

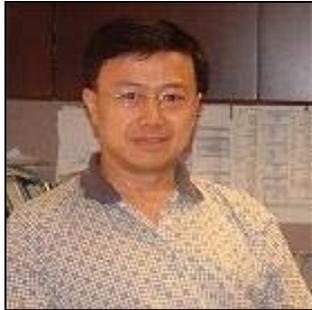


OHIO TRANSPORTATION CONSORTIUM



Annual Report 2008-2009

Director's Message



We are proud that the Ohio Transportation Consortium continued to achieve an impressive record of service during the 2008 operational year. In spite of the tough economic environment in which universities seek to cut budgets and limit activities, The University of Akron and other participating universities of OTC have exceeded the Consortium's goal in its education and research programs.

The Consortium continued to attract students into the field of transportation. Throughout the OTC universities, three new courses were added, students continued to be involved in projects as undergraduate and graduate assistants in research activities, and high school students were introduced to the study of transportation. In 2008, OTC continued to support the participating universities in transportation research, teaching, and outreach. In the most recent round of project solicitation, the Center selected to fund six research and education initiatives in safety and mobility, pavement, traffic impact, and student training. The list of projects demonstrates the diverse expertise in the Consortium in several forefronts of transportation research.

A handwritten signature in black ink, appearing to read 'Ping Yi', written in a cursive style.

Ping Yi
Director, OTC

Board of Directors

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Director, OTC
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Professor, Water Resources
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OTC Annual Report 2008-2009

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About the OTC

The Ohio Transportation Consortium (OTC) was established in 2006 as a Tier II University Transportation Center comprised of eight partner universities throughout the state of Ohio. The University of Akron is the lead institution for the OTC with partner universities including Case Western Reserve University, Central State University, Kent State University, Ohio University, The Ohio State University, University of Cincinnati and University of Dayton. All OTC member universities and their faculty and students are encouraged to take part in OTC activities and all initiatives in research, education, and technology transfer. The OTC has established legal and contract guidelines for research and education program partnerships as well as subcontracting of project awards with participating universities in coordination with the Office of Research and Development at The University of Akron.

The theme for the OTC is *Transportation Mobility and Infrastructure Management*. This theme addresses the challenges facing the transportation systems in Ohio while allowing the Center to draw on the many strengths of its partner universities. The research and education concentrations of OTC partner universities encompass a vast spectrum of expertise including but not limited to: traffic detection and surveillance systems, data mining and fusion; adaptive traffic signals and optimization; location based information system; parking management and traffic calming; crash data analysis; work zone planning and safety; environmental impacts of transportation systems; geotechnical assets and risk management; pavement and highway materials and design, pavement monitoring; monitoring and rehabilitation of bridge systems, nondestructive testing of bridge systems and performance evaluations.

Dr. Ping Yi serves as the OTC Director and is responsible for implementing the Center's Strategic Plan, ensuring compliance with all UTC program requirements, serving as liaison with USDOT, sponsors and other groups and convening technical and managerial meetings as well as attending UTC business meetings and annual meetings as required by USDOT RITA. As Chief Executive Officer, he is also responsible for conducting all programs, managing the Center's funds



and personnel, keeping records of all activities and action, providing administrative management of all projects, setting agendas for all meetings, ensuring budget compliance, developing new initiatives and public presentation of the Center's business and accomplishments, and assuring day to day operations and compliance with the collective requirements of USDOT RITA and other co-sponsors to research activities. In addition to the Center Director, each member university provides a representative to sit on the Board of Directors. The Board of Directors is responsible for monitoring implementation strategies, collaborating with other centers in the region, and performing various planning and administrative functions.

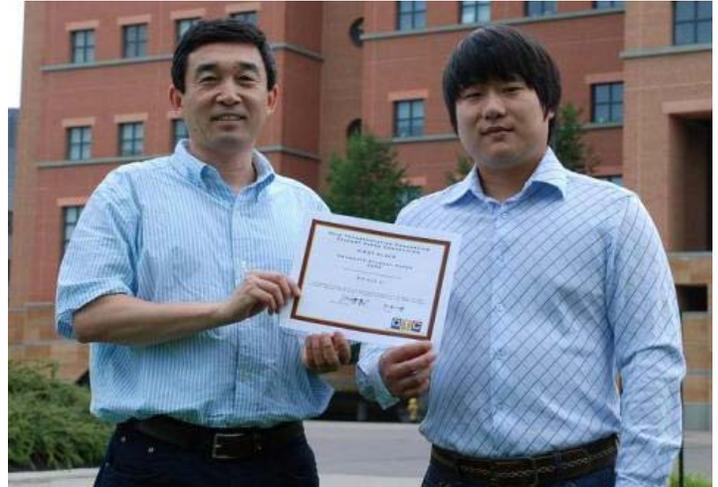
The OTC's Grant and Budget Manager, Cynthia Boll, coordinates grants management with The University of Akron's Office of Research and Development and Office of Controllers. She also serves as the point of contact for external coordination with the diversity of participating universities for funds awarded either directly or as subcontracts from the lead university. Ms. Boll assists the Director in financial dealings, coordinates all bookkeeping, ensures that budget reports and budget projections are updated to maintain long-term financial sustainability of the Center, and ensures that budget management at the Center is consistent with budget reporting at all participating universities.

The Program Assistant, Angela Brodie, aids the Director in activity planning and management and provides general support to all aspects of the Center including daily operations. She initiates and coordinates activities to ensure Center newsletters, webpage, on-site conferences and meetings, outreach events, and other programs are professionally prepared and conducted. She is responsible for submitting all federal reporting materials in a timely manner and updating the Transportation Research Board's Research in Progress website with details regarding all OTC-funded research projects.

Student Paper Competition



Undergraduate Student Paper Competition Winner Jingsi Lang (right) shown pictured with her advisor Dr. Bill Yu.



Graduate Student Paper Competition winner Zhixia Li (right) shown pictured with his advisor Dr. Heng Wei.

The OTC sponsored the first-annual *Student Paper Competition* this past year with excellent results. The competition was divided into two categories, undergraduate and graduate, and competition winners were awarded \$300, a certificate, their abstract in the OTC newsletter, and a link to the complete paper on the OTC website. Many students from OTC participating universities submitted papers in a variety of disciplines, showcasing the many strengths of the OTC membership. Contest winners were Jingsi Lang and Zhixia Li.

Ms. Lang's paper, "Experimental Study on the Use of Lime Sludge for Construction: An Example for Sustainability", was chosen as the winning undergraduate paper. Ms. Lang is a senior undergraduate student in the Department of Civil Engineering at Case Western Reserve University and is advised by Dr. Bill Yu. She was involved in the Case Support of Undergraduate Research & Creative Endeavors Program and has done research with Department Professor Dr. Bill Yu on the topic of Beneficial Use of Lime Sludge during the summer of 2008.

Zhixia Li, a PhD student in Transportation Engineering in the Department of Civil and Environmental Engineering at the University of Cincinnati (UC), won the graduate paper competition with his paper titled, "Modeling Dynamic Dilemma Zones and its Applications". Mr. Li joined UC in January 2007 and is under the advisement of Dr. Heng Wei. His research interests include traffic operations

and control, intelligent transportation systems, and geographic information system applications in transportation. Prior to joining UC, Mr. Li was an ITS software engineer in the R&D department, Shanghai Baosight Software Co., Ltd. in China. He received a B.E. degree in Electrical Engineering from Sun Yat-Sen University, China in June 2003. In addition, he holds two patents in China and is currently a student member of ITE and NACOTA.

Summer Transportation Institute (STI)

STI is an on-going summer program at Central State University for area high school students interested in careers related to transportation. The OTC-funded GPS and Smart Board curriculum enhancements have been incorporated into the instruction over the last two years with great success. Sixty high school students (grades 9-11) have participated in the program over the last two years, which also incorporates funding and participation from the Federal Highway Administration, Ohio Department of Transportation, and other agencies.



Students use GPS units to locate “hidden” treasures.

New Transportation-related Courses at OTC Universities

- Geography of Urban Transportation, Kent State University
 - Transportation Engineering, University of Cincinnati
 - Highway Safety, University of Cincinnati
 - Traffic Signal System Design, Ohio University
-

International CUTC

Dr. Ping Yi, the OTC Director, visited a number of universities in China during the summer of 2009 to promote the international CUTC initiative proposed by CUTC in recent years. The initiative undertakes CUTC's mission to promote communication and information exchange among different universities; it also encourages collaborations between international universities and American universities on transportation education and research. Several Chinese universities want to know more about the history, development and function of CUTC, and have expressed interest in becoming international members of CUTC.

International Conference

Dr. Yi served as conference co-chair of an international transportation conference in Harbin, China in July of 2009. The conference was co-sponsored by a number of organizations including ASCE, and has attracted over 400 transportation professionals from other parts of China. The conference featured speakers from several countries, covering many topics including Transportation Safety, Transportation Planning, Emergency Response Systems and Technologies, Intelligent Transportation Systems, Energy Saving and Alternative Energy, Automotive Exhaust Treatment and Environment Protection Technologies, New Technology on Transportation Infrastructure, Highway Maintenance and Management, Transportation Management, Economics and Policy, Logistics Engineering, Vehicle Operations, Rail and Transit Systems.

Ohio Section ITE & Lake Erie Chapter Meeting

The second-annual OTC co-sponsored joint meeting of the Ohio Section ITE & Lake Erie Chapter was held at The University of Akron's Martin Center in April. Three UA graduate students presented their recent research to the group of area engineering professionals. This experience allowed the students to interact with transportation professionals and gain their unique insight into the adeptness of their research while allowing the professionals an the opportunity to learn more about some of the cutting-edge research performed at the University.

Venkata Suresh Raavi and Boaji Wang presented the topic, "A Novel Approach to Dilemma Zone Problem for High Speed Signalized Intersections". Challenges for traffic engineers rise as safety and efficiency continue to be major concerns on the roadways. Mr. Raavi and Mr. Wang explained how their Intelligent Signal Control System (ISCS), which was developed in UA's Transportation Lab based on the concept of IntelliDrive technology, operates more safely and efficiently due to the proposed algorithm logic that utilizes IntelliDrive technology. Next, Chun Shao presented "On-line Application of Genetic Algorithm in Traffic Network Optimization" addressing the

ever-increasing challenge of traffic congestion. As traffic congestion increases in urban areas, low cost operational treatment providing more efficient traffic operation becomes an attractive approach. Recent improvements in computation power have enabled the application of advanced algorithms in on-line traffic signal control. As a result, GABNOR utilizing Genetic Algorithm was proposed for traffic network optimization in real-time. The competitiveness of this utility when compared to other programs as well as future works to further examine and improve the performance of GABNOR were discussed. The evening ended with key-note speaker Jason Segedy, Director of the Akron Metropolitan Area Transportation Study (AMATS). Mr. Segedy discussed current trends and the challenges facing transportation professionals as well as necessary changes in the future. He stressed the need for improved planning and increased numbers of cooperative projects among communities and organizations. Serving sprawling and dispersed developments is a continuing problem in Northeast Ohio as more and more families are moving to the suburbs and rural areas. Larger lots and scattered developments are becoming the norm. These low-density developments strain infrastructure and community services and must be addressed. Improved land usage would not only improve pedestrian traffic, but it would also reduce trip length, conserve energy, improve aesthetic quality and promote transit. A need for cooperation among local and state government officials, community members and leaders, and area professionals in order to adequately address these issues was discussed.



ASCE Meeting

Over one hundred area professional engineers, engineering students and professors attended the December ASCE meeting highlighted by featured speaker Bradford Beckert, Senior Project Manager for the City of Akron. Mr. Beckert discussed the Goodyear Riverwalk Project in Akron, Ohio, an ambitious project totaling \$900 million in combined private and public funds. As with many major urban construction projects, the Riverwalk project will involve some infrastructure restructuring. The project has approximately \$45 million budgeted for roads, bridges and utilities. Many of these funds have been raised through grants such as the 629 Road Development and funding from the Ohio Department of Transportation. The ASCE meeting provided an excellent opportunity to not only learn valuable information, but also to network with local professionals, educators, and students.

Research

Five new research initiatives were selected for funding by the OTC in Spring of 2009 involving seven of the eight OTC partner universities. The following list demonstrates the broad range of subject areas addressed by the consortium member universities and their researchers.

On-Road Mobile Source Pollutant Emissions: Identifying Hotspots and Ranking Roads

PI: Dr. Ramanitharan Kandiah, Central State University

A considerable amount of pollution to the air in the forms of Hydrocarbons, Carbon Monoxide, nitrogen oxides, particulate matter and air toxics comes from on-road mobile sources. Estimation of the emissions of these pollutants and quantification of the pollutants released are the most important initial steps in the process of controlling air pollution. Dr. Kandiah is conducting a study proposing a methodology (1) to account the On-Road Mobile Source Air Pollutant (ORMSAP) emission, (2) to identify and delineate ORMSAP hotspots, (3) to rank the roads based on the presence of ORMSAP, and (4) to estimate the portion that MSAP contribute to the total air quality. This methodology will be applied to a case study in the Miami Valley Region of Ohio to the historic air quality and ORMSAP data available in the literature and to the data that will be collected by the researchers during the project. The objective is to develop a methodology for identifying similar ORMSAP clusters and pollutant hotspots in a transportation network using a combination of deterministic and data driven mathematical models.

Determination of Traffic Control Device Selection for Nighttime Maintenance of Traffic

PI: Dr. Deborah McAvoy, Ohio University

In order to guide motorists through work zones in a safe, efficient and smooth manner, various traffic control devices, such as drums with alternating orange and white retro-reflective stripes, are used as traffic control devices to channelize traffic through the work zone. The retro-reflective stripes make these drums highly visible, even during the nighttime. Currently, there are three types of retro-reflective strips utilized on these drums, however, a new full cube dia-



mond-grade sheeting (DG 3) has been introduced that can reflect 60 percent more light back to vehicles than the traditional diamond-grade sheeting at nearly five times the cost of engineer-grade sheeting. Some concerns that the retro-reflectivity of the diamond-grade sheeting may reflect too much light from vehicles' headlights back to drivers, potentially causing glare and limiting the ability of drivers to continue safely along their travel path have been raised. Dr. McAvoy is leading a project

to evaluate the effectiveness of drums with DG 3 sheeting as compared to drums with D30 diamond-grade sheeting in work zones with regard to delineation and safety. An economic analysis will be completed comparing the cost effectiveness of both types of sheeting in work zones for various types of highway work zone situations and weather conditions.

Linking Sustainable Transportation in a University Community

PI: Dr. Dave Kaplan, Kent State University

Within the past several years, there has been a growing realization that economic, public health, and environmental concerns must be addressed in sustainable fashion if communities are to grow and succeed. Sustainable transportation seeks to enhance mobility in support of economic development, while at the same time promoting a healthier environment, a healthier community and healthier behaviors. Dr. Kaplan is continuing his research in the area of sustainable transportation at Kent State University and the City of Kent with a project focusing on the factors that can facilitate the development of sustainable transportation networks in and around campus communities. Existing infrastructure and community attitudes will be explored to determine potential actions to increase the share of people who undertake trips by foot, bicycle or bus. Improvements in this area should aid in the overall economic development of Kent and its connection to the university.



Developing an Economical and Reliable Test for Measuring the Resilient Modulus and Poisson's Ratio of Subgrade

PI: Dr. Xiangwu (David) Zeng, Case Western Reserve University (CWRU)

The resilient modulus and Poisson's ratio of base and sublayers are important parameters in the design and construction quality control of highway pavements. There is an urgent need to develop an economical and reliable test that can measure the resilient modulus and Poisson's ratio of compacted soils in the foundation of pavements. As a result, a new laboratory testing technique has been developed in the geotechnical laboratory of CWRU to measure these characteristics using piezoelectric sensors. The technique has been proven to produce reliable results. Dr. Zeng is leading a project that will develop and verify a low cost test based on this technique, lending the way for private commercial production of the testing units. This could have a significant economic impact on the costs of determining resilient modulus and improving design of highway pavements.

Research (continued)

Optimal Loop Placement and Models for Increasing Accuracy of Length-based Vehicle Classification and Stop-and-go Traffic in Ohio

PI: Dr. Heng Wei, University of Cincinnati

CoPIs: Dr. Ping Yi, The University of Akron and Dr. Deogratias Eustace, University of Dayton

Dual-loop detectors have been widely used for traffic monitoring and vehicle classifications. Traffic volume, speed, occupancy, and vehicle lengths can be extracted from dual-loop detectors' data. That makes possible for dual-loop detectors to be a real-time data source for vehicle classifications, travel demand model calibration, and traffic related air pollution impact studies. However, there are still some existing problems or uncertainties in the loop data applications: (1) most existing loop models have been proved to be valid under light traffic but it is not very clear about the accuracy of these models under congested traffic, especially under stop-and-go condition; and (2) usually a network cannot be monitored totally and interpolated data will be applied for blank areas. Optimal loop location solutions are still unclear.

In this project, loop models for length-based vehicle classification under stop-and-go conditions, and standards for optimal loop installations and locations for reliable traffic measurements from loops will be developed. In order to fulfill this goal, the following objectives need to be completed: (1) collecting video ground-

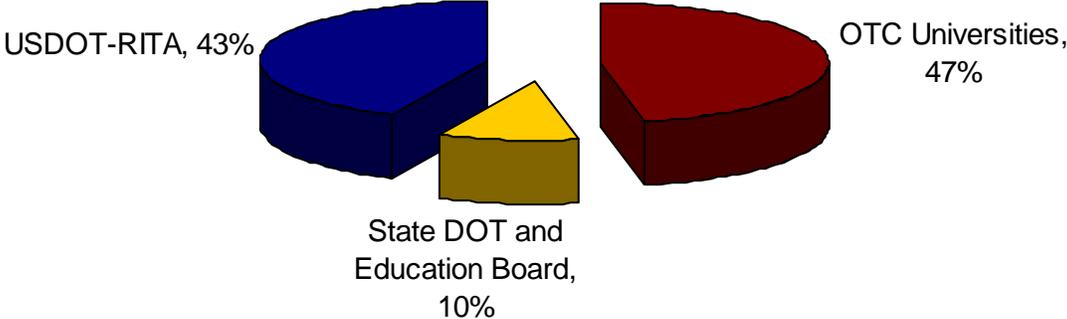


truth event data using VEVID at several loop stations in Columbus, Ohio (Figure 1) to identify error causes for estimating vehicle classifications by loop data; and (2) evaluating the existing standards in other states to develop standards in Ohio and methods for loop placement.

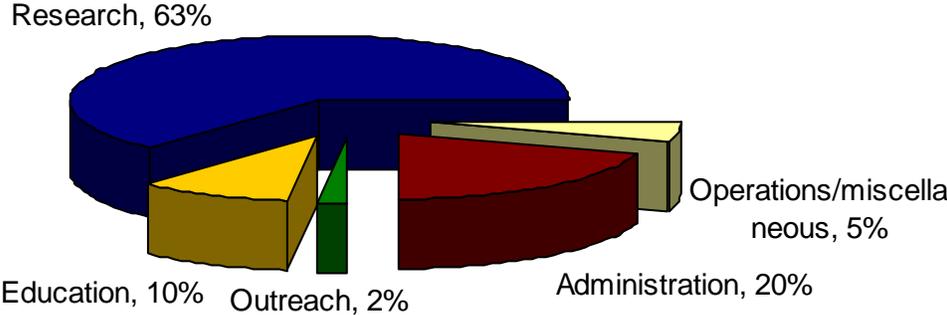
Figure 1. Loop Station V1002 in Columbus, Ohio

Financial Report

Funding Sources



Expenditures



Outstanding Accomplishments

National-level presentations

Eustace, D., "Incorporating Problem-Based Learning and Cooperative Learning Components in an Undergraduate Transportation Engineering Course" presented at the Transportation Engineering Education Conference, Portland, OR, June, 2009.

Eustace, D. and Wei, H., "The Role of Driver Age and Gender in Motor Vehicle Fatal Crashes." presented at the 88th TRB Annual Meeting, Washington, D.C., January, 2009.

Kaplan, David, "Making Sustainable Transportation Work" presented at the Association of American Geographers Meeting, Las Vegas, NV, March, 2009.

Kaplan, David, "Getting Around Campus in a Sustainable Way: How Can We Change Travel Behavior?", presented at the Association of American Geographers Meeting, Las Vegas, NV, March 2009.

Li, Z., and Wei, H., "Modeling Characteristics of Dilemma Zones using Vehicle Trajectory," presented at the 12th Annual NACOTA/WCTA Technical Symposium on Sustainable Transportation Development in China, Washington, D.C., January, 2009.

Nichols, D. Bullock, W. Schneider IV, "Detecting Differential Drift in Weigh-in-Motion Sensors." Presented at the 88th *Transportation Research Record*.

Wei, Heng, "Safety Factors Involved in Signal Dilemma Zone Problem" presented at the Civil and Environmental Engineering Graduate Seminar, University of Cincinnati, Cincinnati, OH, April, 2009.

W. Schneider IV, P. Savolainen, K. Zimmerman "An Examination of Driver Injury Severity Resulting from Single-Vehicle Crashes Along Horizontal Curves on Rural Two-Lane Highways." Presented at the 88th *Transportation Research Record*.

Yi, Ping, "IntelliDrive for Enhanced Control of Traffic Network", NACOTA-ASCE International Conference, 2009

Yi, Ping, "Peak Flow Factor Characteristics at Isolated Intersections", TRB Annual Conference, 2008.

Yi, Ping, "Flexible Detectors to Enhance High-Speed Intersection Safety Through SIL Design", NACOTA-ASCE International Conference, 2008.

Publications

Research Papers

Eustace, D., Griffin, V., and Hovey, P. (2009) "Analyzing the Effects of L.E.D. Traffic Signals on Urban Intersection Safety." Paper accepted for publication by the Institute of Transportation Engineers' ITE Journal.



Eustace, D., Indupuru, V.K., and Owusu-Ansah, S. (2009) “An Exploratory Survey of Drivers’ Knowledge of Right-of-Way at Freeway On-ramp Merging Area.” Paper accepted for publication by the Institute of Transportation Engineers’ ITE Journal.

Li, Z. (2009). “Modeling Dynamic Dilemma Zones and its Applications.” Daniel B. Fambro Student Paper Award of the Institute of Transportation Engineers (ITE), August 2009.

Li, Z. (2009). “Modeling Dynamic Dilemma Zones and its Applications.” 1st place of the Institute of Transportation Engineers (ITE) Lakes District Student Paper Competition, June 2009.

Li, Z. (2009) “Modeling Dynamic Dilemma Zones using Observed Yellow-Onset Trajectories.” Ohio Transportation Consortium (OTC) Graduate Student Paper Competition Winner, June 2009.

Wei, H. and Li, Z. (2009) “Dilemma Zone Modeling Using Yellow-Onset Vehicular Trajectory Data” *ASCE Proceedings of 9th International Conference of Chinese Transportation Professional (ITCCP)*, Harbin, China. August 5-9, 2009.

Ping Yi, et al., “Investigating the Effect of Detector Spacing on Midpoint Based Travel Time Estimation”. Accepted for publication in the *Journal of Intelligent Transportation Systems*, 2009

Ping Yi, et al., "Investigation and Description of Short-Term Peak-Flow Variations: Preliminary Field Study", Accepted for publication in TRR, in press, 2009

Ping Yi, et al., "Consistency of Input-Output Model and Shockwave Analysis in Queue and Delay Estimation", *Journal of Transportation Systems Engineering and Information Technology*, Vol. 8, 2008

Zheng, J.Y, Ma, X.L. Yi, Ping, “Measuring Signal Light Intersection Performance in Real Time with Traffic Sensors”, TRB Annual Conference CD ROM, 2009

Project Reports

Eustace, Deogratias (2008) “Development of a Problem-Based Learning (PBL) and Cooperative Learning (CL) Transportation Engineering Course for Undergraduate Students” .

Jennings, Aaron A. (2008) “Undergraduate Research Internships to Support Exploratory Research in Transportation Engineering” .

Kaplan, David H. (2008) “Kent State University’s Sustainable Transportation Initiative” .

McCord, Mark and Mishalani, Rabi (2008) “Planning for Multi-University Educational Activities Based on OSU’s Smart Bus Campus Transit Laboratory”.

Sritharan, Subramania and Kandiah, Ramanitharan (2008) “Thematic Enhancements for the Summer Transportation Institute” .

Wei, Heng (2008) “Characterize Dynamic Dilemma Zone and Minimize its Effect at Signalized Intersections” .



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