China Telecom (CT) “Share your Incident” + AI-based Network Operation

Chongfeng Xie, Qiong Sun
China Telecom

NMOP@IETF124, Montreal
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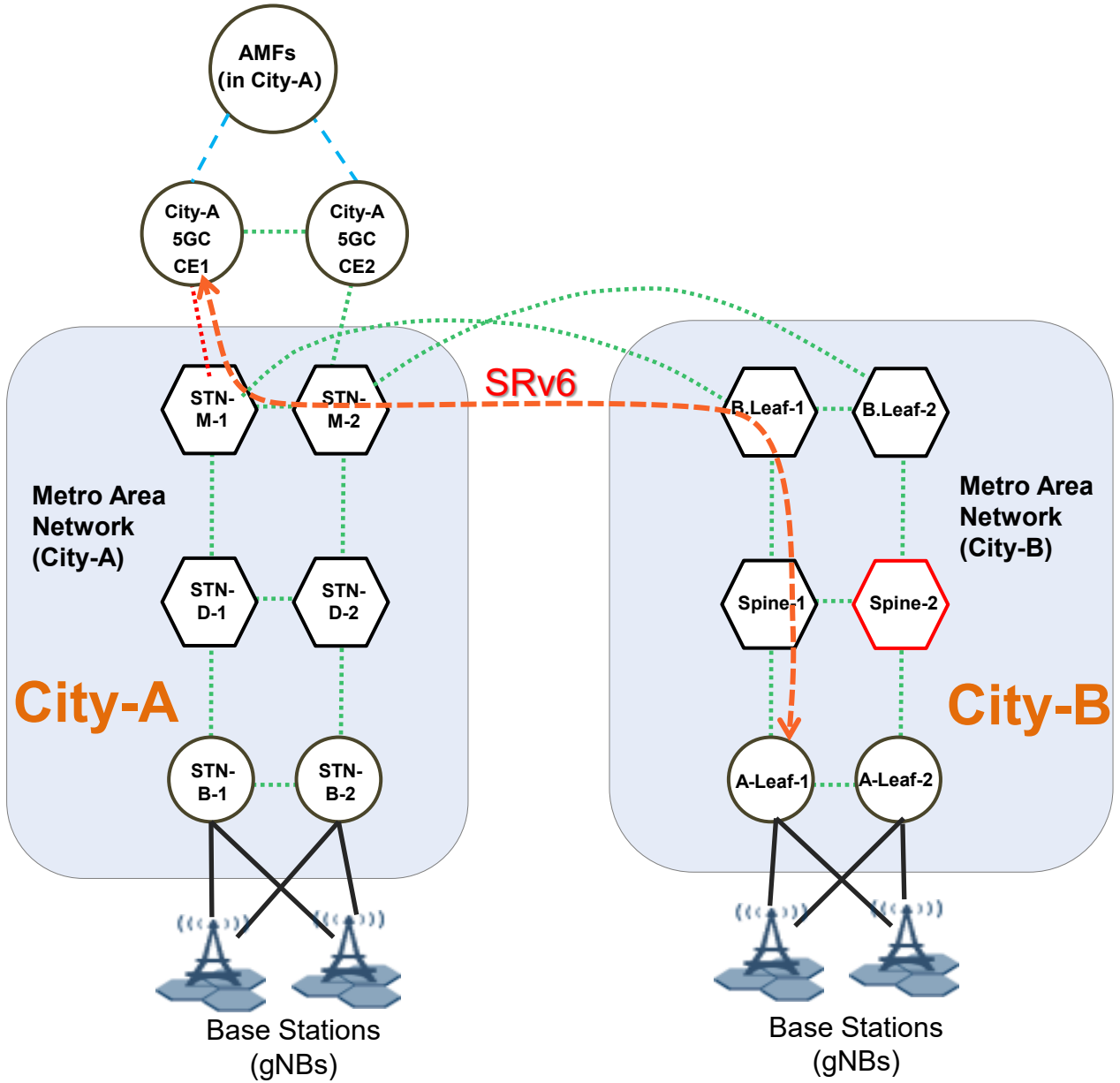
China Telecom Overview

- **Position**: A state-owned operator and a Fortune Global 500 company.
- **User Base: 425 million** mobile users & **197 million** wireline broadband users.
- **Core Technical Strategy:** Pioneering Cloud-Network Convergence, powered by an advanced Cloud-Network Operation System.
- **Services:** A full spectrum including wireline broadband, mobile, voice, leased-line/VPN, IPTV, cloud, IOT, AI, and ICT.
- **Global Reach:** Operations spread across more than 25 countries and regions.

CT's Network Architecture (5G+Metro)



- The 5GC is centrally deployed on a provincial basis across two cities for mutual backup, with all gNBs connected to the 5GC network.
- NG Interface: Control signaling, managing user access, mobility, and sessions, transmitting user surfing data.
- NG data transmission is carried by the SRv6 capabilities of Metro Area Networks(MANs).

5G NG Disconnection Alarm Incident: Postmortem

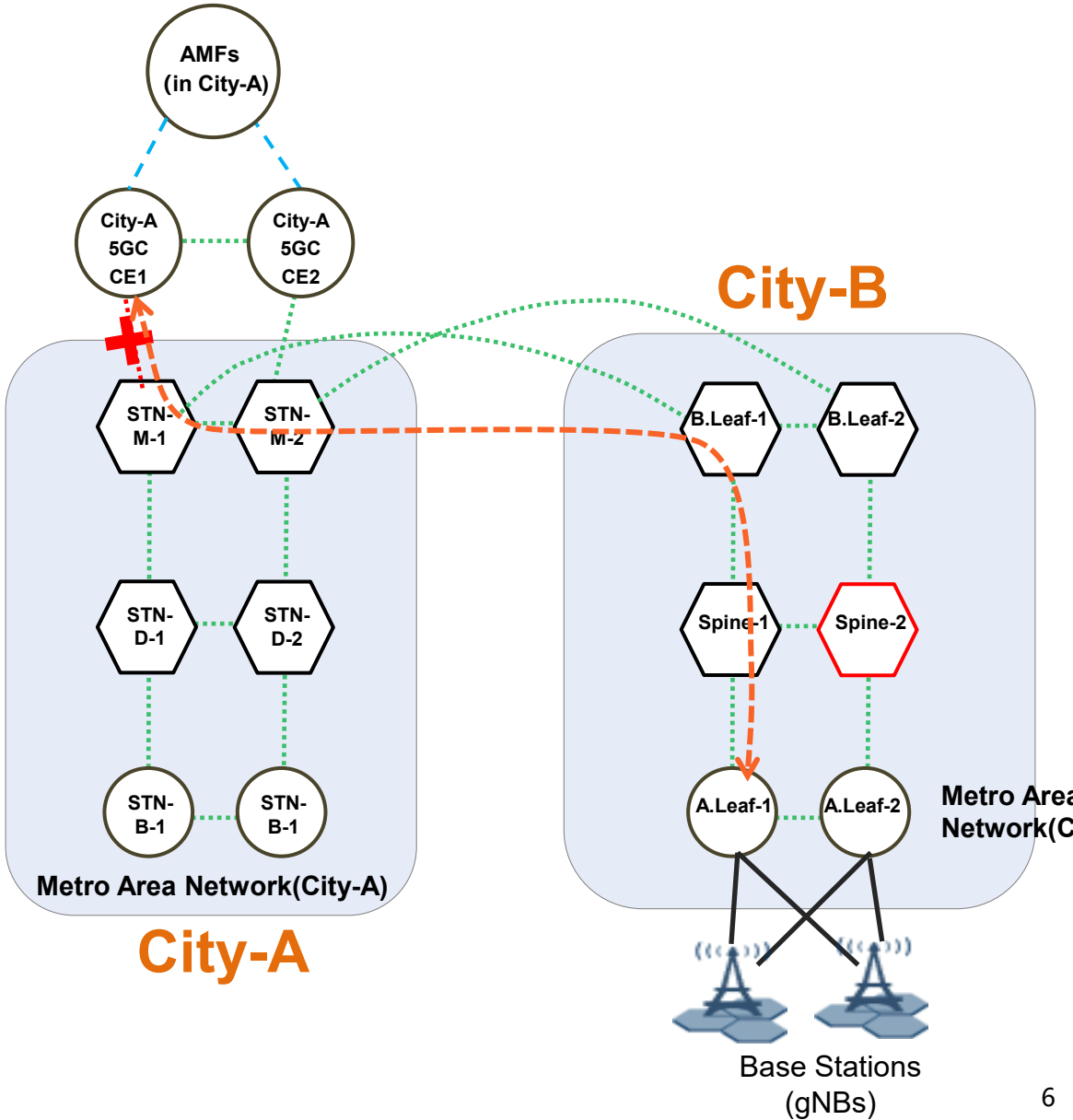
Time	Progress
11:00 AM on Sept. 10	Some base stations reported the NG disconnection alarm, they failed to setup links with 3 AMFs of the 5GC in City-A.
12:00 AM on Sept. 10	O&M conducted packet capture analysis on the 5GC and found that the SCTP connection handshake between the base stations and City-A AMF failed (AMFs received the base station’ s INI packet and responded with an ACK, but did not receive subsequent link setup messages from the base stations).
2:00 PM on Sept. 10	**O&M speculated that the fault is related to 5GC CE link.** (The first alarming time was 0:16 AM, which basically matched the time of 0:15 when the link between City-A network router to 5GC CE was expanded)
3:00 PM on Sept. 10	The transmission team checked the wavelength division side of the link and found that the status was normal. Lab tests with tester were conducted as well.
3:30 PM on Sept. 10	During the transmission test of the link being disconnected, the alarm gradually recovered until it was completely cleared after the link was disconnected
1:10 AM on Sept. 11	The link was restored and the fault did not reoccur.

Troubleshooting and Root Cause Discovery

- The operation team conducted checks on the underlay data network and mobile core network simultaneously, performing PING tests on the addresses of faulty base stations and 3 AMFs, **but found no packet loss**.
- By packets capture on the downstream side, it was found that the source IP address of the SRv6-BE packets sent by CE1 is **unknown address** (all 0s).
- After performing interface shutdown/no shutdown or fiber unplugging operations to cause the interface to become down/up, the source IP address of SRv6 BE encapsulation restored **Normal**.

Root Causes Identified

- **Software bug of CE router**
  - During the capacity expansion, the operation team corrected a misconfigured IPv6 address on the vei9 interface of CE1, this operation triggered the deletion of the IP source address in the underlying ifte table, resulted in the SRv6-BE source IP being **unknown address.**
- **Spine router not reporting this packet discard**
  - When performing source address verification, the Spine (M.Spine1, M.Spine2, Spine1) routers(vendor-B) in City-B discarded SRv6 packets with unknow source addresses.



Tracks for Resolution

- **IPFIX Forwarding Status**
  - Note: if the discarded packet is actually reported. To be tested
- **Information and Data Models for Packet Discard Reporting (**draft-ietf-opsawg-discardmodel-09) and its companion **Information Element for Flow Discard Classification (**draft-evans-opsawg-ipfix-discard-class-ie-01)

AI Empowers Fault Diagnosis and Handling

Pain points and challenges

- In cases of involving cross-disciplinary networks, high complexity results in manual localization taking long time.
- Under complex scenarios, trouble shooting requires on-site manual formulation, which highly relies on human expertise and experience.
- The automation level of fault handling is low.
- Verification after fault handling is a time-consuming manual process(Query and Analysis).

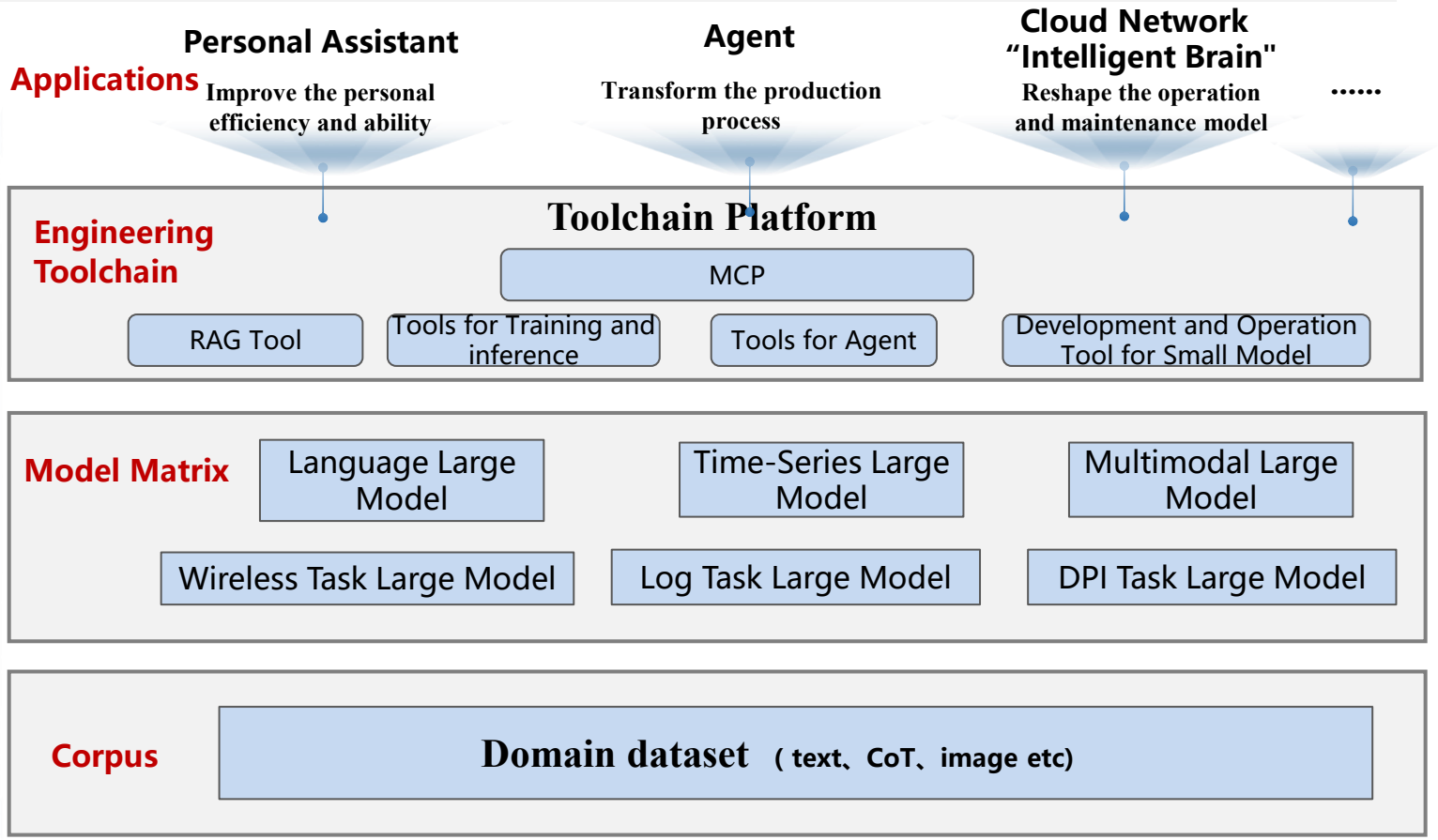
AI-empowered capabilities

- Automatically task tickets assigning based on the intent of NOC.
- Intelligent root cause localization.
- Generating troubleshooting plans and related instructions, recommending resolutions.
- Leveraging AI for expert orchestration and human-machine interaction, enables the automatic execution of task reassignment and suspension.
- Automated verification of fault recovery by querying network and perception metrics through LLM-orchestrated interface calls.

CT's AIOPS Architecture

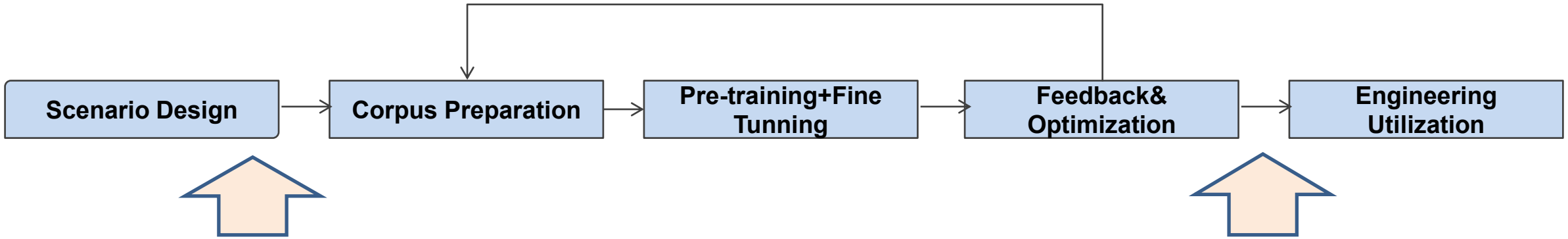
- Built upon open-source general large models, the Network Large Model is a domain-specific large model designed for the autonomous cloud-network operation.
- It covers 5 network scenarios: Network planning, Construction, Maintenance, Optimization, Operation.

- **Corpus.** Data collection and processing, data augmentation, dataset quality Evaluation
- **Model Matrix.** LLM, Time-Series Large Model, Multimodal Large Model, Model Distillation and Inference Optimization.
- **Full-Process Toolchain.** Platform tailored for network scenarios, Model training and inference, Intelligent orchestration and collaboration



The Lifecycle of Network Large Model Development

Break through the entire process from scenario design to engineering utilization.

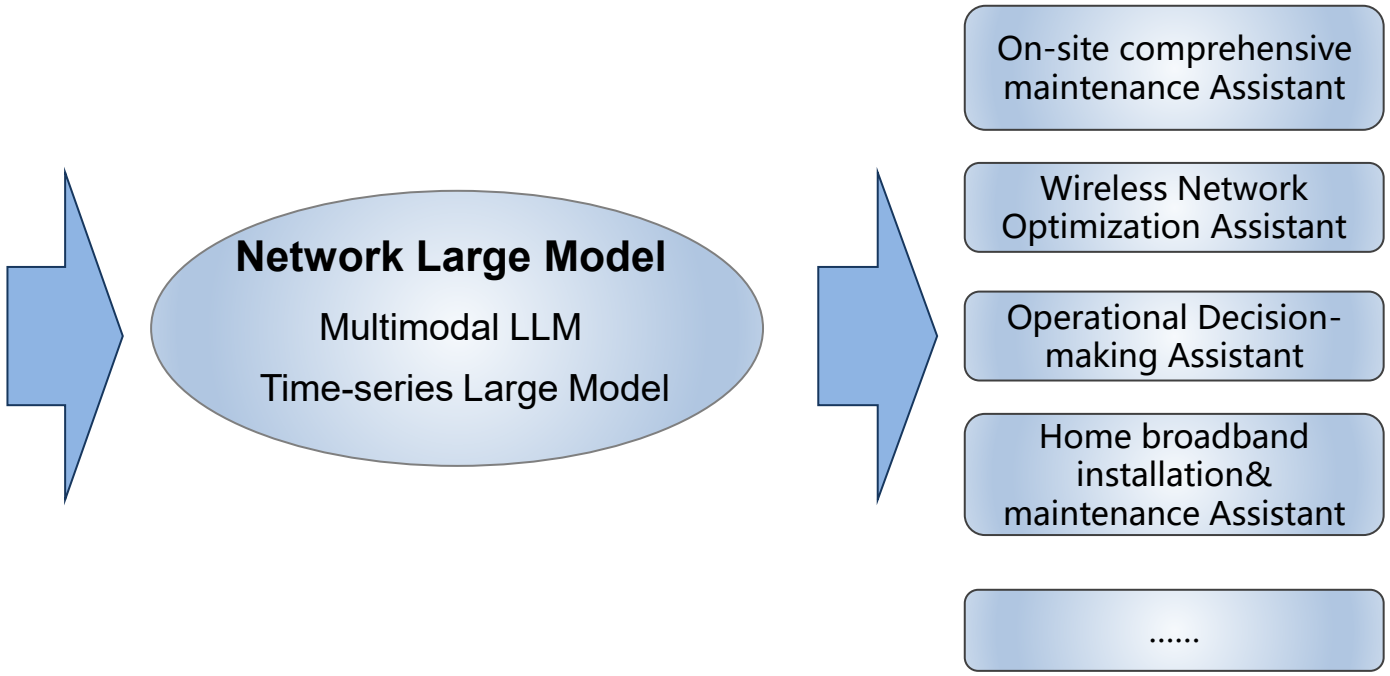


Not only algorithms are needed, but also data processing, optimization of software and hardware deployment, model development, and engineering application etc.

High Quality Corpus is the Foundation

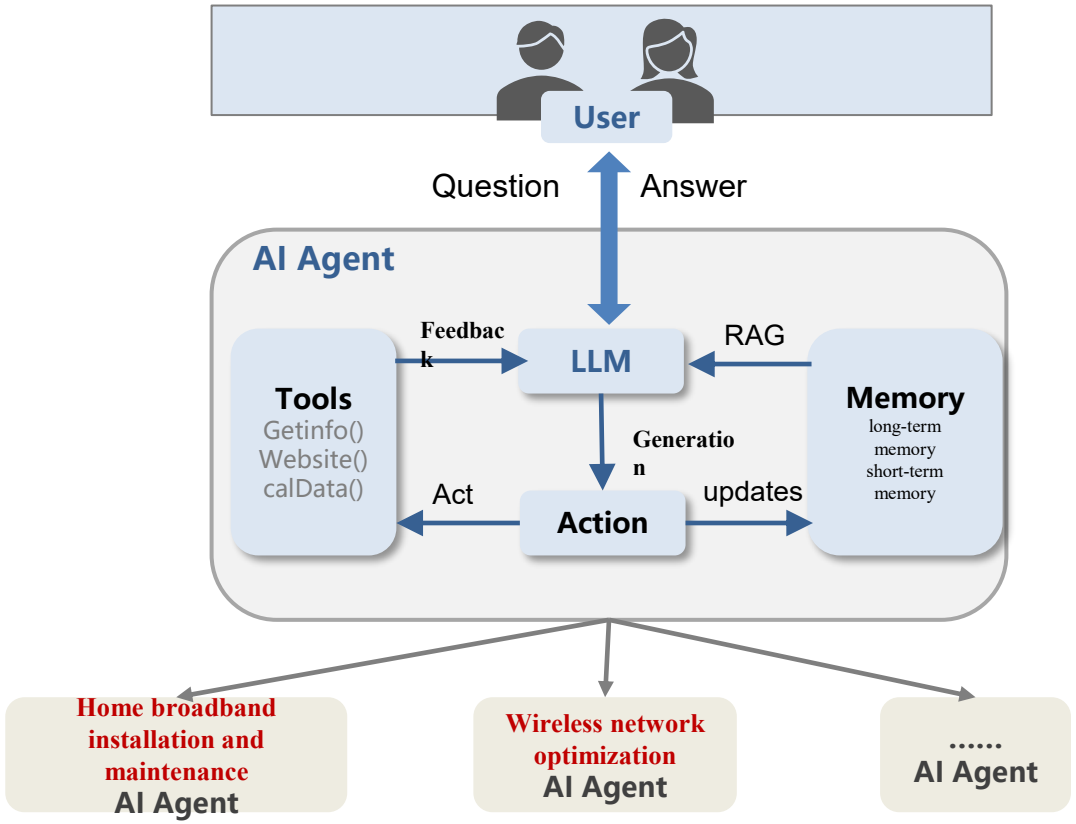
Data quality is important: The development of large-scale, diverse, and high-quality datasets—spanning text, chain-of-thought (CoT), images, domain evaluation data, and professional vocabulary across the cloud and network domains—is crucial for advancing the reasoning capabilities.

Corpus Types and Scale	
Text	More than 9TB
Knowledge graph	334
Image	305GB
Prompt&Response CoT training data	More than 15w items
Task-Oriented CoT Data	614 items/Scenario
Intent recognition corpus	2128 items
Professional Vocabulary	More than 10k items/domain
Domain evaluation data	More than10k items /domain



AI Agents： Autonomous Learning, Adaptation, and Decision-making

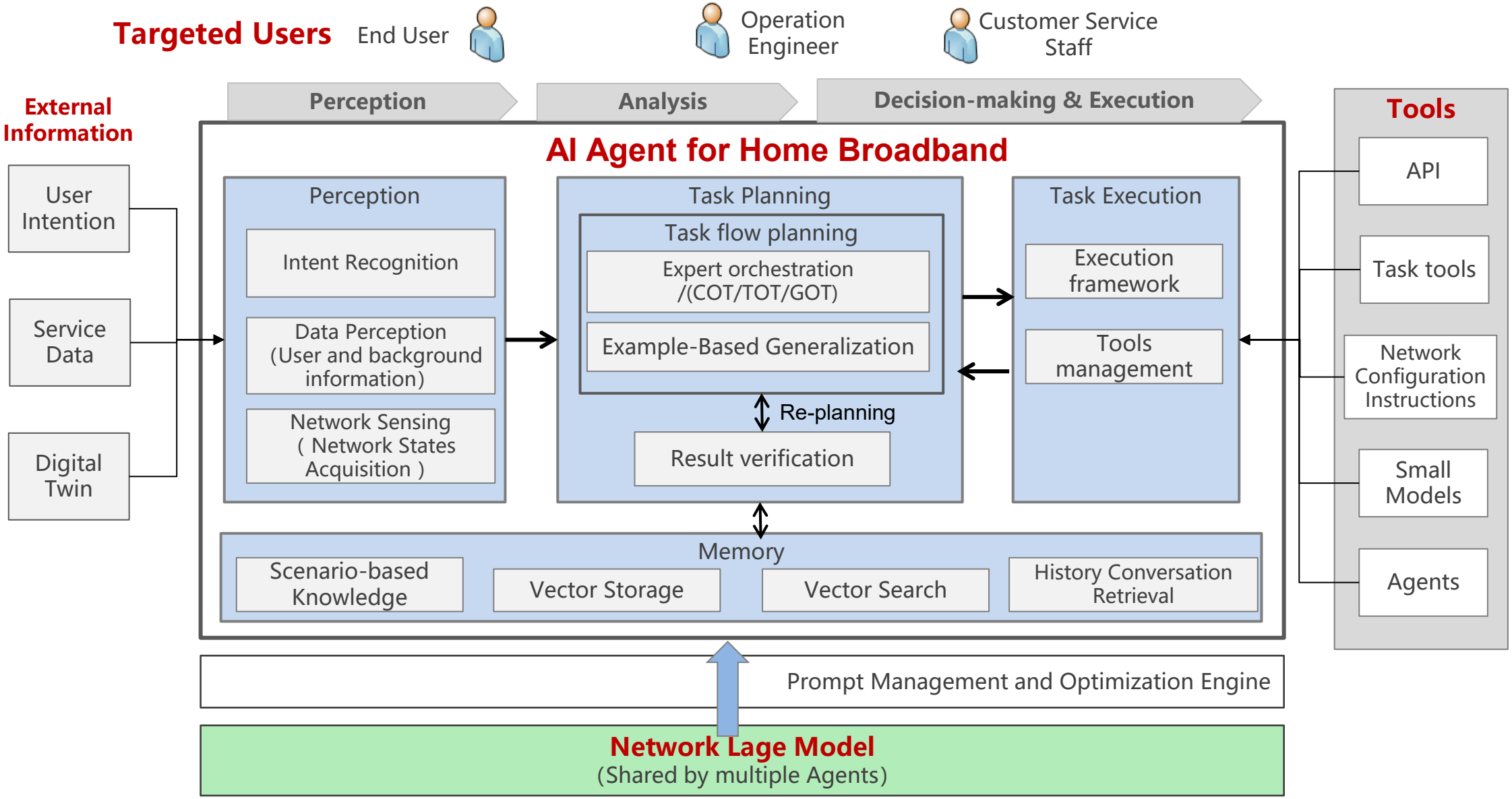
- AI Agents are to perform diverse network operation tasks such as fault management, traffic prediction, and resource allocation.
- The Network Large Model provides intelligent support, offering deep understanding, advanced thinking, and reasoning capabilities.
- Up to now, **930+ AI Agents** have been developed, empower **23** types of **digital employees**



Deployment Status and Key Metrics

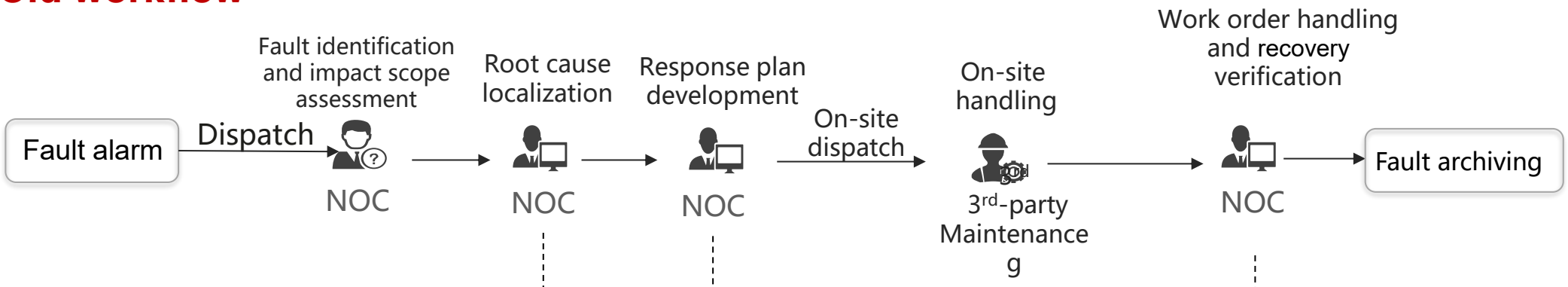
	Status or Metrics
Deployment	• Centralized deployment with unified planning （Centralized Training, Distributed Inference）
Resources	• Over 2000 GPU cards, unified Scheduling of Network-wide Resources
Coverage Scale	• Nationwide usage, covering all 31 provinces in the country, including remote areas and network blind spots in islands • Supporting services(e.g., fault handling, maintenance scheduling), 930+ AI Agents , 23 types of digital employees
Toolchain Platform	• Knowledge management: CoT+Intent recognition + Image + Knowledge distilling, Modular Text-Image RAG + Image RAG • Agent： Multi-Agent + MCP • Large Model Training&Inference+ Small Model Training&Inference
Large Model	LLM+ Time series prediction + Multimodal+ Wireless Network Optimization Large Model • Model Q&A Accuracy: 90%， Tool Call Accuracy: 80% • Task Execution Accuracy: 90%， Temporal Prediction Error: ≤7% • Image Discrimination Accuracy: 75%
Corpus	• Multi-modal Corpus 9.2TB (text, CoT, Intent recognition, Image)

Home Broadband AI Agents

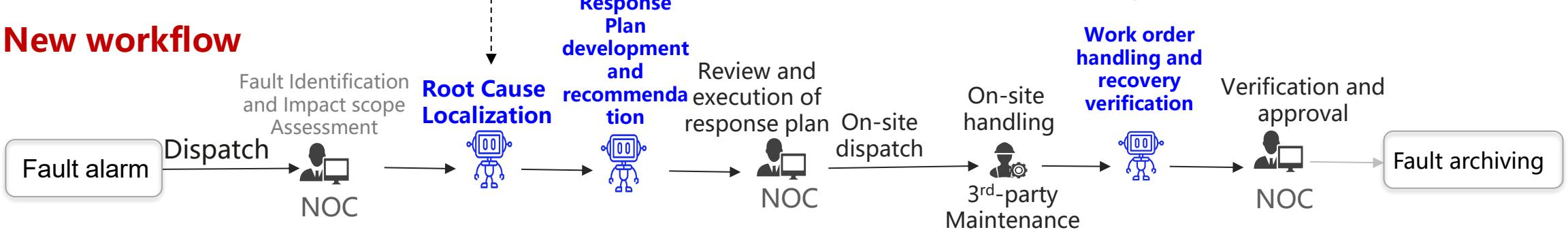


Workflow Change after the Adoption of AI Agents

Old workflow



New workflow



The fault diagnosis and resolution plans are embedded into the overall dispatch work order process, and operations such as reassignment are automatically executed.

AI Agents interact with maintenance engineers to perform management operations such as work order suspension and resumption confirmation.

Results today: AIOPS and LLM

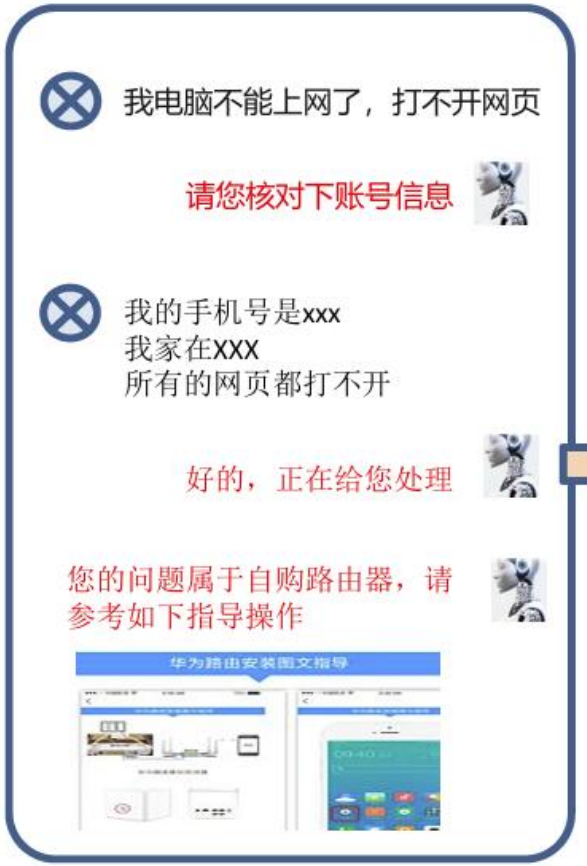
Deployment Effects of Fault Handling Agents

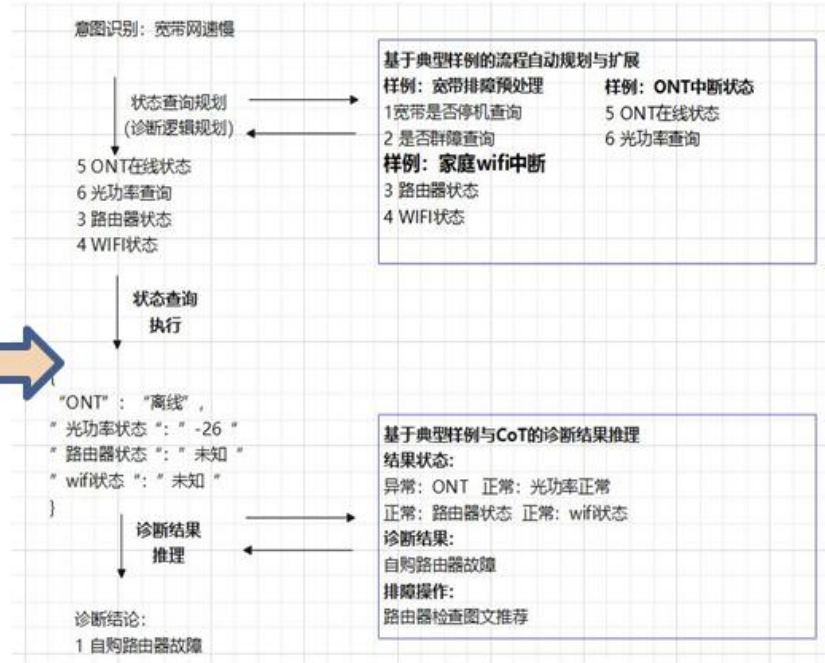
Fault handling time

30mins ↘ **5mins**

Failure count in critical scenarios

↘ **8%**





Standardization Considerations

NMOP Framework (draft-ietf-nmop-network-anomaly-architecture):

- The main workflow is OK but incomplete
- For CT it lacks the interface and building blocks for AI(Agents and Network Large Model)
- We could improve together

Other suggestions (for NMOP or broader IETF):

- Openness of AI Agent and data
- AI Agent identification and authentication, security guarantee for AI Agent access
- User intent recognition based on multimodal interaction
- Openness of tool capability for AI agents (e.g., MCP)
- AI Agent interconnection protocol (e.g., A2A), multi-agent collaboration (e.g., master-slave, distributed, etc.), to accomplish complex tasks

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5G

Thank You