today. This observation also applies to the social sciences, as evidenced by increasing attention to the social impact of telecommunications and to the needs and aspirations of the individuals that comprise a large organization. Thus we can expect that in addition to continued "hard-science" advances in areas such as the basic understanding of materials, and of circuit, transmission, and switching theory, there will be increased contributions by BSTJ authors to solving relevant societal problems as well. A growing involvement in *operational* aspects of the nationwide network is one step in this direction.

As the BSTJ begins its second half-century one thing seems clear, even in this era of change. The flow of ideas, understanding, and concrete realization reported in its pages will continue to represent the main stream of progress foreshadowing the systems that will supply tomorrow's telecommunications demands efficiently, economically, and responsibly.